The Sculptural in the (Post-)Digital Age

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Summary

The Sculptural in the (Post-)Digital Age

Digital technologies have profoundly impacted the arts and expanded the field of sculpture. Art history, however, continues to pay little attention to sculptural works that are conceived and "materialized" using digital technologies. A number of theoretical approaches discuss the implications of the so-called aesthetics of the digital, referring, above all, to screen-based phenomena. This is surprising given that computers became an artistic medium in the 1950s, CNC technology was used as early as the 1960s, and 3D-scanning and -printing processes came to prominence in the 1980s. For the first time, this publication brings together international and trans-historical research perspectives to explore how digital technologies reconfigure the understanding of sculpture and the sculptural leading into the (post-)digital age. Unfolding across four sections, *The Sculptural in the (Post-)Digital Age* asks how we can rethink the artistic medium in relation to our technological present and its historical precursors. Through systematic, interdisciplinary, and historical examinations of the historical forerunners of contemporary 3D technologies, the impact of cybernetics on sculptural theory alongside reflections on the expanded field of digital sculpture and on sculptural materiality, corporeality and monumentality, this anthology advances discussions of the artistic medium for our technological present.

Mara-Johanna Kölmel and Ursula Ströbele

Introduction

The Expanded Field of the Sculptural

In recent years, sculpture has experienced a renaissance. This renaissance is based on altered concepts of sculpture that dispense with statuary, permanence, and the anthropomorphic in favor of time-based, performative, and immaterial digital aspects. Johann Gottfried Herder, for instance, described sculpture as "Bildsäule" and August Schmarsow referred to it as "Körperbildnerin."[1] In addition to these designations, each of which emphasizes different characteristics, sculpture has even been referred to as action: "Handlung" (Franz Erhard Walther); or form of action: "Handlungsform" (Manfred Schneckenburger); as a "real-time system" (Jack Burnham/Hans Haacke); "biofact" (Nicole C. Karafyllis); and performance: "Aufführung" (Erika Fischer-Lichte).[2] This multifaceted expansion between three-dimensional thing and pictorial object is also expressed in terms such as "specific object," "readymade," and "objet trouvé." Historically, the art-theoretical discussion of sculpture has been stimulated by the Pygmalion discourse and the *paragone* debate.[3] But the dissolution

1 Johann Gottfried Herder, *Plastik: Einige Wahrnehmungen über Form und Gestalt aus Pygmalions Bildendem Traume* (1778), ed. Lambert Schneider and Peter Bachem (Cologne: Jakob Hegner, 1969), e.g., pp. 42–43, 62. August Schmarsow, *Unser Verhältnis zu den Bildenden Künsten: Sechs Vorträge über Kunst und Erziehung* (Leipzig: B.G. Teubner, 1903), p. 54.

2 Manfred Schneckenburger, "Plastik als Handlungsform," *Kunstforum International* 34 (1979): 20–31. Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: Braziller, 1968), idem, "Real Time Systems," *Artforum* 8, no. 1 (September 1969), pp. 49–55. Nicole C. Karafyllis, "Biofakte: Grundlagen, Probleme und Perspektiven," *Erwägen Wissen Ethik (EWE)* 17, no. 4 (2006): 547–58. Erika Fischer-Lichte, "Kunst der Aufführung – Aufführung der Kunst: Der Aufführungsbegriff als Modell für eine Ästhetik des Performativen," in Clemens Risi and Jens Roselt, eds., *Kunst der Aufführung – Aufführung der Kunst* (Berlin: Theater der Zeit, 2004), pp. 11–26.

3 For the *paragone* debate as it arose in Renaissance Italy, see Leatrice Mendelsohn, *Paragoni: Benedetto Varchi's Due Lezzioni and Cinquecento Art Theory* (Ann Arbor, MI: UMI Research Press, 1982); Claire Farago, *Leonardo Da Vinci's "Paragone": A Critical Interpretation with a New Edition of the Text in the Codex Urbinas* (Leiden: Brill, 1992). For further reading on the Pygmalion topoi, see Oskar Bätschmann,

of sculpture's boundaries and its convergence with time-based, action-related art forms, such as performance, theater, dance, and music, demand other comparisons. The transgression of classical boundaries of genre and "states of destabilization" of characteristics of genre entail multisensory concepts—works that address not only the senses of touch and sight but might also have olfactory and acoustic dimensions. Despite this, sculpture is often retained as a categorical term. This is the position that the symposium *The Sculptural in the (Post-)Digital Age*, which was hosted by the Zentralinstitut für Kunstgeschichte in Munich, started from in June 2021.[4] After a joint trip to the exhibition *Negative Space: Trajectories of Sculpture* at ZKM Karlsruhe (2019), the idea was born to organize an event discussing sculptural boundaries and phenomena dealing with computer technologies, with digitality and virtuality. Based on these two days, the present publication brings together essays, art-historical and methodological perspectives, that go beyond the symposium and its topics, including historical, partly analogue precursors, material reflections, monumentalities and corpo-realities, feedback loop systems, and the aesthetics of the (post-)digital. Through systematic, historical, interdisciplinary dialogue, the contributions rethink the medium of sculpture in relation to our technological present. The publication thereby also builds on our previous research focus, namely Ursula Ströbele's habilitation on the sculptural aesthetic of the living, *Expanding the Sculptural: Analyses and Theories of Current Border Phenomena: Nonhuman Living Sculptures since the 1960s: Hans Haacke and Pierre Huyghe* and Mara-Johanna Kölmel's PhD, *Sculpture in the Augmented Sphere: Reflections at the Intersection of Corporeality, Plasticity, and Monumentality* which both examine how digital technologies configure our understanding of the sculptural.[5]

Sculptures are objects in the world that point beyond themselves. At the same time, they insist on an inescapable physicality. The facticity of the three-dimensional and the actuality of representation and perception of a sculpture stand in a special tension, which is even increased in digital, virtual sculptures. For a theory of sculpture, Rosalind Krauss's "Sculpture in the Expanded Field" (1979) still forms a central point of reference.[6] After the 1977 monograph *Passages in Modern Sculpture*, which had still argued largely in terms of developmental history in view of a temporalization (time-based forms) of the medium, Krauss

"Pygmalion als Betrachter: Die Rezeption von Plastik und Malerei in der zweiten Hälfte des 18. Jahrhunderts," in *Der Betrachter ist im Bild: Kunstwissenschaft und Rezeptionsästhetik*, ed. Wolfgang Kemp, 2nd extended edition (Berlin: Reimer, Dietrich, 1992), pp. 183–224. Victor Stoichita I., *Der Pygmalion-Effekt: Trugbilder von Ovid bis Hitchcock* (Munich: Wilhelm Fink, 2011).

4 See the Zentralinstitut für Kunstgeschichte's Online-Symposium *The Sculptural in the (Post-)Digital Age*, https://www.zikg.eu/aktuelles/veranstaltungen/2021/das-skulpturale-im-post-digitalen-zeitalter/#the-sculptural-in-the--post---digital-age (accessed July 7, 2022).

5 Forthcoming, Mara-Johanna Kölmel, *Sculpture in the Augmented Sphere: Reflections at the Intersection of Corporeality, Plasticity and Monumentality*, PhD diss. (Leuphana University Lüneburg, 2021) and Ursula Ströbele, *Erweiterung des Skulpturalen: Analysen und Theorien aktueller Grenzphänomene: "Non-human Living Sculptures" seit den 1960er Jahren: Hans Haacke und Pierre Huyghe*, Habilitation (Heinrich-Heine-Universität Düsseldorf, 2020). Both are in the process of being published.

6 Rosalind E. Krauss, "Sculpture in the Expanded Field," *October*, no. 8 (1979): 30–44.

later turned to a reframing and expansion of sculpture in the art of the 1960s and 1970s.[7] She then considered sculpture as "historically determined and not a universal category" and develops a structural understanding of sculpture that simultaneously takes the argumentative step from sculpture to the sculptural in a post-medium condition, as one could argue.[8] Krauss's perspective was directed against a narrow, essentialist or media-specific concept of sculpture, as it had been formulated in Clement Greenberg's modernist art criticism. Her expanded field of a post-medium condition can first be understood literally as a spatial expansion, because the sculpture, Process Art, and Land Art of the 1960s and 1970s opened up new spaces—vast, walkable landscape spaces such as by Alice Aycock, Mary Miss, Robert Morris, and Richard Serra. The field also opens up in terms of temporal extension, insofar as she considers the sculptural actions of the artists as well as the changed processes of reception. In place of an essentialist analysis—one that positively names (essential) features of sculpture—she sets up a negative framework that unfolds in her diagram around the poles of architecture/non-architecture and landscape/non-landscape. In fact, the term "sculpture" is only mentioned twice, as Michael Lüthy has noted: firstly, it denotes objects defined by non-architecture and non-landscape, such as Robert Morris's *Mirror Cubes* and Donald Judd's *Specific Objects*.[9] Secondly, it is included in the title of her essay, namely as a general category of the whole diagram. Whereas Krauss's argumentation in the context of extended photography explicitly pleaded for speaking of *the photographic* (in the sense of the indexical as artistic practice) instead of photography, she only formulates this step for sculpture between the lines. So, it would be consistent with this to no longer speak of "sculpture in the expanded field," but of the "expanded field of the sculptural" and the sculptural as a methodological, structural approach, as Martina Dobbe and Ursula Ströbele argue.[10]

Leaving behind medium-specific restrictions, the sculptural also includes digital and virtual sculptural phenomena (that Krauss does not mention for obvious reasons), which will be discussed in the present publication. The expansion into virtual space as well as the emergence of digital sculptures as an essential form of the dissolution of boundaries in the sculptural is already anticipated in Jack Burnham's survey work *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (1968).[11] Burnham includes tech-based and computer-based sculptural works in his systems aesthetics—by Nicolaus Schöffer, Enrique Castro-Cid or Nam June Paik for example—even if art history until today continues to pay little attention to this kind of work, i.e., at the intersection of the natural sciences and computer technology. In the same year as Burnham's book, Robert Mallary published his article *Computer Sculpture* in *Artforum*, referring to the

7 Rosalind E. Krauss, *Passages in Modern Sculpture* (New York: Viking Press, 1977).
8 Krauss, "Sculpture in the Expanded Field," 1979. See also Martina Dobbe and Ursula Ströbele, "Introduction," idem, *Gegenstand Skulptur* (Paderborn: Wilhelm Fink, 2020), pp. 1–16.
9 Michael Lüthy, "Expanded Field/Rosalind Krauss," in *Skulptur Projekte Münster 07*, ed. Brigitte Franzen, Kasper König, and Carina Plath (Cologne: Walther König, 2007), pp. 356–57.
10 Dobbe and Ströbele, *Gegenstand Skulptur*, 2020, pp. 4–5.
11 Burnham, *Beyond Modern Sculpture*, 1968.

book.[12] He seems to be critical, still bound to the physical facticity of sculpture, and thus offers evaluative criteria for this kind of "*transductive art*." Mallary considers the computer as "*portentous*, because for the first time the sculptor has access to a tool which can be used not only for executing a work, but conceiving as well."[13] As a consequence, he differentiates between "computer-*aided* sculpture" and "computer-*generated* sculpture."[14] Around the same time, together with his students, he wrote the computer program *TRAN2*, which was able to calculate forms that might then be printed, even if the transfer process was still dependent on humans. PROSA, another program, generated three-dimensional solid forms out of a reduced given repertoire (for Mallary's *QUAD* sculptures, see the article by Michael Rottmann, pp. 58–79). At the same time, early computer art of the 1960s by, e.g., Herbert W. Franke, Vera Molnár, Frieder Nake, and Lillian F. Schwartz, as well as feminist media art by Lynn Hershman Leeson, is characterized by a "synergistic, or symbiotic" relationship between the sculptor and the computer. The artwork is not created in a classical studio any longer but in the (seemingly) immaterial sphere of the digital that also (eventually) provides the corresponding channels of distribution.

Meanwhile, there have been a few attempts to expand Krauss's diagram in different directions, being discussed, for example, in *Retracing the Expanded Field: Encounters between Art and Architecture*, edited by Spyros Papapetros and Julian Rose in 2014.[15] Miwon Kwon sums up the state of the discourse as follows: "It is actually quite partial—as it tells only one story about sculpture among many others that could be told … along the lines of commodity culture, or the body, or the phenomenological, for instance."[16] One concept stemming from Krauss's diagram is developed by the artist Joe Scanlan together with Claire Bishop concerning a structural model of "walking" as artistic practice, and a further development in 2015 by Andreas Greiner and Ursula Ströbele that includes axes for time, space, and sense that tries to describe living, virtual, and digital phenomena of the sculptural.[17]

From the perspective of geography, Martin Zebracki examines public sculptures such as Paul McCarthy's *Tree*, a twenty-four-meter-high, inflatable, butt-plug-shaped sculpture that was erected on Place Vendôme in Paris, which fell victim to an act of vandalism and triggered a controversial debate in the press and social media. Even if the destroyed sculpture survived in digital images that were distributed via social media channels, Zebracki

12 Robert Mallary, "Computer Sculpture," *Artforum* (May 1969), pp. 29–35.

13 Ibid., p. 1.

14 Ibid., p. 13.

15 Spyros Papapetros and Julian Rose, eds., *Retracing the Expanded Field: Encounters between Art and Architecture* (Cambridge, MA: MIT Press, 2014).

16 Miwon Kwon, in "The Expanded Field *Then*: A Round Table Conversation: Rosalind Krauss, Yve-Alain Bois, and Benjamin Buchloh, moderated by Hal Foster," in Papapetros and Rose, *Retracing the Expanded Field*, 2014, p. 33.

17 Joe Scanlan in cooperation with Claire Bishop, "Reponses," in Papapetros and Rose, *Retracing the Expanded Field*, 2014, pp. 226–27. Ursula Ströbele and Andreas Greiner, "24h Skulptur: Notes on Time Sculptures," in Ursula Ströbele, Andreas Greiner, and Jan-Philipp Sexauer, eds., *24h Skulptur: Notes on Time Sculptures* (Berlin: Distanz, 2015), pp. 31–37.

considers this pictorial multiplication as part of the work, and one that relativizes the binary boundaries of public space between online and offline, digital and analogue, reality and virtuality. He sees "queering" as a situational-qualitative method: "a means to transform the static of a noun—*queer*—into the action of a verb—*queer[y]ing* … moving theory into methodological activism."[18] This fruitful approach, i.e., "a synergistic rather than confrontational approach" and "orientation toward nonalignment" also allows, following Donna Haraway, potentially uncovering hidden, hitherto silent and implicit knowledge practices, in that the conceptualized clusters serve to subvert and de(con)struct traditional narratives and sculpture-theoretical categories.[19]

Relating to such reflections, Mara-Johanna Kölmel expands Krauss's sculptural field toward an augmented sphere, understood here as an expanded, multi-axial matrix in which life unfolds and becomes the object of artistic and sculptural form.[20] Spheres open up spaces of coexistence in which different tendencies in sculpture can be related to each other. *Sculpture in the Augmented Sphere*, as Kölmel argues, no longer only operates around formal-aesthetic questions internal to art-historical discourse; rather, it is informed by the very fabric and challenges of our contemporary life. The shift from sculpture to the sculptural as discussed in this volume may then also represent the need for a qualitative transformation of research and thinking methods within sculptural discourse. Such critical posture no longer reproduces the same old chronological narratives of sculpture and technological progress, but rather opens them up for alternative perspectives and ways of recounting history.

Research Challenges in the Field of Computer-Based Sculpture since the 1950s

If artists now model their sculptures with software, how can we make sense of the works' spatiality, plasticity, and materiality? When an object can no longer be grasped in a tactile sense, which modes of perception are addressed? What ontological status do such computer-aided works possess that can be experienced both physically (e.g., 3D-printed objects) and virtually (on screen)? How does this experience affect the "aesthetic limit" ("Ästhetische Grenze")?[21] How are concepts of monumentality and site-specificity altered when sculptures easily circulate as files online and can be 3D-printed at any time? How can we think of an

18 Martin Zebracki, "Queering Public Art in Digitally Networked Space," in *ACME: An International Journal for Critical Geographies* 16, no. 3 (2017): 440–74, here 445, https://www.acme-journal.org/index.php/acme/article/view/1354 (accessed August 15, 2022).

19 Ibid., 446; Martin Zebracki, "Public Art and Sex(uality): A 'Wonky' Nexus," in *Public Art Dialogue* 10, no. 1 (2020): 1–10, here 7. Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," in *Feminist Studies* 14, no. 3 (Autumn 1988): 575–99; and Donna Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York: Routledge, 1989).

20 See Kölmel, *Sculpture in the Augmented Sphere*, forthcoming.

21 See Ernst Michalski, *Die Bedeutung der ästhetischen Grenze für die Methode der Kunstgeschichte* (Berlin: Mann, 1996; orig. 1932).

object that arises from an algorithm and appears as pixels on a screen without sharing the same spatial conditions as the viewer? How do we experience objects that only become visible through an app? How can we interpret concepts of authorship in times of digital coproduction and artificial intelligence? Which forms of participation or interaction does the respective interface address? These are some of the questions this publication seeks to address.

The German research networks *Theorie der Skulptur* (Theory of Sculpture) and *Virtualisierung von Skulptur: Rekonstruktion, Präsentation, Installation* (Virtualization of Sculpture: Reconstruction, Presentation, Installation) have made significant contributions to an expanded conception of sculpture.[22] Other noteworthy publications in this context include *Inquiries into Contemporary Sculpture,* edited by Mary Ceruti and Ruba Katrib, the conference series and publications under the title *Sculpture Unlimited,* edited by Eva Grubinger and Jörg Heiser, the publication *Skulptur – Zwischen Realität und Virtualität* (Sculpture—Between Reality and Virtuality), the exhibition and catalogue *Lens-Based Sculpture,* the German Kunstforum *Unbegrenzte Skulptur: Ein Überblick über das Skulpturale heute* (Unlimited Sculpture: An Overview of the Sculptural Today) as well as *The Uncertainty of Objects and Ideas: Recent Sculpture*.[23] These publications conceptualize sculpture as a malleable, heterogenous, and accommodating category, and thus confirm the shift from sculpture toward what we like to term "the sculptural." They also touch upon sociocultural consequences of the information age and the impact of digital technologies on the art in general. However, in-depth studies that carefully look at the conception, production, and reception of contemporary sculpture while also considering an historical lineage and precursors of the employed technologies are still scarce. This is surprising insofar as computers became an artistic medium from the 1950s onward. CNC technologies were already being introduced

22 See Martina Dobbe and Ursula Ströbele, "Theorie der Skulptur | Projekt," http://theoriederskulptur.de/projekt/ (accessed August 15, 2022); Manfred Bogen, Jens Schröter, and Gundolf Winter, "DFG – GEPRIS – Virtualisierung von Skulptur: Rekonstruktion, Präsentation, Installation," https://gepris.dfg.de/gepris/projekt/5365644?context=projekt&task=showDetail&id=5365644& (accessed July 26, 2022).

23 See Mary Ceruti, *Where Is Production?: Inquiries into Contemporary Sculpture*, ed. Ruba Katrib (London: Black Dog Publishing, 2017); Mary Ceruti, *How Does It Feel?: Inquiries Into Contemporary Sculpture*, ed. Ruba Katrib (London: Black Dog Publishing, 2016); Mary Ceruti, *What About Power?: Inquiries into Contemporary Sculpture*, ed. Ruba Katrib (London: Black Dog Publishing, 2015); Eva Grubinger and Jörg Heiser, eds., *Sculpture Unlimited,* (Berlin: Sternberg Press, 2011)*;* Grubinger and Heiser, eds., *Sculpture Unlimited 2—Materiality in Times of Immateriality* (Berlin: Sternberg Press, 2015); Sabine B. Vogel, ed., "Grenzenlose Skulptur: Ein Überblick über das Skulpturale heute," *Kunstforum International* 229 (2014). Adriano Pedrosa, Laura Hoptman, and Jens Hoffmann, *Vitamin 3-D: New Perspectives in Sculpture and Installation* (London/New York: Phaidon Press, 2009); Johanna Burton and Anne Ellegood, *The Uncertainty of Objects and Ideas: Recent Sculpture*, exh. cat. Hirshhorn Museum & Sculpture Garden (New York: Hirshhorn Museum & Sculpture Garden, 2007); Bogomir Ecker and Raimund Kummer, Akademie der Künste, and Kunstmuseum Liechtenstein, eds., *Lens-Based Sculpture: Die Veränderung der Skulptur durch die Fotografie = The Transformation of Sculpture Through Photography*, exh. cat. Akademie der Künste, and Kunstmuseum Liechtenstein (Cologne: Walther König, 2014); Christian Spies, Jens Schröter, and Gundolf Winter, eds., *Skulptur – Zwischen Realität und Virtualität* (Munich: Wilhelm Fink, 2006).

in the 1960s and had important precursors in early centuries, such as the photo-sculpture in France in the 1850s (see the article by Buket Altinoba, pp. 37–57), 3D-scanning and -printing processes were used by artists such as Karin Sander since the 1990s (see pp. 26–33).

One should also highlight that there are important overviews that focus on the conception and production of contemporary post-digital objects at the intersection of design, architecture, and decorative or applied arts. Publications including *Post-digital Artisans*, *Digital Handmade*, *Out of Hand*, or *Digital Crafts* go hand in hand with increasing research into prototyping technologies and digitally driven materialization processes at art schools.[24] These contributions, however, do not specifically relate to sculptural discourse or ground their work in historical trajectories of sculpture.

Although a plethora of conceptual terminologies have been developed to describe the dynamics of "media objects" or "digital objects" in virtual environments, theoretical approaches under the heading of "aesthetics of the digital" tend to discuss such developments from the perspective of image-theoretical and screen-based phenomena.[25] The digital image continues to serve as the focal point for theoretical discussions on digitality.[26]

Notes on the Post-Digital

Counter to such assumptions, we argue that it is necessary to reflect on the implication of such "media change" in the context of sculptural discourses by departing from the physical object and its modes of production. The impetus for this publication is thus also motivated by an approach that considers often parallel discourses in the field of sculpture and new media together, combing them under the post-digital. Today, most aspects of our lives are mediated by digital parameters. The digital has become an inherent feature of our living environment, infrastructures, and production processes, and has thus seeped into the very substance of our reality. This development can be traced through the scientific and technological developments of the last seventy years. It is, however, only in recent years that artistic discourse has disassociated itself from terms such as "new media," "digital" or "net art." Art

24 Lucy Johnston, *Digital Handmade: Craftsmanship in the New Industrial Revolution*, 2nd edition (London: Thames and Hudson, 2017); Jonathan Openshaw, *Postdigital Artisans: Craftsmanship with a New Aesthetic in Fashion, Art, Design and Architecture* (Amsterdam: Frame Publishers, 2015); Ronald Labaco, ed., *Out of Hand: Materializing the Postdigital*, exh. cat. Museum of Arts and Design, New York (London: Black Dog Publishing, 2013); Ann Marie Shillito, *Digital Crafts: Industrial Technologies for Applied Artists and Designer Makers* (London: A & C Black Visual Arts, 2013); Wolfgang Fiel and Ruth Schnell, eds., *Bits to Pieces* (Vienna: University of Applied Arts Vienna, 2013).

25 For the discourse on the aesthetics of the digital, see Claudia Giannetti, *Ästhetik des Digitalen: Ein Intermediärer Beitrag zu Wissenschaft, Medien- und Kunstsystem* (Vienna: Springer, 2004); Katja Kwastek, *Aesthetics of Interaction in Digital Art*, reprint edition (Cambridge, MA: MIT Press, 2015).

26 See Wolf Lieser, *The World of Digital Art* (Potsdam: Ullmann Publishing, 2010); Sean Cubitt, Paul Thomas, Zhang Ga, Brogan Bunt, and Darren Tofts, *Relive: Media Art Histories* (Cambridge, MA: MIT Press, 2013); Sean Cubitt and Roger F. Malina, *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels* (Cambridge, MA: MIT Press, 2014); Christiane Paul, *A Companion to Digital Art* (Malden, MA: John Wiley & Sons, 2016).

incorporating digital technologies is not a discrete cultural entity anymore. In the process, discussion has developed in the direction of a fundamental reorientation of Western culture through the digital. In an attempt to define a period after the initial upheaval from digital technologies, scholars have come to refer to our era as "post-digital." As Florian Cramer points out, referring to Hegel, the prefix "post" in this context is not understood in the sense of a Hegelian idea of progress, as in postmodernism or *posthistoire*.[27] Rather, the term refers to a cultural shift within the digital (including the internet) in a Heideggerian sense, from an event to a state of being.[28] Consequently, the post-digital describes a persistent mutation rather than the end of the digital. It refers to a condition in which the logic of the digital has given rise to a digital mindset and permeates nearly every aspect of human existence.

In 2000, the Australian composer Kim Cascone used the term "post-digital" to characterize an aesthetic of glitches in electronic music. Cascone positioned the notion in opposition to the strict perfectionism of high fidelity. In his essay "The Aesthetics of Failure: 'Post-Digital' Tendencies in Contemporary Computer Music," the musician highlights what he considers to be productive instances of failure in digital technology, such as "glitches, bugs, applications errors, system crashes."[29] According to Cascone, these instances highlight the medium, its autonomy outside of human control, and the potential beyond the typical functions and applications of software.[30] Cascone's contribution describes a disenchantment with the novelty of "new" media. Two years prior, Nicholas Negroponte, founder and chairman emeritus of the MIT Media Lab, had captured a similar sensation in his well-known statement: "Face-it! The digital revolution is over."[31] Negroponte, however, didn't intend to declare the end of the digital age; rather, he was trying to describe a world that is completely permeated by digital technology and in which "like air and drinking water, being digital will be noticed only by its absence, not its presence."[32] Rather than celebrating the idea of technological progress inherent in the "new" of new media or its capacity for subversion that had come to characterize much of the 1990s discourse, Cascone and Negroponte had captured a shift within the debates around digital technology.[33]

In 2006, the artist Marisa Olson coined the phrase "post-internet" to characterize her creative process, which she defined as "making art after being online."[34] Her performances,

27 Florian Cramer, "What Is 'Post-Digital'?," *A Peer-Reviewed Journal About Post-Digital Research* 3, no. 1 (June 1, 2014): 10–24, here 13, doi: https://doi.org/10.7146/aprja.v3i1.116068.

28 Ibid.

29 Kim Cascone, "The Aesthetics of Failure: 'Post-Digital' Tendencies in Contemporary Computer Music," *Computer Music Journal* 24, no. 4 (2000): 12–18, here 16.

30 Ibid., 17.

31 Nicholas Negroponte, "Beyond Digital," *Wired* (December 1998), https://web.media.mit.edu/~nicholas/Wired/WIRED6-12.html (accessed July 21, 2022).

32 Ibid.

33 Cascone, "The Aesthetics of Failure," 2000, 16.

34 Marisa Olson, quoted in Lauren Cornell, "Net Results: Closing the Gap between Art and Life Online," *Time Out New York* (February 9–15, 2006), p. 69.

poems, and music made use of materials found online, which she then assembled offline.[35] Her works' aesthetics no longer adhered to typical net art aesthetics. Instead, it fed off of the mundane, which had long held sway on the web. Olson's statement also highlighted the distinction between the perception of time spent online *and* offline—since the advent of internet-enabled smart phones, this perceived boundary has become ever more elusive. Today, the prefix "post" does not, as it once did, stand for a period of time after being online. Instead, "post" refers to an "internet state of mind, to think in the fashion of the network," as the result of a "complete embeddedness in a ubiquitous network culture."[36] At its best, post-internet art analyses the ramifications of a digital online culture and intends to give equal weight to the material and the immaterial, the physical and the digital, concept and object, form and content.[37] Due to their roots in online visual cultures, "post-internet" artists recognize and, at best, critically scrutinize the material history of the artistic technologies and networks they use. The artist Mel Alexenberg already characterized a similar development in his 2011 book *The Future of Art in a Postdigital Age*, but referring to a post-digital state. Here, he speaks of an interplay between digital, biological, cultural, and spiritual systems: between "cyberspace and real space, between embodied media and mixed reality in social and physical communication, between high tech and high touch experiences."[38]

The diverse research perspectives contributing to post-digital and post-internet discourses intersect in the observation that the digital now frames all facets of cultural life. Digital and networked technology are constantly and covertly present in the post-digital era. According to Kerstin Stakemeier, they have evolved into a "production paradigm" and "meta-medium."[39] In recent years, numerous exhibitions and publications have addressed this changing state of being through an examination of the arts in the age of the internet.[40]

35 See Marisa Olson, "Interview with Marisa Olson," interview by Regine, *We Make Money Not Art* (blog), March 28, 2008, https://we-make-money-not-art.com/how_does_one_become_marisa/ (accessed October 28, 2022).

36 Karen Archey and Robin Peckham, "About the Exhibition *Art Post-Internet*," at UCCA Center for Contemporary Art, February, 2014, https://ucca.org.cn/en/exhibition/art-post-internet// (accessed August 15, 2022).

37 See Artie Vierkant, "The Image Object Post-Internet" (2010), on the website *Jstchillin.org*, http://jstchillin.org/artie/vierkant.html (accessed August 15, 2022).

38 Mel Alexenberg, Mel, *The Future of Art in a Postdigital Age: From Hellenistic to Hebraic Consciousness* (Bristol and Chicago: Intellect Books and University of Chicago Press, 2011), p.10.

39 Kerstin Stakemeier, "Prothetische Produktionen: Die Kunst Digitaler Körper: Über 'Speculations on Anonymous Materials' im Fridericianum, Kassel," *Texte zur Kunst,* no. 93 (March 2014), p. 168.

40 See Eva Respini, *Art in the Age of the Internet, 1989 to Today* (Boston and New Haven: Yale University Press, 2018); Susanne Pfeffer, ed., *Speculations on Anonymous Materials* (London: Walther König, 2018); Nicolas Bourriaud, ed., *Crash Test – La Revolution Moleculaire* (Montpellier: La Panadee, 2018); Franz Thalmair, "Postdigital 1: Allgegenwart und Unsichtbarkeit eines Phänomens," *Kunstforum International* 242 (2016), pp. 38–53; Melissa Gronlund, *Contemporary Art and Digital Culture*; Omar Kholeif, Emily Butler, and Seamus McCormack, eds., *Electronic Superhighway: From Experiments in Art and Technology to Art after the Internet*, exh. cat. Whitechapel Gallery (London: Whitechapel Gallery, 2016); Omar Kholeif, ed., *You Are Here: Art After the Internet* (Manchester and London: Cornerhouse Publications, 2015); Gene McHugh and Domenico Quaranta, *Post Internet* (Link Editions, 2012).

Parallels can be drawn here with discussions from the 2000s that used the terms "post-media" and "post-medium." In Rosalind Krauss's concept of the post-medium—i.e., the proliferation of art forms with heterogeneous materials and production conventions (including installation art/assemblage, happening, installation, performance, etc.)—challenges the status of specific media such as painting or sculpture. According to Krauss, this leads to the overthrow of the traditional understanding of a medium.[41] In contrast to Krauss's post-medium notion, which is linked to Aristotle's reflections on artistic means of expression, Peter Weibel and Lev Manovich's term "post-media" has a different origin. It connects back to Isaac Newton's theory of the ether, which served as the foundation for theories of mass media put forth by Friedrich Kittler, Marshall McLuhan, and others. Lev Manovich and Peter Weibel's concepts of the post-media, which are based on these traditions, seek to characterize a state brought about by technological advancement. This condition is the all-encompassing impact of digital media on society, including the visual arts. Manovich argues that the fact that artists began to use the technologies of mass media to make art (whether it be photography, film, radio art, video art, or digital art)—and thus use the same tools of production, storage, and distribution—led to post-media aesthetics.[42] According to Weibel, the developments also characterized by Krauss and Manovich culminate in the digital revolution of the 1980s and 1990s—the convergence of all media under a universal medium, the computer, and thus a post-media state of life.[43] Weibel underlines the expansion of the media concept: "There is no longer a sculpture outside and beyond the medial experience."[44] This state of post-media is characterized by the equivalence of all media, its entangled appearance, and the emancipation of the viewer.

There have been important contributions to the discussion of the post-digital by Kim Cascone, in relation to electronic music, Alessandro Ludovico, with reflections on publishing, as well as more recently edited journal issues such as *The Post-Digital Condition: A Peer-Reviewed Journal About Post-Digital Research* and the German *Kunstforum International Post-digital 1+2* that link to important debates around new media and the net art of the late 1980s and 1990s.[45] At the same time, they address a fundamental shift in contemporary art by illuminating the impact of network and computer technology in established institutional and mainstream contexts as well as discourses. Post-digital can also be understood as a form of intermedial action. For Joachim Paech and Jens Schröter, intermediality means "more than the hybridisation of the arts…. Intermediality, as we understand it today, knows

41 Rosalind E. Krauss, *Under Blue Cup* (Cambridge, MA: MIT Press, 2011), p. 16ff.

42 See Lev Manovich, "Postmedia Aesthetics," in *Transmedia Frictions*, ed. Marsha Kinder and Tara McPherson (Berkeley: University of California Press, 2014), pp. 34–44.

43 Peter Weibel, "Die Postmediale Kondition," in Elisabeth Fiedler, Christa Steinle, and Peter Weibel, eds., *Postmediale Kondition* (Graz: Neue Galerie, 2005), pp. 9–13, here p. 11.

44 Ibid. p. 12.

45 See Cascone, "The Aesthetics of Failure," 17, Alessandro Ludovico, *Post-Digital Print: The Mutation of Publishing Since 1894*, 2nd edition (Eindhoven: Onomatopee, 2013); Thalmair, "Postdigital 1," 2016; Christian Ulrik Andersen, Geoff Cox, and Georgios Papadopoulos, eds., *A Peer-Reviewed Journal About Post-Digital Research 3*, no. 1 (June 1, 2014).

about the simulability of every form of medial properties through their digital programming. It reconstructs forms in a symbolic representation that refer to the interplay of different media that formulate themselves in it."[46] Similarly, in this volume Verena Kuni coins the term "analogital" to describe the various entanglements of analog and digital material(itie)s and media in the arts since the 1990s (pp. 102–118). As digital technologies have moved from the margins of our society to the center of our daily lives, the focus of artistic and critical discourse has also changed significantly. Art and culture that include digital technologies in their horizons of reflection are now no longer categories in their own right. They no longer occupy a niche that can be ignored by the art market or curators, as was still the case with net art and large parts of media art in the 1980s and 1990s. In a post-digital cultural sphere, the digital is not to be understood as a medium but as an act of interplay or a mode of configuration. It consequently does not lead to a subordination of existing media but to their hybrid transformation.[47]

The contributions in this volume demonstrate how today analog and digital as well as online and offline spaces naturally overlap. They thereby imply a post-digital perspective while also acknowledging that discourses on post-internet or the post-digital have short half-lives and a clear distinction between digital and post-digital cannot always be maintained. More importantly, the sculptural approaches discussed here show how the digital is today fully embedded in the mechanisms of contemporary art. Work of artists featured in this volume including Morehshin Allahyari, Mary Ellen Carroll, Shirin Fahimi, or Skawennati also demonstrate how the debates on post-digitality can no longer be subsumed under the sovereignty of Western media discourse or follow a rhetoric of the "new" in the sense of a linear chronological reading of "progress" (see for example the contributions by Sasha Sobrino, pp. 119–137, and Elizabeth Anne Johnson, pp. 184–197). Today, a post-digital mindset no longer exclusively addresses the technology-based expansion of reality and the interplay between digital and analog life; it can also mark a critical, political, polyphonic or subversive stance.[48] Feminist and decolonial approaches have contributed to imagining digital technology in inclusive ways, to building alternative (infra-)structures, or to providing open-source toolkits for self-organized action. In this sense, a post-digital mindset can also be understood as a gesture toward decolonializing digital space. Far from being neutral technology, it is shaped by its contexts. Different media ecosystems and media natures in turn affect and shape our living environment. As Daphne Dragona points out, the idea is to overcome the "separation of technology and ecology, of the human and the non-human

46 Joachim Paech and Jens Schröter, "Intermedialität analog/digital – ein Vorwort," in *Intermedialität analog/digital: Theorien, Methoden, Analysen,* ed. Joachim Peach and Jens Schröter (Munich: Wilhelm Fink, 2008), pp. 9–12.

47 Ludovico, *Post-Digital Print*, 2013, p. 7.

48 For further reflections on the post-digital in this context, see Mara-Johanna Kölmel and Denise Sumi, "(Post-)Digitalität in den Künsten," in *Handbuch Kulturpolitik*, ed. Johannes Crückeberg et al. (Heidelberg/Berlin: Springer, 2023).

world. The alternatives offered cannot constitute an excuse for continuing to exhaust the earth's natural resources."[49] In contemporary art, one could add, cyber-ecology, eco-fiction, and sculpture are closely linked to each other, as in the work by Tamiko Thiel, Jakob Kudsk Steensen, or Sofia Crespo & Feileacan McCormick.[50] These artists engage with new computer technologies and visual forms of representation to develop a sculptural, fictional aesthetic of the living and to unfold speculative futures of potential worlds in digital images beyond the dominant discourse of the Anthropocene. Against the background of these developments, the heterogenous and trans-historical contributions in our book discuss such important transformation processes in regard to the sculptural.

The Structure of the Book

Unfolding across four sections, the contributions focus on the analysis of sculptural phenomena and their configuration through digital technologies. Through a trans-historical and interdisciplinary perspective, the contributors discuss artistic positions that question sculptural concepts and expand on them. At the same time, they develop and refine methodological approaches that capture sculptural phenomena that have so far been addressed in largely isolated discourses. The shifts and expansions of sculptural discourse in the (post)-digital age can thus be traced. The book is opened by an artistic intervention by Karin Sander, pp. 26–33. Based on her keynote lecture "Arts Meets Science and Technology" from our symposium, she develops a kaleidoscopic picture board of her own sculptures as well as from artistic companions, including Richard Serra, Rachel Whiteread, and Erwin Wurm. These images, selected from her archive, represent various technological processes of today's sculptural field, such as rendering digital data, scanning, and 3D-printing, alongside the sculptural artifacts themselves. Sander's contribution thus offers the ideal backdrop against which the shifts and expansions of sculptural discourse in the (post)-digital age can be traced.

Historical Precursors

The idea of delegating image production to machines can be found in an age before the computer and its various potentials of automation and reproduction. In the nineteenth century, pioneers such as John Isaac Hawkins, James Watt, Benjamin Cheverton, and François Willème developed sculpture reproducing machines leading to questions of originality, authorship, authenticity, scalability, and (artistic) labor. In her essay "'Curious Machines':

49 Daphne Dragona, "Can Art Do the Work? From Narratives to Protocols, from Habit to Ethics," *Springerin*, Digital Ecology, no. 3 (2021), pp. 44–48, here p. 47.

50 See, for example, the unauthorized exhibition *Augmented Species: Invasive Sculptures in Hybrid Ecologies*, curated by Tina Sauerländer and Ursula Ströbele, 2021–22, https://www.zikg.eu/aktuelles/veranstaltungen/2021/ausstellung-augmented-species-invasive-sculptures-in-hybrid-ecologies and http://www.peertospace.eu/blog/2021/9/10/augmented-species-invasive-sculptures-in-hybrid-ecologies (accessed August 1, 2022).

Reproducing Sculpture via Machine and Its Modus of Display in the Nineteenth Century," **Buket Altinoba** takes up modern technologies for reproduction in the arts, especially in the field of sculpture. Already in 1802, the American portraitist and museum owner Charles Willson Peale presented a "curious machine" from Europe that enabled the production of two-dimensional profiles of living models through mechanical invention: the "Physiognotrace" (p. 38). During industrial exhibitions, fairs, or public demonstrations, these historical precursors were presented as humanlike acting machines evoking their magic character and curiosity through a specific display aesthetic. The author examines the relationship between sculpture, craft, and industry through these reproduction machines, and their relevance in today's discussions about sculpture machine installations or 3D-printing.

Following the historical innovations during the nineteenth century, **Michael Rottmann**'s contribution "Aesthetics of (Digital) Machine Sculpture: Automatization, Mechanization, and Mathematization in Minimal, Serial, Conceptual, and Computer Art" focuses on the 1960s. Using case studies of pioneers Robert Mallary and Charles Csuri, he elaborates on the "Otherness of Computer Sculpture(s)" (p. 63), respectively their computer-based production, reception, and specific ontology. Against the background of Minimal Art, these early computer sculptures are still in the tradition of modernity, close to construction-sculpture in the sense of Clement Greenberg. They are mainly based on an object aesthetic, evoking statuary and hapticity. Rottmann thus differentiates between computer-calculated and computer-generated forms, and analyzes correspondences between digital and non-digital arts, such as the significance of mathematization, the creative process with machines, automatization, mechanization, and the shift from 2D to 3D. He argues that digital and non-digital art forms in the 1960s are only understandable in relation to each other and their common historical, political, and cultural context: cybernetics, systems theory, the Cold War, and computerization. Rottmann calls non-digital art forms which make digitality and technology a subject, e.g. Sol LeWitt's Conceptual Art, "co-digital art" (p. 76).

Between the Virtual and the Physical: Material Reflections

Today, hybrid forms of reality coexist. They overlap in technologies that offer augmented or mixed reality and can open new ways of perception. The body of the viewer is involved in an immersive, often multisensory experience. The expanded field of sculpture has also been impacted by digital technologies since the 1960s, although an art history of digital sculpture is still missing. In her article "Sculpting Digital Realities: Notes on Truth to Materials, the Aesthetic Limit, Site-Specificity and 3D-Printing" **Ursula Ströbele** discusses what specific terminology in art history corresponds to these works given their post-medium condition and infrastructural accessibility, their various materialities, immateriality (or rather "neomateriality"), their aesthetic limit, interactive features, and real-time processes. Following the paradigm of *the sculptural in the expanded field* and by using examples such as Franke's early computer sculptures, Shaw's analogue virtual sculpture, Banz & Bowinkel's and Allahyari's references to Antiquity, she asks how media-specific parameters, e.g., *truth to materials*, scalability, and site-specificity are altered when sculptures circulate online and

lose their so-called *siteness*. What ontological status do such computer-aided works possess that can be experienced physically and virtually?

Verena Kuni explores contemporary conditions of the sculptural with a focus on the oscillating relationship and transformations of and between analog and digital material(itie)s and media. In "(IM)MATERIALS—(IM)MATERIALITIES—(IM)MATERIALIZATIONS: Some Thoughts on the Analogital Condition(s) of the Sculptural," she proposes to capture these conditions with the overarching concept of the "analogital." Kuni thus elaborates on the key terminology of "sculptural," "analogital," and "(im)materials," the latter inspired by Jean-François Lyotard, in order to "take up his considerations about the mutual interpenetration of media and matter, material and immaterial" (p. 110). She states that these reflections have changed the relationship between humans and material(s), and also to the sculptural in an ongoing, dynamic process, and illustrates this with artistic projects from the mid-1990s to present, including Aram Bartholl's series *Map* (2006–19). These sculptural materializations of Google Map's iconic pins are set up at the exact spot where the search engine assumes the city center to be. Besides the physical (graphical) sculpture in (analog) public space and the digital images, Kuni suggests that the aerial photographs rethink the powerful entanglements between imagination and image, digital and analog realities.

The multimedia artist **Skawennati** discusses themes of futurity and history as both an urban Kanien'kehá (Mohawk) woman and a cyberpunk avatar. She is known for her work in virtual environments and as cofounder of Aboriginal Territories in Cyberspace (AbTeC), an indigenously determined research-creation network in Second Life codirected by her and Jason Edward Lewis. Her artistic practice moves fluidly across the digital and physical divide. The curator **Sasha Sobrino** has been working with Skawennati on several projects. In "Considering Skawennati's Celestial Trees—Sculpture Between the Virtual and the Physical," she examines Skawennati's *Celestial Tree* sculptures—both virtual and physical—as public sculpture. Led by Skawennati's avatar xox, Sobrino traveled to AbTeC Island with her own avatar, engaging with these participatory sculptures. She explores how these works challenge traditional understandings of materiality and expanded concepts of virtuality and accessibility (p. 120). Art that has been created to be experienced exclusively virtually causes an ontological crisis, argues Sobrino. This prompts conversations on digital materiality, respectively neo-materiality, embodiment, imaginative experience, dematerialization, and the behavior of the recipients. Referring to Patrick Lichty, she describes Skawennati's tree sculptures as "cybrid" as they exist concurrently between various modalities.

Alexandra Weigand, too, is interested in the oscillation processes between the virtual and the physical, between simulation and fact. Her contribution "When the Virtual Becomes Tangible: Tracing Design, Architecture, and Art at the Beginning of the Twenty-first Century" departs from the cultural shift in our experience and perception of reality brought about by computerization. Weigand explores how the aesthetics of contemporary visual and material cultures have changed through digital technology. As a trained designer and art historian, she is particularly interested in the "feedback loops" (p. 139) that result from the increasing digitalization of visualization and design processes. Through the careful study of examples

from the field of art, architecture, and design, including Iñigo Manglano-Ovalle's *Phantom Truck,* contributions by Ronan & Erwan Bouroullec or Julian Mayor and Front Design, she traces how tangible items exhibit the aesthetics of the (digitally) virtual. Weigand investigates a change in aesthetic qualities. She demonstrates how a "tangible virtuality" as a "new spatial experience, that of a materialized, walk-in 'virtual' space" not only questions our habits of perception, but also challenges us to redefine "our position in relation to materiality, object, and space" (p. 158).

Reclaiming Monumentality

When artists approach the sculptural through 3D technologies, it is not only the works' specific materiality or corporeality but also questions of monumentality that have to be fundamentally reconsidered. The third section places the history of sculpture and its deep links to the monument at its center. With the possibilities of immersive digital technology and the internet, the twenty-first-century monument has expanded toward the unmonumental, the immaterial, and the virtual. **Mara-Johanna Kölmel**'s text "The Twenty-First-Century Monuments: Reflections on Intermedial and Nomadic Monumentality" focuses on two Iranian artists living outside of Iran that use digital technologies to reveal the problematic power structures inscribed into sculptural and monumental forms. Morehshin Allahyari and Shirin Fahimi engage with the sculptural codes of monuments to propose novel ways to make and mark a space for painful, diasporic, suppressed, or erased memory. They counteract a monumental aesthetic linked to solidity, permanence, and stiffness with a monumentality that is participatory, generative, mutable, and unfolds between actual and physical spaces. Rethinking the function of sculpture as a monument vis-à-vis its expansion via 3D technologies, expanded reality, and the internet, Kölmel explores a transmedial and nomadic monumentality emerging in recent sculptural discourse.

From heroic, self-aggrandizing, national gestures celebrating ideals and triumphs, the idea of what a monument is, had shifted throughout the twentieth century toward ephemeral, conceptual interventions marking national ambivalence and uncertainty. While monuments today are "born resisting the very premise of their birth," public spaces all over the world are still burdened with the weight of problematic figures, looted artifacts, or trophies of war.[51] **Elizabeth Anne Johnson**'s contribution "Confederate Monument 2.0: Mary Ellen Carroll at *Prospect.3*" on the artist Mary Ellen Carroll demonstrates how artists can offer innovative and imaginative solutions to address the problematic history of public monuments critically without necessarily removing them. In preparation for the *Prospect.3* contemporary art triennial in New Orleans in 2014, Carroll proposed to convert a monument to Robert E. Lee into a transmitter for free, long-range, high-speed wireless internet, which was ultimately not realized. Johnson suggests that Carroll's proposal to repurpose the Confederate monument was a "post-digital choice" (p. 188) that envisaged a radical

51 James E. Young, "Twentieth-Century Countermonuments," in *Encyclopedia of Aesthetics*, ed. Michael Kelly (Oxford: Oxford University Press, 1998), pp. 276–78, here p. 278.

solution to internet inequity while mobilizing the monument's symbolism to attend to the history of structural discrimination shaping unequal internet access in contemporary New Orleans. The contributions in this section thus speak of an artistic reclaiming of monumental structures that goes hand in hand with a general expansion of the very idea of the sculptural monument toward the virtual and digital spheres.

The Expanded Field of Digital Sculpture and the Cybernetic Condition

In a similar vein, the final section of the book casts light on the outward expansion of sculpture through cybernetic theory, computerization, and virtual sculptural models throughout the twentieth and twenty-first century. Claudia Giannetti's essay "Media Sculpture: The Cybernetic Condition" explores the impact of cybernetics on sculptural production employing electronic and digital media. From its emancipation from material, mass, volume, and space to its dematerialization, Giannetti carefully reconstructs sculpture's conceptualization as process and system. Her contribution introduces artists such as Abraham Palatnik, Nicolas Schöffer, Les Levine, and Shigeko Kubota who applied the principles of cybernetic theory to sculptural production. Turning information into electronic-visual creations, their works overcome the dichotomy between materiality and immateriality, between the tangible and the intangible, and introduce notions of feedback, variability, pluri-mediality, and indeterminism into the field of sculpture. Giannetti situates these artistic positions alongside important exhibitions organized throughout the 1960s as well as aesthetic theories such as informational aesthetics, cybernetic aesthetics, and generative aesthetics that developed after World War II up until the 1970s. She shows how these earlier artistic, curatorial, and theoretical advances paved the way for the use of the computer in the arts: from the computer-generated sculpture by George Nees or José Luis Alexanco to the computer-aided sculpture by Analívia Cordeiro.

While Giannetti focuses on the fundamental shift in sculptural production aided by cybernetic theory, Jens Schröter's text expands on Rosalind Krauss's essay "Sculpture in the Expanded Field." By connecting the sculptural to the virtual, Schröter aims to formulate a comparable systematic of "Sculpture in the Digitally Expanded Field" (following the title of his essay). His text is based on the premise that computers are capable of creating virtual sculptural models, namely as mathematical descriptions of spatial objects that lack materiality. In this sense, some forms of computer graphics have a fundamentally sculptural component as they are described with *spatial* coordinate systems. Since digital technology can create virtual representations of media, Schröter argues, the somewhat outdated paradigm of characterizing art as a reflection of medium specificity may be having a comeback. He describes such phenomena as "digital modernism" (p. 223) in the sense that simulation, virtualization, and modeling allow for reposing modernist questions around medium specificity. Schröter closes his reflections on sculpture in the digitally expanded field by speculating how sculptural phenomena such as virtual, 3D-printed, and AR sculpture could qualify as a "virtual-modernist" (p. 234) expansion of the field of sculpture.

Circling back to the publication's beginning, the final section provides additional frameworks for the conceptual shift away from a fixed notion of sculpture and toward the sculptural. The multitude of interdisciplinary and trans-historical contributions that make up this volume then not only enable us to shed light on historical constellations from the perspective of contemporary developments, they also encourage alternative readings of contemporary artistic practices in conversation with their historical forebears. The goal is thus to establish a field of research on sculpture in the (post-)digital age and, in an interdisciplinary dialogue, to continue thinking about the artistic medium of sculpture in relation to our technological present.

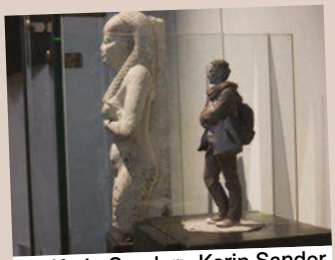
Art meets science and technology

Both in architecture and art, digital technologies and media have led to far-reaching changes in production methods, giving rise to a wide range of reciprocities. Art is thus increasingly abandoning its traditional craft-based form language and seeking inspiration from cutting-edge technical developments, while architecture and technology are creatively exploring the form language of art. Reversed perspectives? A new rubbing of shoulders? Mutual inspiration? Communalities, or diametrically opposed positions?

Digital media and their influence on material production processes open up new technical opportunities and work forms in art, architecture, and the sciences that extend far beyond traditional methodologies. On the one hand the latest technologies change the representational forms of art, and on the other, through new production processes, they allow us to create things possessing not only a wealth of innovative functions but also their own unique aesthetics. Algorithms, 3D scans, robotics, and so forth represent uncharted territory not only in technical but also in aesthetic terms.

Karin Sander (Translation: Stephen Richards)

01 Peter Friese takes a Photo of „Peter Friese 1:10“, 1999, 3D body scan of the living person, FDM (fused deposition modeling), ABS (acrylonitrile-butadiene-styrene), airbrush, Scale 1:10, Height ca. 18 cm, Collection Rebecca and Alexander Stewart, Seattle, Photo © Studio Karin Sander



02 Karin Sander: „Karin Sander 1:5“, 2008, 3D color scan of the living person, polychrome 3D printing, black and white, plaster material, Scale 1:5, Height ca. 32 cm / Installation view Alexandria National Museum, 2008, Photo © Karin Sander

03 Karin Sander: „Werner Meyer 1:10“, 1997, 3D body scan of the living person, FDM (fused deposition modeling), ABS (acrylonitrile-butadiene-styrene), airbrush, Scale 1:10, Height ca. 18 cm, Collection of Landesbank Baden Württemberg, Stuttgart / Installation view Kleinplastiktriennale Stuttgart, 1997, Photo © Studio Karin Sander

07 Karin Sander: „Messebesucher 1:7,7 ... Unlimited (Art-Fair Visitors 1:7,7 ... Unlimited)“, 2001, Mobile scan lab (Scanliner): 3D body scans of the art-fair visitors, 3D printing, plaster material, pigment (chromium oxide hydrate green), Scale 1:7,7 ..., Height each ca. 20–23 cm, Photo © Studio Karin Sander

08 Karin Sander: „Katharina Grosse 1:7,7 ... Unlimited“, 2001, 3D body scan of the living person, 3D printing, plaster material, pigment (chromium oxide hydrate green), Scale 1;7,7 ..., Height ca. 23 cm, Private collection, Photo © Studio Karin Sander

09 Karin Sander: „Michaela Finkbeiner 1:9“, 2002, 3D body scan of the living person, 3D printing, plaster material, Scale 1:9, Height ca. 19 cm, Private collection, Photo © Studio Karin Sander

14 Karin Sander: „Museumsbesucher 1:8, Labor K20 / Museum Visitors 1:8, Labor K20“, 2010, 3D body scans of the living persons in the color of their choice: rapid prototyping, 3D inkjet printing, plaster material, RGB colors, monochrome, Scale 1:8, 23 × 12 × 8 cm / Installation view Museum Lehmbruck, Duisburg, 2013, Photo © Achim Kukulies

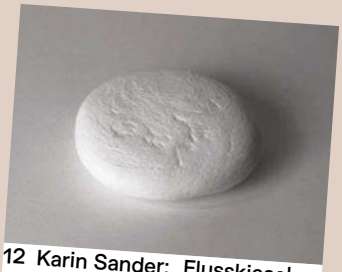
15 3D Prototype: Combining form and color, Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich

04 Werner Meyer, Photo © Studio Karin Sander

05 Karin Sander: „Karl Lagerfeld 1:10“, 2003, 3D body scan of the living person, FDM (fused deposition modeling), ABS (acrylonitrile-butadiene-styrene), airbrush, Scale 1:10, Height ca. 18 cm, Collection of Kunstmuseum St. Gallen, Photo © Martin Steiner

06 Karin Sander: „Valeria Liebermann, Rosemarie Schwarzwälder, Thomas Ruff 1:10“, 2000, 3D body scans of the living persons, FDM (fused deposition modeling), ABS (acrylonitrile-butadiene-styrene), airbrush, Scale 1:10, Height ca. 18 cm, Private collections, Photo © Studio Karin Sander

10, 11 3D Printing work station in the Staatsgalerie Stuttgart, 2002, Photos © Studio Karin Sander



12 Karin Sander: „Flusskiesel 1:1 / River Pebble 1:1“, 2003, 3D scan of the original stone, paper laminate and cutting process PLT A3, 3 × 10,5 × 9,5 cm, Photo © Studio Karin Sander

13 Karin Sander: „Museumsbesucher 1:8, Labor K20 / Museum Visitors 1:8, Labor K20“, 2010, 3D body scans of the living persons in the color of their choice, monochrome 3D printing, plaster material, Scale 1:8, Height each ca. 10–22 cm, Shelf 240 × 1200 × 30 cm, North Rhine-Westphalia Art Collection, Düsseldorf, permanent loan from private collection, Photo © Achim Kukulies

16 Karin Sander: „Barbara Hofkamp 1:5“, 2013, 3D color scan of the living person, polychrome 3D printing, black and white, plaster material, Scale 1:5, Height ca. 35 cm, Private collection, Photo © Studio Karin Sander

17 Karin Sander: „Familie Körner 1:5“, 2013, 3D color scans of the living persons, polychrome 3D printing, black and white, plaster material, Scale 1:5, Height ca. 35 cm / Exhibition view Lens-Based Sculpture. Die Veränderung der Skulptur durch die Fotografie at Akademie der Künste, Berlin, Private collection, Photo © Studio Karin Sander

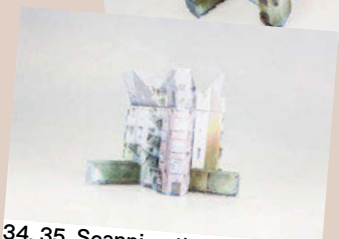
18 Karin Sander: „Reeve 1:5“, 2012, 3D color scan of the living person, polychrome 3D printing, plaster material, color pigment ink, Scale 1:5, Height ca. 27 cm, Private collection, Photo © Studio Karin Sander

19 Karin Sander: „Maximilian Joseph Graf von Montgelas“, 2003–2005, 3D scans of historical representations of Count Montgelas, digitally generated and CNC-milled by a 5-axis milling machine, seawater-resistant aluminum, Height 620 cm, corresponding to the height of nearby sculptures on the Promenadeplatz, Photo © Martin Lauffer

20 Karin Sander: „Smaragd 9:1, verdoppelt / Emerald 9:1, Doubled“, 2000–2003, 3D scan of the original stone, enlarged and milled in aluminum by a 5-axis CNC milling machine, each 50 × 80 × 40 cm, Photo © Studio Karin Sander

26, 27 Scan of „Tongewölbe 1:30“, Ingolstadt, 2015, Photos © Chair of Architecture and Art, Karin Sander, ETH Zurich

24, 25 Scanning and mapping workshop results, Photos © Chair of Architecture and Art, Karin Sander, ETH Zurich

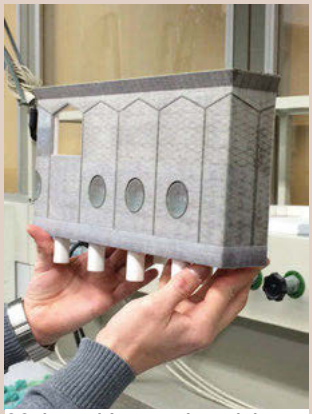


32, 33 Scanning and mapping workshop results, underpass with grafiti in Zurich. Photos © Chair of Architecture and Art, Karin Sander, ETH Zurich

34, 35 Scanning the air space of a courtyard with the positive forms of the negative space. Photos © Chair of Architecture and Art, Karin Sander, ETH Zurich

31 Rendering of additive point data, outward orientation. Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich

21 Karin Sander: „Stein, gespiegelt 1:1 / Stone 1:1, mirrored“, 2018, 3D scan of a limestone, mirrored, two 3D inkjet prints, plaster material, each 19,5 × 32 × 18 cm, Photo © Studio Karin Sander



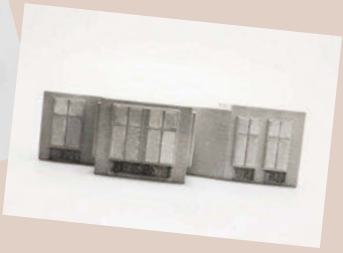
22 In architectural model construction the 3D technique is used: facades are scanned, mapped or modeled onto the buildings and the body of the building is 3D printed, Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich

23 Karin Sander: „Office 1:24“, 2020, 3D scan of the interior, polychrome 3D printing, plaster material, inkjet printing, 15 × 30 × 21 cm, Scale: 1:24, in collaboration with Nicolas Rolle, Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich

28 „Tongewölbe 1:30“, Ingolstadt, 2015, 3D color scan of the internal space, polychrome 3D printing, plaster material, color pigment ink Scale 1:30, 16 × 16 × 12 cm, Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich

29 Detail, „Tongewölbe 1:30“, 2015: The window with the outside is taken through the glass and becomes the image. Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich

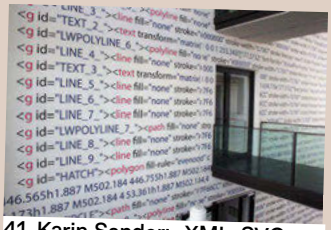
30 Scanning and mapping workshop results, Elevator, 2015, in collaboration with Jonathan Banz and Nikolai von Rosen, Photo © Chair of Architecture and Art, Karin Sander, ETH Zurich



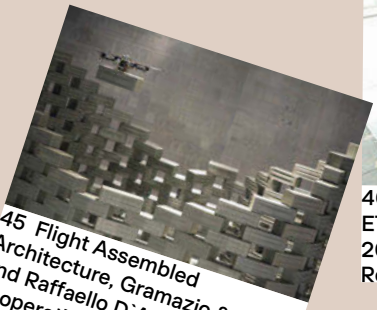
36, 37, 38 Scanning the space of a gallery. Photos © Chair of Architecture and Art, Karin Sander, ETH Zurich

39 Rachel Whiteread, „House, at 193 Grove Road, London E3“, 1993. © Rachel Whiteread, Photo © Sue Omerod

40 Karin Sander: „XML-SVG Code / Source code of the exhibition wall, Laboral – Centro de Arte y Creación Industrial, 2014 Laboral – Centro de Arte y Creación Industrial“, Gijón, E Oracal 638, plotter foil matte, tricolor 4700 × 620 cm, Photo © Sergio Redruello



41 Karin Sander: „XML-SVG Code / Source Code of the New Applied Informatics Building, University of Bayreuth“, 2008, Oracal 638, plotter foil matte, tricolor, 620 × 4700 cm, Photo © Karin Sander

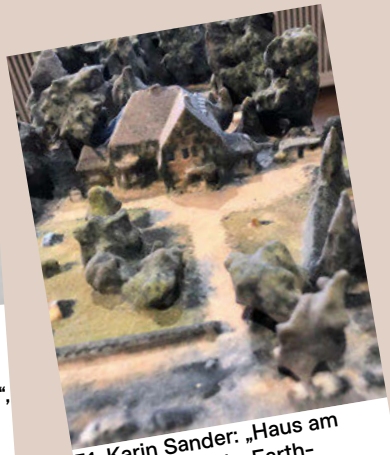


45 Flight Assembled Architecture, Gramazio & Kohler and Raffaello D`Andrea in cooperation with ETH Zurich, FRAC Centre Orléans, 2011 © François Lauginie

46 The Endless Wall, Scientifica ETH Zurich / Universität Zürich, 2011 © Gramazio Kohler Research, ETH Zurich

47 Richard Serra: „The Matter of Time“, 1994–2005, Weathering Steel, Dimensions variable, Photo © Guggenheim Bilbao Museo

50 Karin Sander: „Drei Zinnen, Google-Earth-Daten, 12.02.2020 / Three Peaks, Google Earth Data, 12.02.2020“, 2020, Polychrome 3D print of Google Earth data, plaster material, color pigment ink, 12 × 25 × 26 cm, Photo © Studio Karin Sander



51 Karin Sander: „Haus am Waldsee, Google-Earth-Daten, 07.12.2018 / Haus am Waldsee, Google Earth Data, 07.12.2018“, 2018, Polychrome 3D print of Google Earth data, plaster material, color pigment ink, 11 × 60 × 19,4 cm, Photo © Studio Karin Sander

52 Erwin Wurm: „Fat Car“, 2001, Mixed Media, 130 × 265 × 480 cm, © Erwin Wurm

42 Christian Kerez: „Incidental Space“ (Interior view), Swiss Pavilion, Venice Architecture Biennale, 2016, Photo © Oliver Dubuis

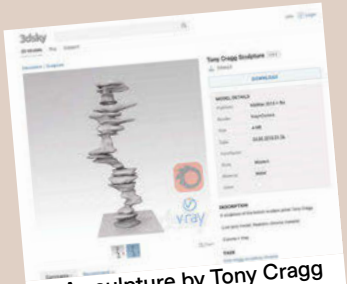
43 Christian Kerez: „Incidental Space“, Swiss Pavilion, Venice Architecture Biennale, 2016, Photo © Oliver Dubuis

44 Structural Oscillations, Installation at the 11th Venice Architectural Biennale, Gramazio Kohler Research, ETH Zurich, 2007–2008, Photo © Alessandra Bello

48 Digital Grotesque, Grotto Interior, Hansmeyer/ Dillenburger

49 Dynamic Grammar, Dillenburger

53 Urs Fischer: „Untitled“, 2011 © Urs Fischer. Courtesy of the artist and Galerie Eva Presenhuber, Zurich. Photographer: Stefan Altenburger



54 A sculpture by Tony Cragg as a download file at 3dsky.org

55, 56 Karin Sander: „Museumsbesuch Kunst Museum Winterthur / Museum Visit Kunst Museum Winterthur“, 2018, Virtual reality technic, 3D visualization, Dimension variable, Photos © Studio Karin Sander

Historical Precursors

Buket Altinoba

"Curious Machines"

Reproducing Sculpture via Machine and Its Modus of Display in the Nineteenth Century

Abstract

The relationship between the human body, sculpture, and machine is demonstrated by mechanical or artistic works performing at the intersection of aesthetics and scientific practice. Considering the mutual interaction of body and technology, the idea of delegating image production completely to machines can be traced to two main developments: the creation of drawing machines for multiplying portraits, like the physiognotrace, and to the conception of machines for reproducing sculpture, both of which were invented in the late eighteenth and the early nineteenth century. Thus, relevant to the development of modern exhibition culture, this paper takes up modern technologies for reproduction in the arts with a focus on practices in the field of sculpture: since 1800, industrial exhibitions, museum collections or public demonstrations of humanlike machines that replicate sculptures stand for a specific display aesthetic as well as the notion of the magical or even curios as a topic. Ultimately, machines and their active role in the reproduction process of artworks will be contextualized via Gilbert Simondon (1958) and will position the machine and the object as active agents in the entangled fields of art, science, and technology.

Key Words

Sculpture reproducing machines, physiognotrace, François Willème, John Isaac Hawkins, Benjamin Cheverton, Charles Willson Peale

The relationship between the human body, sculpture, and machine is the core element of exhibitions that demonstrate objects performing at the intersection of art and science from the modern era till the present. In 2007, for example, the ZKM | Center for Art and Media Karlsruhe exhibited current artistic positions that expanded metaphors of "intelligent machines" that were produced since Wolfgang von Kempelen's (1734–1804) apparatuses, the chess automaton (1770). Two years later, the Berlin Georg Kolbe Museum was displaying "Romantic Machines" in the exhibition titled *90 Years of Kinetic Art, 9 Works,*[1] which

1 Marc Wellmann, ed., *Romantische Maschinen: Kinetische Kunst der Gegenwart* ,exh. cat. Georg-Kolbe-Museum-Berlin (Berlin: Wienand, 2009).

covered perspectives of automation and moving sculpture. Both exhibitions give insight into the technical-historical importance and intrinsic world of the apparatus. In particular, the display of the chess automaton found its expression literally in the notion of the "body" in the machine: "The secret of the machine that supposedly possessed artificial intelligence was later discovered to be a human hidden within it."[2]

Early automata exercised great fascination for the scholars in view of the philosophical discourses on "the genius" at the time, particularly considering the mutual interaction of body and technology. Mainly since the end of the eighteenth century, newly invented machines were increasingly popularized while displayed as spectacles to astonished audiences. Relevant to the development of modern culture, the notion of magic has thus shown a remarkable connection to technology—alongside sculpture, they were often presented in exhibitions or private collections. As a component of the royal cabinets of curiosities in the past, the magical or even curios became a relevant topic in the transition to modern exhibitions. Since 1800, industrial exhibitions, fairs or public demonstrations of human-acting machines have been used for a specific display aesthetic. Only a few decades after Kempelen's ruse on the European princely houses, in 1802, the American portraitist and museum owner Charles Willson Peale (1741–1827) was presented a "curious machine"[3] from Europe that enabled the production of two-dimensional profiles of living models through mechanical invention: the physiognotrace. Its creator, John Isaac Hawkins (1772–1855) later worked—like his contemporary James Watt (1736–1819)—on a machine for copying in three dimensions, which also received attention from the sculptor Benjamin Cheverton (1794–1876), who demonstrated the sculpture-reproducing machine successfully at London's Great Exhibition in 1851. A decade later, François Willème's "photosculptures" reevaluates different notions of dimensionality that as early as 1838 culminated in the virtualization of sculpture by referring to techniques such as stereoscopy.

This paper aims to elaborate on different notions of reproduction beyond the cultural- and media-critical implication of Walter Benjamin's analysis of reproduction.[4] By following Jens Schröter's research on the rendering of sculpture in the historical context of technical reproduction media,[5] this contribution pursues the developments from the plane reduction

2 See the exhibition documentation, Center for Art and Media website, https://zkm.de/en/event/2007/06/wolfgang-von-kempelen-man-in-the-machine (accessed November 2, 2022). See also Bernhard Serexhe and Peter Weibel, eds., *Wolfgang von Kempelen: Mensch in der Maschine/Man in the Machine*, exh. cat. Zentrum für Kunst und Medientechnologie Karlsruhe (Berlin: Matthes & Seitz, 2007), p. 6.

3 *Aurora*, Dec 28th, 1802, quoted in Wendy Bellion, "Heads of State: Profiles and Politics in Jeffersonian America," in *New Media, 1740–1915*, ed. Lisa Gitelman and Geoffrey B. Pingree (Cambridge, MA: MIT Press, 2003), pp. 31–60, here p. 32.

4 This paper is based at some points on the results of the journal article by Buket Altinoba, "Das 'Multiple' im 19. Jahrhundert: Von Skulpturmaschinen, Techniktraktaten und Porträt-Miniaturbüsten," *Figuren der Replikation, kritische berichte* 48, no. 3 (2020): 67–80.

5 Jens Schröter, "Wie man Skulpturen rendern soll: Zur Geschichte der transplanen Reproduktion," in *Skulptur – Zwischen Realität und Virtualität*, ed. Gundolf Winter, Jens Schröter, and Christian Spies (Munich: Wilhelm Fink, 2006), pp. 231–74, here p. 233. See also Jens Schröter, *3D: Zur Geschichte, Theorie und Medienästhetik des technisch-transplanen Bildes* (Munich: Wilhelm Fink, 2009).

of a three-dimensional object to a surface (physiognotrace) to the automated reproduction of sculptural objects (sculpture machine, photosculpture). Therefore, this paper not only takes up machines regarding their active role in the reproduction process of artworks in different formats and sites in the first half of the nineteenth century in Britain, France, and the United States. In the theoretical context of the discourse about art and materiality, it also considers the ontological approach to machines and objects according to Gilbert Simondon, which will be contextualized according to the notion of the machine and the objects as active agents to position them in the entangled fields of art, science, and technology.[6] With the onset of industrialization, technologies for reproduction in the arts developed with a special focus on sculptural objects and materiality. A further aim is to assess how the increased mechanization and automation affected the traditional craftworking methods of sculptors in terms of authorship and control.

The contribution deals above all with achievements of industry and technology that mingle with the arts as new entanglements changed the perception of dimensional awareness through their display. Yet, with Jonathan Crary, it is crucial to note how science and art have been intertwined fields of knowledge and mechanical practice[7] since the nineteenth century, while according to Lorraine Daston the simultaneous "migration of imagination to the artistic pole"[8] fostered the new disunion of art and science. Extending these thoughts to the interactive change of visual perception, the display gets a realm where dynamic and moving aspects of the object can unfold in opposition to the immobility of the viewer. The medium of sculpture, which usually precedes the movement of the viewer in space, is here thoughtfully reversed with a special focus on the interplay between magic, technological virtuosity, and mechanical automata. With the variable positioning and installation of display in relation to the viewer, sculpture anticipating questions of today's notion of the sculptural in the digital context: rather, the machine, its output, the procedure as a whole, is to be understood as a kind of historical precursor of current procedures of transformation or simulation of sculpture (3D-printing, 3D-rendering, volumetric scanning), also regarding its onsite presentation: a new path in the field of three-dimensional reproduction.

6 Gilbert Simondon, *Du Mode d'existence des objets techniques* (Paris: Aubier, 1958). See also Bruno Latour, "Do Scientific Objects Have a History? Pasteur and Whitehead in a Bath of Lactic Acid," *Common Knowledge* 5, no. 1 (1996): 76–91. Bruno Latour, "On Interobjectivity," *Mind, Culture & Activity* 3, no. 4 (1996): 228–45.

7 Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, MA: MIT Press, 1990), p. 15.

8 Lorraine Daston, "Fear & Loathing of the Imagination in Science," *Daedalus* 134, no. 4 (2005): 16–30, here p. 17.

I. Magic, Technological Virtuosity, and Mechanical Automata around 1800

> "This curious machine, perhaps, gives the truest outlines of any heretofore invented, and is placed in the Museum for the visitors who may desire to take the likenesses of themselves or friends."[9]

The so-called physiognotrace introduced in the United States in 1796, ten years after its invention at the French court,[10] was, in the beginning, a practiced mechanical process for image-making by French emigrants such as J. J. Boudier, Charles B. J. F. de Saint-Mémin (1770–1852), and Thomas Bluget de Valdenuit (1763–1846).[11] A modified version of the machine was developed by the British-born inventor John Isaac Hawkins who emigrated to the US around 1800 and received an American patent for it in 1802.[12] The following year, he presented the pantograph-based device that he had designed to trace portraits for the purpose to supply copies to Charles Willson Peale (fig. 1). A portraitist, Peale made use of the practical ability of the new acquisition, which was a device "so simple [of] construction, that any person without the aid of another, can in less than a minute take their own likeness in profile."[13] As a result, the physiognotrace was integrated into Peale's collection of "wonderful" curiosities (*Wunderkammer*) which he had only a short time later transferred into the Philadelphia Museum.[14] Here, he exploited the machine for "accurate representation"[15] commercially by demonstrating it publicly in his museum so visitors could get a machine-made profile included in the entry fee.[16]

Indeed, one can assume that Hawkins knew the apparatuses of Chrétien and Saint-Mémin. Yet, the progress in the machine of Hawkins was remarkable. According to Peale's letter to his close friend and president Thomas Jefferson, wherein he enthusiastically de-

9 Part of Charles Willson Peale's announcement in the newspaper *Aurora*, Dec 28th, 1802, quoted in Bellion, "Heads of State," p. 32.

10 Developed in Paris by Gilles-Louis Chrétien (1754–1811) and patented in 1786, the physiognotrace was in use till 1830. For further information, see Gisèle Freund, *Fotografie und Gesellschaft* (Munich: Rogner & Bernhard, 1974); Peter Frieß, *Kunst und Maschine: 500 Jahre Maschinenlinien in Bild und Skulptur* (Munich: Deutscher Kunstverlag, 1993), pp. 134–36.

11 "Saint-Mémin went to New York in 1793 as a refugee from the French Revolution and by 1796 had taught himself the techniques of engraving. From Thomas Bluget de Valdenuit (1763–1846), his partner in 1796–97, he learned to take profile portraits in the manner used by Gilles-Louis Chrétien in Paris in the 1780s and 1790s. Between 1796 and 1810, Saint-Mémin made about 900 bust-length profile portraits using a pantographic drawing device called a physiognotrace." Joan M. Marter, *The Groove Encyclopedia of American Art*, vol. I (New York: Oxford University Press), p. 353.

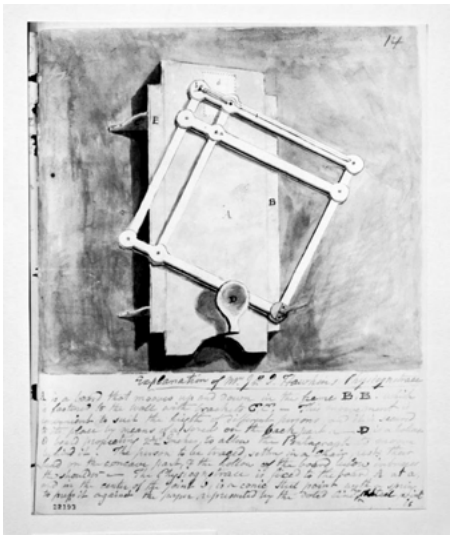
12 See Frieß, *Kunst und Maschine*, p. 138.

13 *Philadelphia Repository*, January 1, 1803, quoted in Bellion, "Heads of State," p. 32.

14 "Placed in the northwest corner of the Long Room, the instrument was one of many modalities of representation—visual, political, classificatory, didactic—operative within the space of the State House." Ibid., p. 44.

15 Bellion, "Heads of State," p. 31.

16 Ibid., p. 34.



1 Charles Willson Peale, *Explanation of Mr. Jno. I. Hawkins Physiognotrace*, 1803.

scribed the results,[17] this version could proceed "without the help of an artist or engraver."[18] In contrast to the French physionotrace (without the g) that—due to the political escape of Saint-Mémin—reached the US as a scaled-down portable model, the operator of the machine was now even able to portray himself:[19] Chrétien and Saint-Mémin's machines included a visor, allowing the artist to work at a distance and aim at their model. Against this, Hawkin's machine was bolted to a wall.[20] Thus, the sitter operated alone, and the machine allowed a direct and unmediated (and therefore representative) image. In her essay on the imagery production during the presidential elections and the making of immediate profiles at the turn of the century, Wendy Bellion not only explains the procedure of the exhibited physiognotrace but also mentions its visual and performative qualities.[21] As the machine's advertisement referred to the slogan "Friendship esteems as valuable even the most distant likeness of a friend,"[22] Peale "sat a plaster bust of his own distant friend, Thomas Jefferson, before the 'curious machine' and traced the simulacrum of the president's physiognomy"[23] in

17 See *Philadelphia Repository*, January 1, 1803, quoted in ibid., p. 32.
18 Quoted in Frieß, *Kunst und Maschine*, p. 138; translated by the author.
19 Frieß, *Kunst und Maschine*, p. 136.
20 While the model was sitting under the machine, the semicircular cutout in the board rested on his shoulder. For people of different heights, the board could be adjusted appropriately to the heights of the anchored guides. Then it was only necessary to touch the profile of the head with the stylus on the pantograph, and a drawing pen or engraver leaves the facial outline reduced on the drawing sheet or copper plate to be finished. See ibid., pp. 138–39.
21 Bellion, "Heads of State," pp. 31–60, here p. 32.
22 The beginning of Charles Willson Peale's announcement in the newspaper *Aurora*, December 28th, 1802, quoted in ibid.
23 Ibid.

2 Charles Willson Peale, *Smoke-Eater*.

front of the audience. This aspect of showmanship is interesting on two levels: on the one, Peale profited from Jefferson's celebrity along with the promotion of the physiognotrace on display: Jefferson's silhouette was reproduced and distributed to visitors at Peale's museum against the background of an ongoing presidential election. On the other, a sculptural bust was clamped into the device for the performance as an embodied signifier of bodily absence. This notion of absence, along with the prominence of the portrayed, is symbolized by the medium of sculptural portrait, demonstrating the place of the bust in Victorian culture—a topic corresponding at the same time with the sentiments of the epoch of classical romanticism. Another example of a bust integrated into a three-dimensional installation was Peale's *Smoke-Eater* (fig. 2), which recalled the Franklin stove or similar French versions, standing isolated and centered in the room, simulating sculptural aesthetics:

> Peale's "smoke-eater." Peale built his stove in brick, favoring its heat radiating qualities over iron; he covered the brick with plaster, which was whitewashed and then painted to look like marble. The bust on top was initially Cicero, but Peale later sought to replace it with one of Linnaeus. The smoke rose to the top of the stove and was then sucked down a pipe, which was perforated at the level of the fire, at which point it underwent further combustion. The hot air would then continue along a horizontal pipe under the floor to the outside of the building.[24]

Regarding the sculptural quality, the medium's title refers to the human features and the author's anthropological interest, resulting from prominent eighteenth-century lectures such as Julien Offray de La Mettrie's *L'homme machine* (1747). Peale, who viewed "the

24 *The Weekly Magazine*, vol. 2, no. 25 (July 21, 1798), pp. 353–54, quoted in Sidney Hart, "'To Encrease the Comforts of Life': Charles Willson Peale and the Mechanical Arts," *The Pennsylvania Magazine of History and Biography* 110, no. 3 (1986): 323–57, here p. 328, 340.

human body as a complex machine,"[25] had designed and installed this "fascinating and complex mechanism that not only supplied sufficient heat but became an exhibit itself." "Astonished visitors to the museum were able to look through a vent in the pipe and see a stream of smokeless hot air leaving the stove."[26]

Besides the aesthetic reflection, Peale was highly interested in the operating system that produced output seemingly without the human hand.[27] Though machines do not intervene all on their own—mechanical procedures commonly require in decisive moments the practiced hand of an instructed person—drawing machines in particular claimed to operate independently of human intervention. Elizabeth Bacon refers in her dissertation on *Drawing Machines* to the writing of Johann Caspar Lavater's (1741–1801) *Whole Works* and explains why he drew attention to the notion of the "machine alone, autonomous, unadulterated." The emphasis of outlining from nature as the "creator" stands in opposition to the "suggestion of the artist's body, [which] is hidden behind the physiognotrace's screen."[28] Especially considering Lavater's chair for outlining silhouettes (1776),[29] "[t]his rhetoric of automation and self-evidence is characteristic of period descriptions of the device."[30] Two thoughts arise from this: firstly, the pictorial output—called the *profile*—was the result of the cast of a shadow produced by a candle that allowed the hand of the artist to follow it naturally and without any seeming effort. Secondly, according to the "mysterious" or "strange" procedure during candlelight that hid the intervening body behind the animated machine, the latter was supposed to be perceived as "ghostly, haunted by the hand of an operator who never materializes."[31]

If we take a position on Bacon's remarks on the ghostly in the context of Lavater's method that was popular due to the emerging interest in physiognomy during the Enlightenment, we must put another contemporary example aside which is only little written about: the "Bou-Magie" (1778). Invented in Hamburg by Jacob von Döhren (1746–1800), the machine for portrait reproduction was supposed to act magically.[32] As the title

25 Ibid.

26 Ibid., p. 339.

27 Peale worked in his early career as a clock and watch repairer, an area of pre-industrial mechanics. Ibid., p. 325.

28 Ibid., p. 179. The fully automated process is questioned today and is assumed to be "semi-automated". Elizabeth Bacon, Drawing Machines: Image and Industry in Early America, PhD diss. (Harvard University, 2017), p. 180, http://nrs.harvard.edu/urn-3:HUL.InstRepos:41140245 (accessed January 7, 2021).

29 For further information on Lavater's chair, see Frieß, *Kunst und Maschine*, p. 132. See also Olaf Breidbach, "Physiognomische Präsentation: Zur Physiognomik Johann Caspar Lavaters," in *Natur im Kasten: Lichtbild, Schattenriss, Umzeichnung und Naturselbstdruck um 1800*, ed. Kerrin Klinger and André Karliczek (Jena: Friedrich-Schiller Universität, 2010), pp. 26–34.

30 Bacon, *Drawing Machines*, p. 180

31 Ibid.

32 The artist, writer, and naturalist tried to optimize printing processes from 1777 onward under the pseudonym Hans Plattversius. Döhren developed a technique for reproducing existing silhouettes, for which he used roughened, blackened plates of brass and zinc that he pressed onto the paper. This enabled him to generate numerous accurate copies in a short time, which he sold at a profit nearly a century before the practice of printing photography in mass reproduction emerged. See Gustave Kowalewski,

of Döhren's book *Silhouettes of Contemporary Scholars Made en Bou-Magie*[33] recalls the name of the machine, such an expression also emphasizes the ghostly expression "bouh" ("boo") and the magic as it emanates from likewise automated machines based on the pantograph. The mysteriousness is strengthened by the fact that the author says in the preface of the cited writing, what Bou-Magie is not, but promises to still explain what it is.[34] Within this rhetoric of the childishly simple, enigmatic, or even magical, we also find an idea reiterated in many of the period's visual representations of automated mechanisms, tracing back to an image tradition related to the pantograph. The latter, a widely employed copying and perspective device, was a well-known drawing aid and auxiliary tool (comparable to the surpassed perception of the "drawing" in art history) during the seventeenth and eighteenth century.[35] It was only recently that Margarete Pratschke analyzed the frontispiece of a treatise that the physician Christoph Scheiner had published in the early seventeenth century concerning the construction and use of this device taking into account art-theoretical issues. The manual, titled *Pantographice: Sev Ars Delineandi*, was introducing a newer version of the stork's beak, the pantograph which Christoph Scheiner (1575–1650) had invented as early as 1603, and finally published the treatise in 1631 in Rome.[36] Pratschke understands the pantograph's illustration on the front page as a "visual instruction manual," referring to the mode of presentation: it demonstrates to the viewer the new possibility of using the already known rod parallelogram as a full "automated procedure."[37] For this purpose, the depiction (fig. 3) shows an anthropomorphic cloud, equipped with a hand and an eye, floating in the center of the picture, magically presenting both modes of operation: a small and equally sized reproduction. The audience illustrated here had to be convinced of the new and innovative potential of a device already known, and contrasting to the old drawing tradition embodied by the putto.

Even further developments of the pantograph—as a "collapsible mechanism of levers"[38]—are significant for the artistic production of scale, also in the third dimension: the sculpture reproducing machine that was invented at the beginning of the nineteenth century was also based on the pantograph system. However, Martin Kemp mentioned sculpting machines (and there are different types of them) solely as the idea of "[a] variant on

"Bou-Magie und Physionotrace: Ein Beitrag zur Geschichte des Bildnisses," *Hamburg in Zeitschrift des Vereins für Hamburgische Geschichte* XXII (1918), pp. 168–79.

33 The book depicts silhouettes made with his machine. Jacob von Döhren, *Die Silhouetten Jetztlebender Gelehrten en Bou Magie* (Hamburg, 1778).

34 Gabriel Christoph Benjamin Busch, *Handbuch der Erfindungen*, vol. 2 (Eisenach, 1803), p. 142.

35 See Robert Dossie, *The Handmaid to the Arts*, vol. 1 (Oxford: Nourse, 1758).

36 Christoph Scheiner, *Pantographice seu ars delineandi res quaslibet per parallelogrammum lineare seu cauum, mechanicum, mobile* (Rome: Ex Typographia Ludouici Grignani, 1632).

37 Quoted in Margarete Pratschke, "'Wie von selbst' – Strategien der Innovationslegitimierung in Christoph Scheiners Frontispiz zum Pantografen von 1631," in *Imagination, Repräsentation und das Neue*, ed. Pablo Schneider, Christiane Kruse, and Horst Bredekamp (Munich: Wilhelm Fink, 2010), pp. 321–33, here p. 323; translated by the author.

38 Bellion, "Heads of State," p. 42.

3 Christoph Scheiner, Frontispiece (book illustration), *Pantographice seu Ars Delineandi,* 1630.

the Scheiner-Wren system."[39] Yet, recently, pantographic apparatuses were perceived in the art-historical literature as auxiliary instruments that were irrelevant to the creative process because they undermine the artistic myth of the original idea. Since the pantograph at best "copies," it was merely discussed on an art-historical or art-theoretical level. But sculptures, profiles, and busts, which were "multiplied" in different materials, shapes, and sizes at the beginning of industrialization, must be discussed here as "products" of technical ingenuity and interpreted together with the machine in their agentive role in the setting of image making as well as for their role in building the art-historical canon.[40]

While this part mainly discussed the two-dimensional aspect of mechanical reproduction in the context of drawing machines invented and presented publicly as a magical spectacle from the early modern period till the end of eighteenth century, the following section will introduce types of sculpture machines that carry this fascination for the machine and its output on in the nineteenth century. Arguing then in the final section that the display of these machines certainly possessed qualities of sculptural exhibits and serve to produce a magical spectacle, it is the aim to highlight the perception of the viewer and the attitude toward the genre of sculpture that continued to change with the beginning of the nineteenth century.

39 Martin Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven: Yale University Press, 1990), pp. 182–83.

40 See Buket Altinoba, "Das 'Multiple' im 19. Jahrhundert: Von Skulpturmaschinen, Techniktraktaten und Porträt-Miniaturbüsten," in *kritische berichte*, 2020.

II. From Sculpture to Invention: From Invention to Sculpture

The same year, in 1803, John Isaac Hawkins returned to England, so the technology also moved there: together with Hawkins's return, the physiognotrace arrived in London not via France, where the apparatus was developed, but via the US detour. Improvements of the physiognotrace established a new portraiture technique in Britain as Hawkins made the first machine-made profile of Benjamin West, the president of the Royal Academy of Arts.[41] In London, Hawkins pursued his dispositioned mechanical and scientific interests,[42] which he had intensified in the workshop of Peale's Philadelphia Museum.[43] As reported in 1808 by *The Monthly Magazine*, Hawkins "has established a museum for the reception and exhibition of useful mechanical inventions and improvements."[44] This exhibition referred to his own inventions, yet not exclusively, as other technical innovations were also introduced. Overall, the exhibits served to astonish the audience by displaying objects and machines with curious, humorous, practical, and visual qualities including another machine for reproducing the scale of the recorded.[45] Yet again, the term "curios" is here used as one of the main features of Hawkins's collection. This topic is not only linked to the elites' gained knowledge from access to royal cabinets of curiosities since the early modern period; it also stands close to the display of sculpture, technology, and science, such as the painted exhibition view by Samuel Rayner titled *Interior of the Mechanics' Institute (Derby Exhibition)* from 1839 (fig. 4) is illustrating three decades later—an industrialized cabinet of curiosities. Here, the display shows the status and importance of sculpture, especially demonstrating the portraiture bust presented in the context of science and industry and its popularization in the first half of the nineteenth century.[46]

Meanwhile, Hawkins started to work—like many at the time—on machines for reproducing in the third dimension. According to Ben Russell it was the time of "technical challenge and financial rewards of making high-quality copies of sculpture,"[47] and it was far

41 Frieß is also noticing that by selling his American patents to colleagues and friends in the US, Hawkins not only could afford further investigations, but also obtained patent protection in Britain for most of his inventions, including the physiognotrace. See Frieß, *Kunst und Maschine*, 1993, p. 139.

42 Hawkins is described as a "multifaceted man, a civil engineer, inventor and sometime composer, poet, preacher and phrenologist whose father had been a clockmaker." Ben Russell, *James Watt: Making the World Anew* (London: Reaktion Books, 2014), pp. 213–15.

43 Hart, "To Encrease the Comforts of Life," p. 341.

44 *The Monthly Magazine*, no. 17 (June 1, 1808), p. 355; See also *The Medical and Physical Journal* 19 (1808), p. 575.

45 "[A] machine, to be towed across a river, which will at the same moment drawn on paper, to any reduced scale, the exact shape of the bottom; shewing, at one view, the depth of water in every part, together with the width of the river." *The Scots Magazine*, June 1, 1808, p. 445.

46 The high number of visitors proves the emerging public interest in the scientific and academic fields as "[n]early 100,000 people visited the exhibition during the eighteen weeks it was open." Martina Droth, Jason Edwards, and Michael Hatt, eds., *Sculpture Victorious: Art in an Age of Invention, 1837–1901*, exh. cat. Yale Center for British Art, (New Haven/London: Yale University Press, 2014), pp. 30–31.

47 Russell, *James Watt*, p. 213.

4 Samuel Rayner, *Interior of the Mechanics' Institute (Derby Exhibition)*, 1839.

more than just the economic gain. Against the backdrop of industrialization and the growing interest in automated procedures for reproduction, the engineer and inventor James Watt had already begun to build "sculpture-copying machines" in 1804 that were conceived as "enigmatic."[48] In her article "Nineteenth-Century Sculpture and the Imprint of Authenticity," Angela Dunstan explains the notion of the "inanimate sculptors" in the context of the "recurring dream of inventors"[49] to create sculpting machines starting with the activities of James Watt:

> [D]uring the years of his retirement to his garret in the early nineteenth century, [James Watt] developed prototypes for just such a machine which would build upon the replication principles of his copying press in order to copy sculptures using parallel hinged arms: one with a pen which was traced around the original work while the other arm was attached to a blade which replicated the original in a soft material such as wax or alabaster.[50]

48 Ibid., p. 217.
49 Angela Dunstan, "Nineteenth-Century Sculpture and the Imprint of Authenticity," in *Interdisciplinary Studies in the Long Nineteenth Century*, no. 19 (2014): 11–12.
50 Ibid.

The idea of experimenting with independent processes that turned three-dimensional originals into three-dimensional copies came up during Watt's stay in Paris in 1802, where he had observed "an implement … used for tracing and multiplying the dies of medals"[51] at an exposition.[52] Such a machine, called the *tour à medaille*, was according to Frieß displayed at the Conservatoire des Art et Métiers and the Institut de France as early as the beginning of the eighteenth century.[53] Whereas Watt's interest in three-dimensional objects was probably first aroused in the 1770s in the famous workshops for pottery making of his friend Josiah Wedgwood, where many of his acquaintances had been portrayed after medallions taken from plaster molds.[54] As a consequence, Watt had a large number of plaster casts delivered from Paris in 1792, so the later workshop of Watt recalled a "sculptor's atelier:" As Russell reports, the famous engineer not only set up this collection of antique sculptures that should have made him a collector, but also collected the casts, so he was an "avid collector of molds for antique figures."[55] After seeing the machine in Paris, Watt made several attempts "by experimentation" to develop two machines, one for full-size copies (equal sculpturing machine) and one for reduced copies (proportional sculpturing machine) between 1804 and 1809. While both machines were based on the pantograph mechanism, as Russell explains the procedure,[56] the equal-size machine was, in addition "more capable of producing three-dimensional objects with a greater degree of surface relief."[57] Since the first results still required manual reworking, Watt was able to produce smoothly polished surfaces for the first time with his machine, which he had improved in May 1809.[58] Similar to Peale's copy of the Jefferson profile, the first sculpture Watt copied was a small head of his friend the economist Adam Smith. When making portrait busts, including his own, Watt consulted experienced sculptors, such as Francis Leggatt Chantrey (1781–1841), from whom he had also learned to carve in stone in 1815.[59] Watt continued to work on these machines until his death in 1819—without ever obtaining patents for them. Insofar as

51 James P. Muirhead, *Mechanical Inventions of James Watt* I, 1854, p. ccxlii.

52 See Jane Insley, "James Watt and the Reproduction of Sculpture," in *Sculpture Journal* 22, no. 1 (2013): 37–65, here 43.

53 There, the machine came to France as a gift from the Russian tsar. See Frieß, *Kunst und Maschine*, 1993, p. 206.

54 Jane Insley, "James Watt and Reproduction of Sculpture," 2013, p. 43.

55 Russell, *James Watt*, p. 208.

56 "[A]n item to be copied and material to make the copy from, usually a block of plaster of Paris, were positioned on the machines side-by-side. A feeler and a rotating cutting tool were also positioned side-by-side, and mounted so that as the feeler was carefully traced across the surface of the original, the cutter followed and repeated exactly the same movement. As the tool was rotated at high speed by a treadle, so plaster was removed and the copy formed." Ibid., p. 206.

57 Russell, *James Watt*, p. 206.

58 In further steps, Watt changed the "shape of the cutters" to such an extent "that they could run without vibration and at high speed." See Insley, "James Watt and the Reproduction of Sculpture," 2013, pp. 37–65; see also J. G. Pollard, "Matthew Boulton and the Reducing Machine in England," *The Numismatic Chronicle* 11 (1971): 311–17.

59 For Watt's close collaboration with artists and artisans to produce portraits by machine, see Insley, "James Watt and the Reproduction of Sculpture," 2013, p. 45.

Russell questions its practicality and "purpose outside the workshop,"[60] Frieß notes that "only a small circle of friends learned of his experiments" and that it was Hawkins who "went public with his invention a few years after Watt's death."[61] It is worth considering whether the machines really worked and if so, better or worse than the technical drawing or design promised. Not until 1837 did Hawkins demonstrate the sculpture-reducing machine that relied on the use of an "engine lathe," before a committee at the British Association for the Advancement of Science meeting.[62] The same year, *The Literary Gazette* wrote enthusiastically not only about the features of the machine and its inventors—Hawkins together with his younger colleague and sculptor Benjamin Cheverton—but also marvelled that not "a single touch from the artist"[63] was required to execute the specimens of sculpture. Together with his mentor, Cheverton had developed further the idea of the automated procedure of sculpture making: combining both of the machines that Watt invented—one for equal-size reproduction and the other for proportional sculpturing or reducing—Cheverton was able to reproduce sculptures equally, as precisely as he could, and scale down proportionally with one machine.[64] In the editorial to the 2013 issue of *History of Photography*, Patrizia Di Bello informs us of the accurateness of these technical processes.[65] Information on the reliability and high precision of the machine-made replicas can be found later, according to Rebecca Wade, in Matthew Digby Wyatt's statement "for the opening of an exhibition of the Arundel Society at the Crystal Palace in 1855": taking the example of the sculptures "Theseus, Ilissus and Plate 47 of the Parthenon Frieze," reduced in size by Cheverton's machine, the considerable remark was that they were "microscopically, almost magically reproduced."[66] In the nineteenth century, how the objects were made became more and more the focus, while using Antiquity "as hooks for publicising new processes of reproduction"[67] become a spectacle. In order to shed some light on the notion of displaying a technique and process relevant in the context of the magical spectacle, it is important to outline the machine and its agency.

60 Russell, *James Watt*, p. 217.

61 Quoted in Frieß, *Kunst und Maschine*, p. 209; translated by the author.

62 *The Mechanics' Magazine, Museum, Register, Journal, and Gazette* XXVI (Oct. 1–March 31, 1837), p. 154.

63 *The Literary Gazette and the Journal of the Belles Lettres: A Weekly Journal of Literature, Science, and the Fine Arts*, ed. William Jerdan, vol. 21, no. 1078 (1837), p. 593.

64 See Frieß, *Kunst und Maschine*, p. 210.

65 "In Watt's and Cheverton's machines, original and copy are clamped to plates connected by geared arrangements that keep them in the correct spatial relationship as they rotate to carve new portions of the copy, layer by layer. This enables the manufacture of exact copies in different sizes but in the right proportion, which is impossible with moulding and casting alone." Di Bello, "Photographs of Sculpture," 2016, p. 9.

66 Rebecca Wade, *Domenico Brucciani and the Formatori of 19th-Century Britain* (New York: Bloomsbury, 2019), p. 52.

67 Gabriel Williams, *Industry and the Ideal: Ideal Sculpture and Reproduction at the Early International Exhibitions,* PhD diss. (University of York, 2014), p. 29.

III. The Machine between Actor and Tool and Sculpture

Twelve years after the exhibition of the Derby Mechanic Institute, the London Great Exhibition of 1851 offered "the display of sculpture alongside objects of science and industry … to reach a pinnacle."[68] The Crystal Palace in London hosted an array of objects testifying to both artistic and technical virtuosity while its display served as a spectacle for the audience.[69] This form of displaying inventive devices and equipment was something Victorian scientific society was all too used to; so, "Benjamin Cheverton exhibited busts and reductions carved on-site using his machine; and photography was declared by the juries to be 'the most remarkable discovery of modern times.'"[70] Cheverton was very busy in the years following the fair because of the growing demand for reproductions of artworks in different materials,[71] also fostered by institutions like the Art Union and the Arundel Society.[72] The latter institution had made it their goal to "promote a greater knowledge of art through … reproductions."[73] The same effect is to be said for David Brewster with his portable lenticular stereoscopes, who "claimed that half a million prism stereoscopes had been sold"[74] within a few months after its presentation at the Crystal Palace. While Brewster's optical device, which turned two-dimensional photographs into a three-dimensional visual experience, amazed the audience, Cheverton's success was granted for copying to scale "plaster versions of the marble sculptures."[75] In contrast to sculptors like Francis Leggatt Chantrey, who used the pointing machine in his workshop practice,[76] Cheverton's aim was to demonstrate

68 Droth, Edwards, and Hatt, *Sculpture Victorious*, 2014, pp. 30–31.

69 For further information on the presentation of the sculpture reducing machine at the Great Exhibition, see Buket "Engineers as Artists: Artists as Engineers—The Reproduction of Art Objects at the Great Exhibition 1851," in Buket Altinoba, Alexandra Karentzos, and Miriam Oesterreich, eds., *Gesamtkunstwerk Weltausstellung? Re-Visioning World's Fairs*, *RIHA Journal* (forthcoming). See also Paul Atterbury and Maureen Batkin, *The Parian Phenomenon* (Ilminster: Richard Dennis, 1989), p. 19.

70 *Morning Chronicle*, July 18, 1851, p. 2, quoted in Patrizia Di Bello, "Photographs of Sculpture: *Greek Slave's* 'Complex Polyphony' 1847–77," *Interdisciplinary Studies in the Long Nineteenth Century* 22 (2016): 16, doi: http://dx.doi.org/10.16995/ntn.775.

71 Due to its new design, Cheverton not only created "much more precise" copies, but was also the first to exploit the sculpting machine commercially, after having achieved great success at the Great Exhibition. Cheverton achieved a Class XXX Prize Medal for the alabaster copy of Theseus, "as exemplifying the reduction by machinery of statues." Authority of Royal Commissioners (1852b), CXVII. See also: Droth, Edwards, and Hatt, *Sculpture Victorious*, 2014, p. 67; Frieß, *Kunst und Maschine*, p. 210.

72 Different copies of the reproduced figures were mentioned in the catalogue as produced "for the Arundel Society, in electro-bronze." *Authority of Royal Commissioners, Official Descriptive and Illustrated Catalogue: Great Exhibition of the Works of Industry of all Nations* 3 (London, 1852), p. 672.

73 *Conservation Journal*, no. 23 (April 1997), http://www.vam.ac.uk/content/journals/conservation-journal/issue-23/the-arundel-society-techniques-in-the-art-of-copying/ (accessed January 5, 2021).

74 Anthony Hamber, *Photography and the 1851 Great Exhibition* (London: V & A Museum, 2018), p. 40.

75 Droth, Edward, and Hatt, *Sculpture Victorious*,2014, p. 67.

76 For further information, see Greg Sullivan, "Sir Francis Chantrey's Plaster Models, Their Use in His Practice, and His 'Improved Pointing Instruments,'" in *Il valore del gesso: Come modello, calco, copia per la realizzino della scultura*, ed. Mario Guderzo and Tomas Lochman (Possagno: Terra Ferma Edizioni, 2017), pp. 223–35, here p. 226.

the technological advancement in the production of sculptures within the sphere of machines, and offered to make the reproductive processes publicly visible: "Statuettes, busts, and bas-reliefs, in ivory, alabaster, marble, and metal; carved by a machine from originals of a larger size"[77] were displayed in the exhibition's section "Sculpture, Models, and Plastic Art, Mosaic, Enamels & Co." The additional comment, that "[t]hose in ivory and marble, [were] not finished by hand," underlines that under the sign of mechanical innovation and the technical application of materials, the presentation of "automation" via machine as an experimental arrangement generated popularity and was intended to serve for the entertainment of the audience: "It is well known that the Victorian had a taste for new scopic experience and optical drama. The nineteenth century saw a craze for magic lantern shows, phantasmagoria and camera obscura, and advancements in the technology."[78] And Patricia Di Bello summarizes popular nineteenth-century optical strategies as a "recreation that used magic lanterns to project images onto glass, cloth or smoke to create high affecting, ghostly public spectacles."[79]

A decade later, French artist and entrepreneur François Willème took aspects of fantasy and showmanship to the extreme by hiding his apparatus from the audience: "which contains no instruments, no apparatus, to highlight better the marvel that will follow."[80] Willème's process illustrates another method of reproducing sculpture that combined several processes to portray living models in the third dimension. His invention that he presented at several exhibitions,[81] acted as a visualization of sculpture made through different processes: behind the scene the copy of a model was reproduced with the help of hidden cameras and reworked by the hand of a skillful sculptor in the end.[82] So, it was not the actual product that counted, but the magical spectacle of the moment of its making comparable to photography.[83] The narrative of technological marvels continued to grow against the background of the changes resulting from late eighteenth- and nineteenth-century industrialization.

77 *Authority of Royal Commissioners,* 1852d, p. 832.

78 Jonathan Shears, *The Great Exhibition, 1851: A Sourcebook* (Manchester, UK: Manchester University Press, 2017), p. 60. He continues his explanation referring to the notion of the spectacle known as the "phantasmagoria" to explain new sensations of machine proceeded materials and surfaces that were capable of "enshrining fantastical possibilities." Shears, ibid., pp. 61–62.

79 Patrizia Di Bello, "'Multiplying Statues Machinery': Stereoscopic Photographs of Sculptures at the 1862 International Exhibition," *History of Photography* 37, no. 4 (2013): 412–20, here 413.

80 Quoted in Michele Bogart, "Photosculpture," *Art History* 4, no. 1 (1981): 54–65, here 55: "qui ne contient aucun instrument, aucun appareil, comme pour mieux fair ressortir la merveille, qui va suivre"; translation by the author.

81 It premiered in Dublin in 1865 and two years later again at the Paris World's Fair, where it received great attention. See *The Art Journal* IV (1865), p. 248 and p. 345.

82 As a final step, the resulting clay model was molded in the sculpture tradition and could be transferred to various materials such as porcelain or bronze. See Winfried Gerling, "Die eingefrorene Zeit oder das bewegte, stillgestellte Filmbild," in *Freeze Frames: Zum Verhältnis von Fotografie und Film,* ed. Stefanie Diekmann and Winfried Gerling, Metabasis vol. 4 (Bielefeld: transcript, 2015), pp. 146–71, here p. 153.

83 As Michele Bogart points out, it was Willème's intention to bring his invention closer to the technical wonder of photography: "Photosculpture is discoursed as if it were a three-dimensional photograph

5 Benjamin Cheverton, *Machine for Reproducing Sculpture*, 1826.

Displaying machines and experiments that turned two-dimensional or three-dimensional originals into copies of the same or smaller size created new potential by challenging the visual perception. Both the studio architecture and the recording process used in its place showed a great deal of emphasis on the effective staging of technology as magic.[84] The suddenness of the effect and the playful effortlessness of its occurrence, as well as its relative independence from human action, are among the distinguishing characteristics of procedures classified as magical: "Here, the automatism of the photographic process conveys the fantasy of an almost instantaneous sculpture."[85]

Magic was a central issue grounding this view of the industrial, scientific, or artistic display as slightly anachronistic byways and curiosity. Thinking of sculpture, this enabled meta-

rather than a laborious, multi-step, sometimes manual transcription process. … In photosculpture the artist and the machine were virtually one and the same." Bogart, "Photosculpture," p. 59.

84 See Albert Kümel, "Körperkopiermaschinen: François Willèmes technomagisches Skulpturentheater (1859–1867)," in *Skulptur,* Winter, Schröter, and Spies, 2006, pp. 191–212, here pp. 194–95. See also Schröter, *3D*, 2009, pp. 91–97.

85 Quoted in Bogart, "Photosculpture," 1981, p. 55: "L'automatisme du procédé photographique vehicule ici le fantasme d'une sculpture quasi instantanée"; translation by the author.

6 Plaster bust of Benjamin Cheverton.

mophoric potential insofar as some parts of the sculptural body were highlighted or hidden through visual effects and shades that generated new insights, while, to quote Jacques de Caso, "in a complex model individual parts may be reduced separately and later joined."[86]

Given the fact that there are no photographic or postcard illustrations of these machines on display, it is worth looking in more detail—especially considering the notion of the object made "without the use of human hand"—at a photograph, likely taken in 1924,[87] showing Cheverton's machine and three busts (fig. 5): the depiction presents an archaic-looking apparatus of wooden construction with an integrated three-dimensional pantograph. This is interesting because machines at that time were already made of industrial materials, an aspect which evoke notions of nostalgia. Also remarkable in this image is the "original" object: a plaster cast of an antique bust and the small blank, both mounted vertically. Apart from

86 Jacques de Caso, "Serial: Sculpture in Nineteenth-Century France," in *Metamorphoses in Nineteenth-Century: Sculpture*, ed. Jeanne L. Wasserman (Cambridge, MA: Harvard University Press, 1976).

87 The object number (1924-292) refers to the date when the machine was integrated in the collection of the Science Museum London.

some tools and the bust placed on the floor, no other elements of the reproduction process or setting are visible in the photograph. Indeed, the background of the image is empty. In this respect, the staging seems magical because Cheverton's machine appears to carry out the operational process "as if by itself." On closer inspection, the sculptor himself is present in the form of the self-portrait: a bust placed on the floor, acting as a sculptural stand-in for the author, testifies to the presence of Cheverton as the inventor of the machine (fig. 6). Besides this classical artist's topos, it is probably no coincidence that the plaster bust, which was mounted here for reproduction, is none other than another version of William Henry Fox Talbot's (1800–1877) "fancifully"[88] titled *Patroclus*. According to Geoffrey Batchen, who analyzes this well-known plaster bust in the context of Talbot's early photographic experiments: the ancient heroic tale of self-sacrifice would have been all too familiar to the contemporary audience who knew Homer's *Iliad*.[89] This specific form of rhetorical replacement is, as Batchen notes, exhausted in an endless string of medial substitutions: "the plaster bust stands in for a human figure, a photograph for the plaster bust, and the bust for the original marble carving (now in the British Museum)."[90] The mythological subject of the hero being replaced by someone ordinary could be—if we think further—an indication of the popularity of the reproduction itself. Whoever staged this scene must inevitably have drawn a connection to the English inventor's earliest photographic attempts: in 1844, the same year Cheverton was awarded a patent for one of his machines, Talbot published the world's first "photo book" and manifesto *The Pencil of Nature*, which shows the same plaster bust of *Patroclus*: plates V and XVII depict *Patroclus* from different viewpoints. One year later, in 1845, the Royal Society exhibited some of Cheverton's mechanically produced sculptural copies in ivory, including a bust of Queen Victoria, which he made after the original by Francis Leggatt Chantrey. One can assume that Talbot and Cheverton knew each other, especially as they must have met during different society events and presented their work results as Di Bello confirms:

> In London, machine carvings, electrotypes, daguerreotypes, and Talbotypes were seen and compared at the events organized by the Royal Society throughout the 1840s and 1850s, where Benjamin Cheverton's ivories, "mechanically sculptured" using his reducing machine, a perfected version of Watt's prototypes, could be admired next to displays of "excellent … Talbotypes," or "M. Claudet's photographic specimen."[91]

Each of these interfaces and overlaps between cultures of display, mechanical reproduction, and classical art are striking; it is no coincidence that the *Patroclus* plaster bust, which was

88 Geoffrey Batchen, "An Almost Unlimited Variety: Photography and Sculpture in the Nineteenth Century," in ed. Roxana Marcoci, *The Original Copy: Photography of Sculpture of Sculpture, 1839 to Today*, exh. cat. Museum of Modern Art (New York, 2010), pp. 20–26, here p. 23.

89 Ibid., p. 23.

90 In the battle for Troy against Hector, Patroclus, who faithfully replaced his companion Achilles, fell tragically. This specific form of rhetorical substitution is, as Batchen concludes, now exhausted in an endless string of medial substitutions. Ibid.

91 Di Bello, "Photographs of Sculpture," 2016, p. 9.

borrowed from the British Museum, was a popular motif both in the photographs made by Talbot and— as can be assumed—in the use of Cheverton's sculpture machine: in the current Cheverton collection at the Art Gallery of Ontario in Toronto, which comprises several hundred miniature ivory busts, there is a exact reproduction with a smooth surface titled *Patroclus* that the Thompson Collection Institute dates from early 1840.

Recent historical photography discourse has pointed to the fact that photographic pioneers like Louis Jacques Mandé Daguerre, William Henry Fox Talbot, and Hippolyte Bayard (1801–1887) collected modern as well as classical sculptures, plaster casts, or moulages, arranging these objects in groups for their respective photographic experiments.[92] What is less known is that the protagonists mentioned above were also interested in antiquity: the engineer James Watt and his successors John Hawkins and Benjamin Cheverton had amassed their own sculptural collections. So, they were not only interested in the machine's utility for art, but also wanted to make the ideal of Antiquity as the one "to be incorporated"[93] into the technical reproduction. It is important here to point out the common denominator, the common ethos, and the common dispositive: the machine. Mechanical modes for reproducing and multiplying three-dimensional objects or photography as a chemical process occur coincidentally at approximately the same time and were publicly demonstrated with references to a magical spectacle. Both techniques have decisive characteristics in common: on the one hand, the great interest in portraiture, on the other hand, the medium of sculpture. This historical context may plausibly explain the desire to reproduce the same motif twice—one in two-dimensions, the other one in three-dimensions—when it comes to the *Patroclus* bust, which was a subject of both symbolic and semantic discussion at the time.

Conclusion

This article has recast the machine and the medium of sculpture, its reproduction, and display alongside the collecting practice and inventive activity of engineers and mechanical-minded artists at the time of early industrialization. Referencing Russell, three levels intertwined when it comes to the self-awareness of the artists-engineers summarized: firstly, a new attitude and "world of mechanically reproduced sculpture" initiated by Watt's machine; secondly, Watt's—but also Peale's, Hawkins's and Cheverton's—ambition to set up a collection with both antique sculptures and their copies, finished casts, molds for Antique figures, and busts; that, thirdly, contributed to the creation of a museum that not only can be

92 See Anthony Hamber, "Higher Branch of the Art," in *Photographing the Fine Arts in England, 1839–1880* (Amsterdam, Gordon and Breach, 1996); Stephen Bann, ed., *Art and the Early Photographic Album* (Washington, DC/New Haven/London: Yale University Press, 2011).

93 For the topic of the incorporation of antiquity through material appropriation, see Charlotte Schreiter, "Bildhauerische Technik und die Wahrnehmung antiker Skulptur: Francesco Carradoris Lehrbuch für Studenten der Bildhauerei von 1802," in ed. Ernst Osterkamp, *Wissensästhetik: Wissen über die Antike in ästhetischer Vermittlung* (Berlin/New York, Walter de Gruyter, 2008), pp. 239–66, here p. 240.

understood as a "personal embodiment of a new mechanical age"[94] but also resulted in the immortality of the inventor and atelier owner.[95] On the basis of the examples discussed, a complex structure becomes visible into which the notion of the machines regarding pictorial and sculptural reproductions can be placed, i.e., between art and technology, art collection, *Wunderkammer* and world exhibition, materiality and performance, canon and "modernity." It turns out that in this context of theatricality the term "curious" is helpful: *curiositas* has very ambivalent connotations already in pre-modern times and has certainly become a leading category of the eighteenth and nineteenth centuries. It might also function as a pivotal link between popular and elite culture, art and the need to "show off." This shows that visuality played a key role in the nineteenth century (Crary), which also becomes apparent in the presentation of technical novelties of mechanical and optical media at various exhibitions: the briefly mentioned stereoscope, for example, was presented publicly and very quickly advanced to become one of the most popular visual devices for dimensional viewing, but photographic apparatuses and machines for mechanically reduced sculpture also played a central role here. And François Willème's "technomagic sculpture theater,"[96] which corresponds to the photo-sculpture process, can be compared to the current image generation of digital media. With such apparatuses, the limits of art were not only explored, but so too was the collective faith in the future of art, which coincides with the future orientation of technical developments, and which can be seen above all in the machines. All this can touch upon topics relevant for the nineteenth century, such as magic and phantasmagoria, which developed into mass media in modern times, but also "teaching media," which characterizes objects and apparatuses in a very appealing way: The subject of putting science into a scene is to be considered in terms of the specific civilization of culture, and also through popularization.

Against this given background, mutual conditions must be assumed: by exhibiting the sculpture reproducing machine as an image-making procedure alongside other media in Victorian society and staging it together with the miniature-like portrait busts, Cheverton suggests that he is on an artistic-technical level with the photo pioneers, scientists, and engineers. As a sculptor and artist, he also aims to inscribe himself in the history of the great inventors—just as important as the social advancement from artisan to gentleman status within Victorian society. Comparable to the painted portraits of presidents and painters such as the Royal Academy of Art, the first "artist-engineer" of modernity stages himself (qua self-portrait) together with the machine and speculates that his "perfect copies" (e.g., *Patroclus*), which were supposed to surpass the often "damaged" original, will be widely circulated by means of serial production—as a "multiple." Contrary to previous assessments that Cheverton's interest was of a purely commercial nature, it is more likely that

94 Russell, *James Watt*, p. 208.
95 Ibid., p. 205.
96 See the title of the book; Kümel, "Körperkopiermaschinen François Willèmes technomagisches Skulpturentheater (1859–1867)," 2006.

he intended to join the ranks of the great names as an artist, in keeping with the contemporary motto that the Great Exhibition of 1851 also aimed for British sculptors. With his "manifesto-like" concern, Cheverton celebrates the union of art and technology. This is not unlike today, when artists like Angelo Bulloch or Patrick Tresset exhibit audio-interactive and performative drawing machine installations or even exhibitions such as *Romantic Machines* displaying machines and their output as art: possessing qualities of the sculptural, Michael Sailstorfer's "popcorn machine" (titled *1:43-47*)[97] does not only testify to a specific form of theatrical production that has a humorous and at the same time threatening effect on the viewer, but can also be understood first and foremost as a sculpture.

97 Wellmann, ed., *Romantische Maschinen*, exh. cat. Georg-Kolbe-Museum Berlin, p. 63. For the image of the work, see the artist's website, https://sailstorfer.com//works/143-47-frankfurt-2008 (accessed January 5, 2021).

Michael Rottmann

The Aesthetics of (Digital) Machine Sculpture

Automatization, Mechanization, and Mathematization in Minimal, Serial, Conceptual, and Computer Art

Abstract

Today's 3D-printed digital sculpture can be traced back—not only in a technical sense—to the 1960s, when our digital culture developed. Using the examples of pioneers Robert Mallary and Charles Csuri, this paper reconstructs and distinguishes computer-based productions of sculpture, its reception, and its ontology. One focus is the discourse of sculpture, image, and form. A comparison with Minimal, Serial, and Conceptual Art is suggested not only because Minimal Art was a hot spot of sculptural discourse, but also because it reveals correspondences between digital and non-digital arts, which exist on the level of draft, production, and discourse: a creation with certain machines, mathematization, automatization, mechanization, and a 2D/3D-discourse.

It will be argued that the examined digital and non-digital artforms in the 1960s, the time of pre-post-digital art, are only understandable in relation to each other and their common historical context: cybernetics, systems theory, the Cold War, and computerization. Taking the cultural-historical and politico-economic context into account, it will be demonstrated that one can identify specific reactions to digital technology and media and its impacts on art and society—which is why I call the non-digital artforms "co-digital art."

Key Words

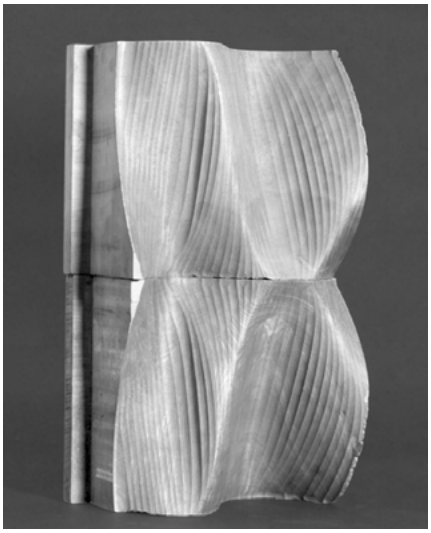
Computer sculpture, automation, 2D/3D, machine, form, co-digital art

Sculpture in the 1960s: Arrival of the Computer

Following the story of Charles Csuri that he posed for fellow artist and friend George Segal for his work *The Diner* (1964–66), the life-sized, figurative plaster sculpture in it represents an artist, who is sitting at a diner bar and who had studied at Ohio State University with a

focus on portrait painting and turned toward computer art in the 1960s.[1] After Csuri had started teaching at the same university, and around 1965 became interested in computer graphics and film, he made works such as *Sine Curve Man* (1967), which was awarded from *Computers and Automation,* and created—and this is of interest here—the computer sculpture *Numeric Milling* (1968) with an IBM 7094 computer system (figs. 1, 2).[2] So, Csuri not only acted as a model, but also developed a mathematical one. In this regard, together with programmer James Shaffer he published the paper "Art, Computers and Mathematics" (1968), where they wrote: "Our most recent project is sculpture using a 3-axis, continuous path, numerically controlled milling machine."[3] Numerical representation in connection with a computer is considered a characteristic of digital media.[4] George Segal, in turn, had made automation a subject in his figurative work *Laundromat* (1966–67).

1 Charles Csuri, with James Shaffer, *Sine Curve Man,* 1967, black ink, paper, Calcomp drum plotter model 565, punch cards, IBM 7094, 104 × 104 cm.



2 Charles Csuri, *Numeric Milling,* 1968, wood, 3-axis milling machine, IBM 7094, punch cards, 36 × 56 × 22 cm.

1 See Kerry Freedman, "Oral History Interview with Charles A. Csuri," Charles Babbage Institute, October, 23, 1989 (University of Minnesota, Minneapolis), pp. 1–35, here pp. 3–4, 14, https://conservancy.umn.edu/handle/11299/107236 (accessed April 6, 2021).

2 Anonymous, "Charles A. Csuri, Numeric Milling," Charles A. Csuri Project website, Ohio State University, https://www.csuriproject.osu.edu/Detail/objects/768 (accessed April 6, 2021).

3 Charles Csuri and James Shaffer, "Art, Computer and Mathematics," *AFIPS—Conference Proceedings* 33 (1968), pp. 1293–98, here p. 1297.

4 See Lev Manovich, *The Language of New Media* (Cambridge, MA/London: MIT Press, 2001), pp. 27–29.

In 1964, it was Donald Judd who reviewed Segal's *The Diner* in a commendatory manner, for what he argued was the tension between the real (size, appearance, and space) and the artificial (material).[5] In the same year, he penned his essay "Specific Objects" (1965), which served as a theoretical basis for (his) three-dimensional object art and as an attack against the well-established genres of painting and sculpture.[6] Last, but not least, at that time he also created his works—especially the bar-like series progressions like *Untitled* (1965) (DSS 84)—on the basis of numerical *schemes* and made use of fabrication.[7]

This was recognized by artist and theorist Jack Burnham, who argued in his 1968 book *Beyond Modern Sculpture*—a teleological history of sculpture since modernism in light of the development of technology—with a view to the above-mentioned progression: "More than anything else, the efforts of the Minimal or Object sculptors characterize the mathematical intentions of this decade."[8] We will come back to these intentions, especially those of the "sculptors," who are inappropriately called Minimal artists.

At this point, we can record the fact that the notion of sculpture was by no means homogeneous in the 1960s: at first, the modernist, especially figurative and nonfigurative handmade plastic art like that of Pablo Picasso, was discussed as sculpture as well as "construction-sculpture,"[9] which Clement Greenberg made out, for instance, in David Smith and which will be introduced in more detail. This broad range widens out in the second half of the decade through (Minimalist) object art and computer sculpture. This is documented by the inventory-taking exhibitions *The 1960s: Painting and Sculpture from the Museum Collection* (1967) at the Museum of Modern Art[10] and the *Annual Exhibition: Contemporary American Sculpture* (1968) at the Whitney Museum of American Art. In each of these shows, George Segal, Donald Judd, and Robert Mallary—a further computer sculptor, who will be treated here—were represented. Mallary exhibited in the Whitney show his "computer sculpture" *Quad II* (1968), the second one of the *Quad* series (fig. 3).[11] Like Csuri, he was an educated artist who got access to computers as a faculty member. In 1967, after he

5 See Donald Judd, "Local History" (1964), in Donald Judd, *Complete Writings 1959–1975: Gallery Reviews, Book Reviews, Articles, Letters to the Editor, Reports, Statements, Complaints* (Halifax/New York: The Press of the Nova Scotia College of Art and Design, 2005), p. 153.

6 For it and discrepancies between Judd's essay, works, and Minimal Art, see Michael Rottmann, *Gestaltete Mathematik: Geometrien, Zahlen und Diagramme in der Kunst in New York um 1960: Mel Bochner – Donald Judd – Sol LeWitt – Ruth Vollmer* (Munich: edition metzel, 2020), pp. 108, 116, 125.

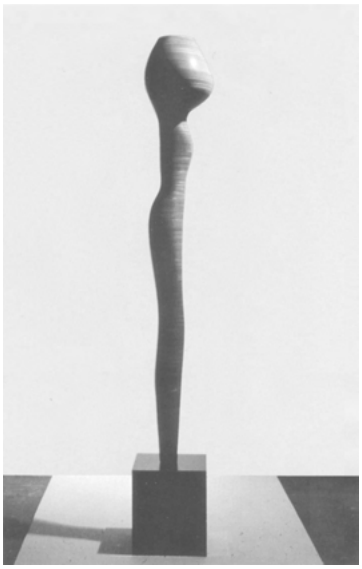
7 See ibid., pp. 116, 181–92.

8 See Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century*, 4th printing (New York: Braziller, [1968] 1975), p. 147.

9 See Clement Greenberg, "Sculpture in Our Time" (1958), in *Clement Greenberg: The Collected Essays and Criticism*, vol. 4: *Modernism with a Vengeance 1957–1969*, ed. John O'Brian (Chicago/London: University of Chicago Press, 1986), pp. 55–61, here pp. 57–58.

10 See "The 1960s: Painting and Sculpture from the Museum Collections," press release, Museum of Modern Art New York, June 27, 1967, https://assets.moma.org/documents/moma_press-release_326520.pdf (accessed April 8, 2021).

11 See *1968 Annual Exhibition Contemporary American Sculpture*, exh. cat. Whitney Museum of American Art New York (New York: Whitney Museum of American Art, 1968). The catalogue mentions *Quad III*, which is considered to be made in 1969. So I assume it was the very similar *Quad II*.



3 Robert Mallary, *Quad II*, 1968, computer-aided sculpture, plywood and laminate, IBM 1130, ca. 195.5 × 25.5 × 30.5 cm (without base).

had started his professorship of art at the University of Massachusetts in Amherst, he turned toward the computer, in particular with an understanding that the machine could generate and transform images.[12] In 1968, together with his son Michael Mallary and/or student programmers, he wrote the first version of his "computer sculpture program" TRAN2 for the local IBM 1130 system,[13] which was introduced into the market in 1965, and created with it, still without a screen, his first computer sculpture *Quad I* (1968)—just in time for presenting it at *Cybernetic Serendipity* in London.

Against this background, the following discussion will look at computer sculpture of the 1960s, which will be understood as an art form, but also foremost as a three-dimensional object. As computer sculpture emanates from a creative process that integrates a digital computer—which basically defines digital art—computer sculpture qualifies as a digital machine sculpture and an early field of three-dimensional digital image making. This study will especially be done because computer sculpture has been treated in art history, but has received less attention than computer graphics. It may be due to a quantitative asymmetry of artworks and their historical technical *dispositif* as well: special machines for graphics (e.g. the plotter) had been developed, but comparable output devices for three-dimensional objects didn't exist, and only a few protagonists gained access to the milling machines of industry.

12 Robert Mallary, "Computer Sculpture: Six Levels of Cybernetics," *Artforum* (May 1969), pp. 29–35, here p. 31.

13 Ibid.

For a variety of reasons, computer sculpture will be related to Minimal, Serial, and Conceptual Art, which are closely connected in the second half of the 1960s.[14] The latter are regarded as central places for a (critical) negotiation of sculpture. Furthermore, what will be demonstrated is that parallel developments can be made out: a mechanization in the sense of an increasing use of machines, as in the fabrication of Minimal Art's objects, can be identified. It can thus be understood as non-digital machine sculpture, although it was brought into position against sculpture—thus we have two kinds of machine arts in play (yet the relationship between humanity and machine will not here be an issue per se). In addition to this, mathematization and automatization—both usually associated with the use of a computer—as well as a 2D/3D debate have to be mentioned, and each of these will be discussed. Last but not least, the connection between sculpture, Minimal Art, and information technology has been drawn (in the historical discourse).[15]

If sculpture in a broader, structural sense (à la Rosalind Krauss), which has been discussed via the "sculptural" (*dem* "*Skulpturalen*"), is pursued less here than a work-centered (*werkzentrierte*), object-oriented conception of sculpture—although a tendency of "liquefaction" of the object has been described in the historical discourse[16]—this is because the latter can be found in both fields of machine sculpture.

One focus of what follows is the discourse of sculpture, image, and form in light of technology, in which a predominating understanding of sculpture since modernism once again considerably changed in the context of the use of (digital) machines. Another focus is the creative and production processes, ending in sculpture as object. An aesthetics of (digital) machine sculpture demands this because the artwork is determined by its machinic production, and refers to it, which is preserved in its form and materiality. "In the aesthetic presence the production is constitutively forgotten," as Sebastian Egenhofer has explained. "But it belongs to the structure of the artwork, to touch and turn the border of this oblivion."[17] It remains to be shown with the examples below how this applies to technology-based art from the 1960s.

All art movements that are treated here—and this is the claim—have to be thought of in a common historical ground, which prevails all the more if one takes into account the sociopolitical and cultural-historical situation in the United States—keywords here are cybernetics, systems theory, computerization, and Cold War—and the embedding into the historical *dispositif* of production. There was a critique on and a reflection of production and technology in art tied to it there, which will be considered here.

14 See Edward Shanken, "Art in the Information Age: Technology and Conceptual Art," *Leonardo* 35, no. 4 (2002): 433–38.

15 See, e.g., Jack Burnham, "Systems Esthetics," *Artforum* 7, no. 1 (September 1968), pp. 30–35, p. 32.

16 See Rosalind Krauss, "Sculpture in the Expanded Field," *October*, no. 8 (1979): 30–44. See Burnham, "Systems Esthetics," 1968, pp. 30–35; Martina Dobbe and Ursula Ströbele, "Gegenstand: Skulptur," in *Gegenstand: Skulptur*, ed. idem (Paderborn: Wilhelm Fink, 2020), pp. 1–16.

17 Sebastian Egenhofer, *Produktionsästhetik* (Zurich: diaphanes, 2010), p. 7. Translation by the author.

It will become evident that the examined (digital) machine sculpture of the 1960s—when today's digital culture significantly started to develop—can be understood as a prehistory of today's 3D-printed sculpture, like that of Karin Sander or Nick Ervinck, not only in a technical, but also in a conceptual respect.

This will be argued in a theoretical manner and a historical reconstruction. Let's now closely examine Csuri's and Mallary's computer sculptures,[18] whose same date of origin invite a comparison. A first contextualization in the discourse of sculpture will be revealing.

The Otherness of Computer Sculpture(s)

In a formal respect, both artists' computer sculptures follow a certain tradition of modernity but can also be related to the already mentioned "construction-sculpture," which was announced by Clement Greenberg in 1958 again as new and forward-looking.[19] Since modernity, sculpture no longer needed to be mimetic and monolithic.[20] Both computer sculptures make use of the former, but not of the latter. Csuri's *Numeric Milling* is made of unpolished wood; it is small-sized and compact (33 × 56 × 22 cm) and without a pedestal. It has convex and concave parts, and the latter show groove-like depressions. Like Constantin Brâncuși, who was mentioned by Greenberg as a transformer of the human figure into geometric, abstract forms,[21] Csuri kept the shape blocky and used a single material. Contrary to this, Mallary used expanded possibilities. The life-sized, pole-like sculpture *Quad III* (213 × 35 × 33.6 cm) which is very similar to the already mentioned *Quad II*, seems to surpass its pedestal and to head in a meandering and line-like manner for height. One could get the impression of a potentially infinite continuation, as in Brâncuși's *Endless Column*, but for a thick plug at the upper end that closes it off and, pushing downward in accordance with gravity, opposes the upward soaring. The material and color of *Quad III* no longer appear—as in construction-sculpture in which color could also a be applied[22]—as a unity.

The computer sculptures nowhere near fulfill all the characteristics of construction-sculpture.[23] But Csuri, Mallary, and the "constructor-sculptor" are unified by an open-mindedness toward new techniques and materials: "a work or its parts can be cast, wrought, cut or simply put together: the new sculpture is not so much sculpted as constructed, built, assembled, arranged."[24] To distinguish sculpture and plastic art (*Plastik*) just in the manner of subtractive or additive work by "carving and modeling" had become anachronistic.[25] In that way, Mallary could take up his assemblages, which he described as a "combining and

18 Two male artists are treated here, so a desideratum would be to identify and research female artists working in the 1960s as computer sculptors.
19 See Greenberg, "Sculpture in Our Time," 1958, pp. 57–58.
20 Ibid.
21 Ibid.
22 Ibid.
23 Ibid.
24 Ibid., pp. 58, 61.
25 Ibid., p. 58.

recombining" of (found) objects.[26] Furthermore, the computer sculptors could build on the material culture and practices of construction-sculpture. Traditional materials like "stone, bronze and clay" would be substituted by "industrial materials like iron, steel, alloys, glass, plastics, celluloid, etc., etc., which are worked with the blacksmith's, the welder's and even the carpenter's tools."[27] Thus Greenberg attested to "the medium a new flexibility" and "a wider range of expression."[28]

The two computer sculptors belong to that group of artists in the 1960s who mainly speak euphorically and assertively about the possibilities of computers in art: technical restrictions, which they also mentioned, were understood as challenges[29]—let's keep in mind that both artists did research at universities. However, when their forms and materials seem to be modern, this must be seen in the context of the technical *dispositif* of the 1960s. In a paradoxical manner, the surfaces provide information about the difference of their production methods: *Numeric Milling* shows traces of the milling machine, whereas the smooth, shining paint (*Fassung*) of *Quad* results from the artist's manual work. It was an aesthetic decision by Csuri because the milling machine could produce smooth surfaces.[30] With the machinic *sculptura* an impression of direct carving could even appear—a method without a model as an intermediate step. At the same time, the decisions of the artists were bound with the possibilities of technology. So, Mallary's program *TRAN2* could calculate forms, which could be printed with an inkjet printer, but it was Mallary himself who had to transfer them onto a plastic or plywood panel, cut disks out, and stack and cover them with the help of a metal axis.[31] The 48 to 100 contours, which could be realized with the IBM 1130 system, where not enough to reach a smooth, continuous form as Mallary explained.[32]

Here, a first differentiation of computer-sculpture can be done with a view to its production and the role of the computer: Csuri produces the object directly with the machine, Mallary develops forms with the computer, and his subsequent manual process could be described as plastic-constructive. In each case, the computer enabled just a partial automatization, and the creative processes were manual-machinic or analog-digital hybrids in a pre-postdigital (art) world.

26 See Copper Giloth and Justin P. West, *Robert Mallary: Pioneer in Computer Art 1992*, Vimeo video, 26:53, no date, uploaded by Copper Giloth, https://vimeo.com/133915501, here 3:24 (accessed December, 27, 2021).

27 See Greenberg, "Sculpture in Our Time," 1958, pp. 58–59.

28 Ibid.

29 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, p. 1298; Mallary, "Computer Sculpture," 1969, pp. 32–33.

30 See the Charles A Csuri Project website, https://csuriproject.osu.edu/index.php/Detail/objects/768 (accessed April 11, 2021).

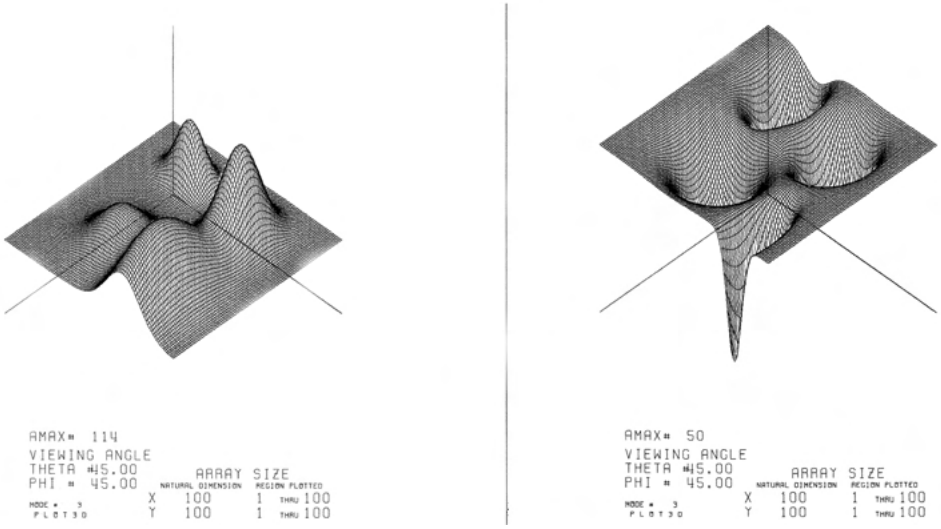
31 See Mallary, "Computer Sculpture," 1969, p. 32.

32 Ibid., p. 31.

Ontological Aspects of Computer Sculpture

For Charles Csuri and Robert Mallary, the computer possessed outstanding significance because of its potential to generate multiple forms, also new ones, in the sense of the gestalt of an object.[33] Referring to this in the historical discourse, which was characterized by thinking about forms, the following question was relevant: Which (artistic) media can be operated by computer and controlled and modified dynamically with the passage of time? Visual forms could be displayed with the principle of light on a screen in two dimensions or with a projection in three dimensions—as both artists mentioned[34]—but in each case only in an ephemeral manner. They could permanently be supplied to perception with a plotter in two dimensions (fig. 4) and with a milling machine in three dimensions. With these different appearances a question of ontological modes arises: What was the historical conception of computer sculpture?

In contemporary theory of digital images, which is more applied to computer graphics, it is common to think in a binary relation of image and code, thus ascribing the digital medium a dual nature.[35] It is in dispute whether a materialized and externalized image



4 Charles Csuri, plotter drawing of *Numeric Milling,* 1968, ink, paper, Calcomp Drum Plotter Model 565, punch cards, IBM 7094.

33 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, pp. 1294–95. Mallary; "Computer Sculpture," 1969, p. 31.

34 Ibid.

35 Actually, there are more relevant elements like diagrams, programs, etc. See Michael Rottmann, "Programm und Diagramm: Überlegungen zum digitalen Bild und zur Automatisierung anhand der Computergrafik der 1960er Jahre von Frieder Nake," *Kunstgeschichte Open Peer Reviewed Journal* (December 7, 2021): 1–23, here 4, https://www.kunstgeschichte-ejournal.net/589/ (accessed December, 7, 2021).

outside the computer system can be regarded as a digital one. This is furthered by the fact that otherwise its specific digital technical conditionality would remain unconsidered; the counterargument is that an external image, other than an internal one, could no longer be processed.[36] In any case, code and image—which can be also three dimensional—are in a close but "paradoxical relationship":[37] the image is caused by the code in an arbitrary way and refers back to the latter—if it can be identified as coded.

Csuri and Mallary share an awareness of the connection of sculpture and code, they distinguish "code," "program," "data," and "sculpture," not least because they were both programming or were otherwise rather involved.[38] Nevertheless, they understood computer sculpture as a three-dimensional object. The ontological problem, appearing with computer sculpture, was not treated explicitly in the American discourse of sculpture of the 1960s to my knowledge.[39] However, the artists examined here exemplarily show a distinction of the following states of computer sculpture: (1) the external sculpture as a real three-dimensional object, generated with a computer system and produced by machine and/or hand afterward (computer-generated/produced sculpture). (2) The internal sculpture—we would talk nowadays about a virtual object—as a pictorial object, which is processed within a digital system and becomes visible, for example, on a screen; as Csuri could not display the "[m]athematically generated surfaces," they were printed.[40] (3) A mathematical and algorithmical mode of being can be identified as associated with it. Addressed here are the program and the data of a sculpture, whose basis is mathematical, because it is a central property of the computer to automate calculations; algorithms for the calculation of mathematical issues could moreover be included in what was mentioned as a basic principle for a (parametric) generation and examination of visual forms.[41]

In research literature a "dematerialization of art" (Lippard/Chandler) and information technology have been considered together, especially with a view to the transformation of an artwork into code and information.[42] With the same direction of impact and in the context of his systems aesthetics for painting and sculpture, Jack Burnham described a change

36 Ibid.

37 See Claus Pias, "Das digitale Bild gibt es nicht – Über das (Nicht-)Wissen der Bilder und die informatische Illusion," *Zeitenblicke* 2, no. 1 (May 8, 2003), n.p., https://www.zeitenblicke.de/2003/01/pias/pias.pdf (accessed March, 22, 2008). Translated by the author.

38 They also used technical terms like "processing" and "transformation." See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, p. 1293; Mallary, "Computer Sculpture," 1969, pp. 29–35.

39 The difference between "object" and "software" was discussed. See Les Levine, "Systems Burn-off X Residual Software," in *Software: Information Technology: Its New Meaning for Art*, ed. Jack Burnham, exh. cat. The Jewish Museum (New York: The Jewish Museum, 1970), pp. 60–61. For a discussion in the German discourse (e.g., by Herbert W. Franke) see the essay of Ursula Ströbele in this volume.

40 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, p. 1297.

41 Ibid., p. 1294. See Margit Rosen, "A Record of Decisions," in *Charles A. Csuri: Beyond Boundaries, 1963—present*, ed. Janice Glowski (Columbus, OH: College of the Arts, Ohio State University, 2006), pp. 25–45, 34–35, 42.

42 See Shanken, "Art in the Information Age," 2002.

from the "unique work" to an "unobject" in the way of a "liquefaction";[43] Robert Morris, for instance, had transmitted the working plans of his *L-Beams* so they could be rebuilt on site without transporting them between the exhibition venues[44]—this is close to the idea of sending data and 3D-printing a work.

Accordingly, it is remarkable that, although Csuri was interested in movement, variation, and transformation and thus in dynamical forms—we remember his interest in portraiture—which computer film enabled him to pursue, Csuri made a permanent sculpture.[45] It is insightful to speculate about the reasons: the production of a three-dimensional object could be motivated by Csuri's technical research. Such an object was permanent, experiential, exhibitable, and tradable—this artwork-oriented attitude could be rooted in Csuri's education. We have to consider that in the 1960s a real (but not too big) sculpture—from today's perspective perhaps surprising—could circulate better than a virtual one, because computers, if at all, were difficult to transport, generally not networked, and mostly not equipped with a screen, and thus hardly usable in exhibitions.[46] In Serial and Conceptual Art, the work-centered concept of art was relativized by the emphasis on order or the idea, as well as the transition to languages, diagrams or even certificates, which also attacked the suitability for the market. It remains an open question whether a virtual sculpture would have been accepted as art in the 1960s; it anyhow could have been reproduced easily with a data carrier, but not protected with the technology of non-fungible tokens (NFT). In any case, computer sculpture as a three-dimensional object could be reconnected to an established genre and in such a way legitimized and more easily fed into the discourse of sculpture.

Let's now turn toward the mathematical characteristics and art experience of (computer) sculpture and its theorization, because, with the machine, mathematics is also in play: not only is the construction of a machine prepared by calculations, but with digital machines at the latest computing also became an essential task.

Mathematical (Computer) Sculpture

If one asks for the experience of an external computer sculpture, one can assume methodically initially that it differs from that of a traditional sculpture. Therefore, specific properties have to be identifiable on a phenomenal level, otherwise the respective experiences would coincidence.

Specifications could be: (1) traces of the (technical) production method, (2) materials and forms, as well as (3) their mathematical/coded basis. An identification due to previous knowledge, for instance via discourse or provided by additional information like photo-

43 See Burnham, "Systems Esthetics," 1968, p. 32.
44 Ibid.
45 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, p. 1295.
46 Here, it proves true that art history benefits from precise argumentation concerning historical technology.

graphs, diagrams, and texts in the exhibitions of Serial and Conceptual Art, is not meant here. Arguing with sculpture as an object reminds us that its infrastructure or display can also be decisive: for instance, is the computer relation of a virtual sculpture on a screen (in an exhibition) evident. The sense of the introduced description, "computer relation" refers to a problem: a received computer sculpture can be made totally by machine (like that of Csuri or today's 3D-printed pieces) or partly by machine and partly by hand, when, for example, prefabricated elements were assembled. They can also be made totally by hand (like that of Mallary), when, for example, a computer-calculated and -generated form becomes artistically converted. One could distinguish between a digital sculpture and a quasi-digital sculpture, which are both computer-based sculptures, fully or partly made by machine, and a virtual sculpture in the sense of a computer-based draft, which serves as an intermediate step in a creative process, ending in a handmade sculpture. A crucial aspect—for the term "computer sculpture"—is that at least at one point of the creative process—in an interplay of artists, things, and techniques—the computer comes into operation, whose basic determination is numerical computation. In response to this, here I will focus on mathematization in the sense of a "synthetic math,"[47] as Robert Smithson puts it, not least because the other, above-named identifiers are not less problematic: the materials can, but need not be specific. While Csuri worked with the traditional material wood, which can be carved by machine, today's 3D-printing uses Acrylnitril-Butadien-Styrol (ABS), for instance, which can be glued. Likewise, the consultation of traces proves a delicate matter. When Robert Morris asks us to consider that new mechanical production methods in the art could eliminate traces of production,[48] he related this to manual work, that is why one has to object that exactly his detection can be a trace, to namely that of the machine. Moreover, we have to consider that manual work can be imitated with machines and machined precision can be imitated with manual work. The "problem of form" will be discussed more detailed now.

Questions of form and materiality, on production and perception of art as well as their complex interplays have been treated within Minimal, Serial, and Conceptual Art, in particular for three-dimensional objects on a numerical basis. Aiming at the realization of certain aspects within production and perception, especially neutrality and objectivity as well as a debate concerning European aesthetics (i.e., proportion),[49] Donald Judd and Sol LeWitt created since 1963—actually before there was a talk of Minimal and Serial Art—works like *Untitled* (1963) (DSS 41) and *Wall Structure* (1963) by numerical schemes and considered appearing effects, especially the relationship of form and order. It is insightful to contextualize computer sculpture with these processes, even though they were determined by other traditions and intentions/objectives, and the numerical schemes are not strict formalizations because they don't have to be executable on a digital machine. However, the same goes

47 Quoted in Rottmann, *Gestaltete Mathematik*, 2020, p. 18.
48 See Robert Morris, "Notes on Sculpture: Part III," *Artforum* 5, no. 10 (Summer 1967), pp. 24–29, p. 26.
49 See Rottmann, *Gestaltete Mathematik*, 2020, pp. 220–24, 289–93.

for the digital code, depending on the way of production of a computer sculpture, or rather the degree of automatization.

Since the beginning, the unusual forming of the (pre-)minimalistic objects aimed at visual exploration of their structure, especially by offering shadows, reflections, and parts for looking at, through, or inside in an interplay with the three-dimensionality. In such a way, they aimed at the relation of seeing, thinking, and knowing. The genesis of a form out of manifold impressions corresponds to the problem of constancy of form (*Formkonstanz*), which was discussed in Rudolf Arnheim's Gestalt-based theory of perception. He pointed out that form and color play an important role in perceiving an object, but also in the context of visual thinking.[50] Another important issue was explained by Donald Judd: a numerical order could be realized and could compete against the form or even dominate it.[51] Thus, a form could be relativized—as the Minimalists also argued—not only by color and materiality.[52] Depending on the ontological model on which it was based, this was contrary to an art based on factuality, but was beneficial in the intended argument with Clement Greenberg and his formalist modernism. With the appearing relationships of the empirical and intelligible, or rather the visual and invisible, the roles of form and seeing as constitutive elements of art were challenged—in accordance with contemporary theory of perception. For the sake of completeness it should be noted that Robert Morris went one step further with a view of the self-experiences of the viewer—what is known today as the phenomenological approach to Minimal Art—and showed with his works, such as his *L-Beams*, referring back to Maurice Merleau-Ponty, that a form can be understood only as gestalt in space-situation-body-relations[53]—Greenberg himself modified formalism in 1967.[54]

Due to these events, in particular relating the Minimalist objects to numerical orders, Judd, and even more so Morris, were described by Burnham as precursors of a systems aesthetic, which he considered paradigmatic with a view to the technological situation; it started with Morris when he brought forms like in *Permutation* (1967) gradually in changing relations,[55] while for Judd's *Progressions* he declared: "Here sets, defined as numerical values, have nothing to do with dimension or finite proportion generated through Euclidean space perception, but transcend the intuitive-concrete to become extensions of pure process and transformation." He continues: "Sculpture becomes 'thingified' by means which cannot be perceived except through the rules for ordering finite or infinite sets of abstract points in a given continuum."[56] Sculpture would mirror a development in modern geometry, which has left (according to Oswald Spengler) the area of visual and empirical and measurable objects behind, and acts now with mathematical functions; thus "Object sculpture," following

50 Ibid., p. 153.
51 Ibid., pp. 204–17, 236–40.
52 Ibid., pp. 135–36.
53 Ibid., pp. 166–71.
54 See Clement Greenberg, "Complaints of an Art Critic," *Artforum* (October 1967), pp. 38–39.
55 See Burnham, "Systems Esthetics," 1968, p. 32.
56 Burnham, *Beyond Modern Sculpture*, 1975, p. 147.

Burnham, shows "that the mathematical model can no longer solve the iconic problems of sculpture."[57] There was a harsh replica by Judd—we will get back to this at the end.

Here, it is important to note that while Judd takes actions against the identification of the intelligible part or rather the mathematical connotation, LeWitt made the tension the content of his work. In his *Serial Project #1 (ABCD)* (1966) he played with it and carries the relativization of form to extremes, which now could be shaped arbitrarily to some degree—as long as the generative rule, here a linguistic-combinatorial one, could be reconstructed.

At the same time, Burnham made out a discrepancy in Judd's *Progressions* with a view to the numerical determination of the objects and their impression and declared with it an inextricable entanglement of the determinants of sculpture: "More than simply an art object's list structure, Judd included phenomenal qualities which would have never shown up in a fabricator's plans, but which proved necessary for the 'seeing' of the object."[58] Actually, the alleged sparse, geometrical objects offer quite a few sensual dimensions regarding their chromaticity, materiality, and lighting conditions, and in that way they would be more than a "list-structure"—which is what programmers call it, namely a listing of those properties which are required for the recreation of a physical object.[59]

Computer sculptors Csuri and Mallary, who had presumably to face up to the technical challenges, could have profited from this discourse. This affects more than the proportion between work and viewer—as a life-sized vertical *Quad III* evokes an anthropomorphism. When the role of form was questioned, the computer sculptors at the same time exposed the potential of the computer within the process of form-finding: in a combinatorial manner as a variant-machine and in a cybernetic manner as a decision-machine. Like the objects of Minimal Art, the computer sculptures were not built for a reception or illustration of its mathematical bases. The latter were elaborated in such a way that they hardly could be identified by a common viewer. The curved forms of *Numeric Milling* are based on Bessel functions—the canonical solutions of Bessel's differential equations[60]—which are of media-technological interest because they find application in calculating how electrical waves propagate in wires.[61] However, in art and design they were not used to my knowledge. Nevertheless, on this level *Numeric Milling* refers to the development of procedures for generating curved surfaces with smooth transitions in mathematics. Such surfaces, which were researched and advertised by General Motors Research Laboratories, were of importance, for instance, for the bodywork of the automobile industry. Thus, the computer sculptures—particularly also the biomorphically appearing one of Mallary—touch on the traditional dualism of geometric and organic forms. What kind of form a given one is, could no longer be determined "superficially" in the 1960s, but only via its manner of origin; Donald Judd could have profited from this insight, because he showed—despite his familiarity with

57 Ibid.
58 Burnham, "Systems Esthetics," 1968, p. 32.
59 Ibid.
60 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, pp. 1297–98.
61 See Paul Schafheitlin, *Die Theorie der Besselschen Funktion* (Berlin/Leipzig: Teubner, 1908), pp. 2–3.

mathematical geometries—a dualistic understanding of form.[62] It seems paradoxical, since Judd's works provide an impression and even identification of mathematics, whereas computer sculptures disable the identification. Finally, computer sculptures like *Numeric Milling* indicate that in the 1960s knowledge and practices of the working world were picked up and applied in the arts. The (mathematical) modeling of surfaces was one thing, but their technical realization quite another—even when both could be entangled in computer production systems.

Mechanization/Automatization

For his work with computer sculpture Charles Csuri was in the right place: he was an academic in Ohio, where the Cincinnati Milling Machine Company operated, and with which he cooperated around 1968.[63] An objective of the use of such machines was to automatize production in an economic sense, reducing primarily manual work, which had been emphatically sought since the 1950s.[64] This happened in the "navigable water" of cybernetics, which was known by the computer sculptors,[65] and in which automatization possessed not inconsiderable significance[66]—Norbert Wiener was called the father of modern cybernetics and the "Father of Automation."[67] Correspondingly, in 1952 an Automatically Programmed Tool System (ATP system) was presented in *Scientific American* as an innovation, which as an analog-digital milling machine system for tools not only proceeded the production process automatically, but also controlled it with "[f]eedback control."[68] Such automation technology makes evident that automatization in a technical sense has to be distinguished in different grades. Under these circumstances one could say that Mallary was engaged in a semi-automation (*Quad III*) and Csuri strived for a complete automation (*Numeric Milling*). Because the functionality of the programming language, which was applied in Automatically Programmed Tool systems, had been not adequate for his artistic purposes, Csuri developed his own procedures.[69]

Mechanization and automatization can be made out—in different ways—also in Minimal and Conceptual Art as well as Serial Art. Arguments were made on the level of methods and objects, which happened in particular in the context of a systems discourse in which,

62 See Rottmann, *Gestaltete Mathematik*, 2020, pp. 29, 51–55.
63 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, p. 1298.
64 See William Pease, "An Automatic Machine Tool," *Scientific American* (September 1952), pp. 101–15, p. 105.
65 See Mallary, "Computer Sculpture," 1969, p. 29.
66 See Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine*, 2nd edition, 4th printing (Cambridge, MA: MIT Press, [1948] 1985), p. 39.
67 Anonymous, "Dr. Norbert Wiener Dead at 69: Known as Father of Automation," *The New York Times*, March 19, 1964, p. 1.
68 Pease, "An Automatic Machine Tool," 1952, p. 101.
69 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, pp. 1297–98.

among other things, work with numbers and rules was understood as systemic.[70] Accordingly, Minimal Art was characterized in the second half of the 1960s not only by industrial materials like steel, aluminum, acrylic or mirror glass, but also by "machine production"—as art historian Jutta Held has analyzed.[71] With fabrication, the artworks changed from the early ones with "traces of workmanship" to "precisely worked, standardized articles."[72] What was done to realize neutrality, for example by erasing the personal handwriting, as was rightly criticized, resulted in the opposite, because now references to industrial or social conditions of production existed. The applied "mathematical rules," following Held, would have been taken "out of the technical world" and "reproduced" by the artists, the "alleged primary shapes" (*Urformen*) are "mediated by recent industrial products" and the "normalized boxes" would mirror "the automatic way of production."[73]

With the use of commercial, technical machines, especially the self-acting ones like the automaton, a certain automatization happened—here understood as a process, which runs totally or partly without the participation of a human being. The debate was not only held on automation technology in the narrow sense. Robert Morris, for instance, attested to Minimal Art another kind of automation, which "precludes any 'arranging' of parts": "The 'how' of making was automated by accepting the method of forming necessary to rectilinear things."[74] For Morris, this practice fits in a system-based art, which his broad conception of "automation" rests on. So "many 20th-century artists"[75] as well as Renaissance sculptor Donatello would have in common, as Morris quite understandably explained, "that some part of the systematic making process has been automated."[76] In these cases, "the artist has stepped aside for more of the world to enter into the art," and at the same time external determinants could unfold their effects within the forming process.[77] Morris offers only a few artists (such as Jasper Johns, Frank Stella, John Cage, and Jackson Pollock), but not LeWitt, who will be addressed here. In a characterization of his Conceptual Art, LeWitt explained that after choosing the formal means, the application of an "idea,"[78] for example

70 See Michael Rottmann, "Kalkulierte Innovationen: Zur Kritik der Systematisierung von Entwurfs- und Innovationsprozessen in der Kunst um 1960," in Claudia Mareis and Rottmann, *Entwerfen mit System*, Studienhefte Problemorientiertes Design, no. 10, ed. Jesko Fezer, Oliver Gemballa, and Matthias Görlich (Hamburg: Adocs, 2020), pp. 123–221.

71 See Jutta Held, "Minimal Art – Eine amerikanische Ideologie," in *Minimal Art: Eine kritische Retrospektive*, ed. Gregor Stemmrich (Basel/Dresden: Verlag der Kunst, 1995), pp. 444–70, here pp. 446–47. Translation by the author.

72 Ibid., pp. 446–47. Translation by the author.

73 Ibid., pp. 459–61. Translation by the author.

74 See Robert Morris, "Some Notes on the Phenomenology of Making: The Search for the Motivated," *Artforum* 8, no. 8 (April 1970), pp. 62–66, here p. 66.

75 Ibid., p. 65.

76 Ibid.

77 Ibid.

78 LeWitt used "idea" and "system" synonymously. See Rottmann, *Gestaltete Mathematik*, 2020, pp. 249–53.

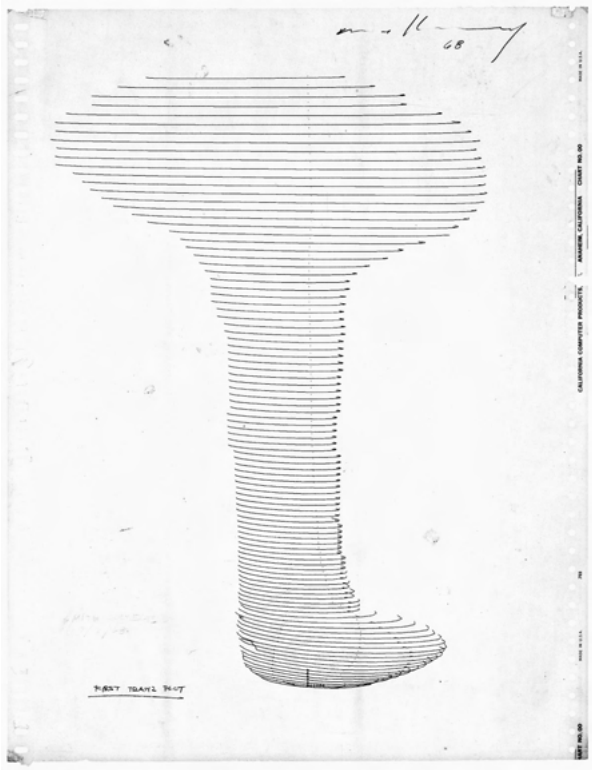
a system (of rules) implies that: "The process is mechanical."[79] His machine metaphor became famous: "The idea becomes a machine that makes the art."[80] As I have argued elsewhere, LeWitt, as well as Mel Bochner, partly automatized their processes in their Serial Art by working with matrixes of mathematics in a generative manner, because these diagrams operated on paper as "symbolic machines."[81] One can also find this notion, which is bound to "rule-media" as I put it,[82] in LeWitt's understanding of text as a kind of a flow chart, which could function as "an operational diagram to automate art"—the artist exemplified this through his programmatic *Sentences on Conceptual Art* (1969).[83]

It becomes apparent that in Serial and Conceptual Art alternative mechanizations and automatizations were declared and pursued. Such practices were by no means only imitative or assertive. Rather, they have to be considered explorative and reflexive; they addressed internal art categories like the idea of the artist genius and were targeted against modernism. As Morris explained: "However it is employed, the automation serves to remove taste and the personal touch by co-opting forces, images, processes, to replace a step formerly taken in a directing or deciding way by the artist."[84] Other than écriture *automatique*, the automatism of Surrealism, which was used to activate and explore unknown areas (of the unconsciousness)—a procedure which stimulates the artist by turning off the control of consciousness, but keeps her/him determinative in the end—with technical-machinic automatization, parts of the creative process were handed over to overcome the restrictions of the (conscious) self.[85] They were also used with a view to addressing the cultural imprint, especially to turn off the personal "biases," which is something Csuri mentioned for computer work.[86] Morris talked about a "controlled lack of control."[87] He made a good point when he accentuated that with automation the arbitrary in art would just not diminish, because now forces would be effective, which are "beyond his [the artist's] total personal control."[88]

2D/3D and In Between

One technical problem in the making of computer sculpture in the 1960s was the entire representation of a three-dimensional object with a digital model, as Robert Mallary has

79 See Sol LeWitt, "Sentences on Conceptual Art," *0–9*, no. 5 (January 1969), pp. 3–5.
80 Sol LeWitt, "Paragraphs on Conceptual Art," *Artforum* 5, no. 10 (1967), p. 79–83, here p. 80.
81 See Michael Rottmann, "Checking Creativity: Machines, Media and Mathematics in Early Computer, Serial and Conceptual Art," *Proceedings: Conference EVA Copenhagen 2018: Politics of the Machine—Art and After*, Aalborg University Copenhagen, May 15–17, 2018, pp. 1–10, here p. 5–6, doi: 10.14236/ewic/EVAC18.2.
82 See ibid., p. 6.
83 Quoted in Rottmann, *Gestaltete Mathematik*, 2020, p. 278.
84 Morris, "Some Notes on the Phenomenology of Making," 1970, p. 65.
85 For Bochner, see Rottmann, *Gestaltete Mathematik*, 2020, p. 289.
86 See Csuri and Shaffer, "Art, Computer and Mathematics," 1968, p. 1295.
87 Morris, "Some Notes on the Phenomenology of Making," 1970, pp. 65–66.
88 Ibid., p. 66.



5 Robert Mallary, plotter drawing, 1968, computer-generated Drawing with *TRAN 2*, ink on plotter paper, IBM 1130, plotter, ca. 30 × 40 cm.

explicated.[89] It can be assumed that computer programs were oriented to existing output devices like the screen and plotter, which had been designed for two-dimensional displaying. If three-dimensional objects were displayed on its surfaces in an illusionistic manner, their representations did not need to be identical with those of an actual three-dimensional object. Considering this technical condition, it becomes comprehensible why sculpture was thought and practiced—as discussed for *Quad III*—as a compound of two-dimensional elements. A starting point was the older idea of "multi-planar image synthesis,"[90] the description and creation of three-dimensional forms with two-dimensional ones—in *Quad III* stapled disks—in the way of a contour map (fig. 5). The displaying and making of three-dimensional forms could be stimulated by mathematics, which has a long tradition of representing (geometrical) objects (of higher dimensions) and methods of projection and intersection, as well as by industry, in which such concepts must be developed for milling,

89 Mallary, "Computer Sculpture," 1969, p. 30.

90 See Robert Mallary, Interview, in *Artist and Computer*, ed. Ruth Leavitt (New York: Harmony Books, 1976), pp. 4–8.

punching, or casting three-dimensional forms (e.g., milling machines with three axes).[91] From this viewpoint, computer sculpture—plastic procedures included—could be more interesting than computer graphics for industry and its development of mostly three-dimensional products.

The subject of dimensionality was also an issue for Greenberg and for Minimal, Serial, and Conceptual Art, as I have shown elsewhere, in respect to the theory of sculpture and the aesthetics of production: the relationship of two- and three-dimensionality was an ingredient, because these art forms operated with transforming media, for instance a draft into an object, and they related both types of dimensionality, in presentations of multipart works for example.[92] One could talk about pendulousnesses. Painting as a starting and reference point was increasingly made and understood as object-like (Johns, LeWitt, Judd, Stella), thus helping to reach object art; the same goes for Mallary: "I conceive of an image as a monolith, an actual object in an actual place, aggressive in the factuality of its physical and sculptural attributes of surface, shape and substance."[93] He was interested in the interspace between painting and sculpture—the "impasto of painting" could "preserve[] its pictorial 'skin,'" but also allows for being "transformed into sculpture"—seeing in himself "more a painter than a sculptor."[94] Many of the mentioned artists continued a kind of drawing and/or turned back to graphics later; LeWitt even pursued a maximal two-dimensionality with his *Wall Drawings*.[95] So, artists like Judd and LeWitt not only attacked modernism with a rhetoric of change, for example with their terms "Specific Objects" (Judd) and "Structures" (LeWitt), but also with an interdimensionality (*Zwischendimensionalität*), as I call it, which can be ascribed to their painting-originated space-expanding objects in the early 1960s, like the already mentioned *Wall Structure* (1963) or Judd's *Relief* (1961).[96] These objects are in-betweens and can be located between painting and sculpture, which are commonly described as two- and three-dimensional media; actually, Greenberg argued that media specificity is also determined by dimension number—he declared painting as two-dimensional, sculpture as three-dimensional. Minimal and Serial Art were busy with the relation of draft and artwork and their discrepancy.[97] Moreover, the object's three-dimensionality was an important ingredient in the discourse of image and sculpture of the 1960s (in Minimal Art)—aspects of it had been already addressed (*L-Beams*): a specific body-relatedness and a critique of its (kinaesthetic) experience (Krauss, Morris) as well as the discrepancy between

91 See Jens Schröter, *3D: History, Theory, and Aesthetics of the Transplane Image* (New York/London/New Delhi/Sydney: Bloomsbury, 2014).

92 See Rottmann, *Gestaltete Mathematik*, 2020, pp. 122–25. Dimensionalites are here understood in an art-historical sense, not in a strictly mathematical one (a physical, flat surface is actually not a 2D object).

93 Robert Mallary, Statement, in *Sixteen Americans*, ed. Dorothy Miller, exh. cat. Museum of Modern Art (New York: Museum of Modern Art New York, 1959), pp. 47–51, here p. 47.

94 Ibid.

95 See Rottmann, *Gestaltete Mathematik*, 2020, p. 295.

96 Ibid., p. 123.

97 For Stella and Judd, see Rottmann, "Checking Creativity," 2018, p. 7.

system and object. While in the context of a phenomenological approach, the object-viewer relation was also treated.[98] Therefore, Robert Morris suggested that Minimal Art "attempted to mediate between the notational knowledge of flat concerns (systems, the diagrammatic, the logically constructed and placed, the preconceived) and the concerns of objects (the relativity of perception in depth)."[99] In contrast, the artistic process and media of draft-like drawing were exposed, aiming not only against formalism, but also against capitalism and materialism. LeWitt explained that a "doodled drawing" with the basic idea is as important as a "three-dimensional structure."[100] And elsewhere he wrote: "I wasn't showing a formal sculpture, I was showing a thought process."[101] The well-known "dematerialization of art" was diagnosed. It is quite understandable that the transformation of reality into information—and this can be applied to today's debate about social media—was criticized (by Les Levine) because "direct, corporal experiences" would be replaced by "second-hand mental experiences."[102]

A Broader Perspective and Conclusions

Computer sculpture on the one hand, and Minimal, Serial, and Conceptual Art on the other hand, have considerable intersections concerning internal themes of art—in terms of the discourses of form, image, and sculpture. They clearly show parallels with a view to mathematization, mechanization, and automatization as well as a 2D/3D debate. The historical context in the United States, which was built in particular by cybernetics, systems theory, computerization, and digitalization as well as the Cold War, gives us a framework for further explanations. I want to argue that both art fields have to be thought of together. The presented events in Minimal, Serial, and Conceptual Art can be made out as a parallel history of early digital art. Accordingly, Conceptual Art and art and technology were determined in their relation as "constituents of larger social transformations from the machine age of industrial society to the so-called information age of post-industrial society."[103] Such art movements, which can be linked to digital art and its subjects and its (information) technology, which are—like LeWitts's Conceptual Art—more or less explicitly thematized and reflected, but without commercial or built (digital) machines, I want to call "co-digital art." Their intersection—for just that reason they are named here as (digital) machine arts—is still the current question, how certain artforms behave with technology and the mechanization of art and society, in particular which man-machine relationship they represent and which role they assign to the body.[104] This all is the more true since mechanization and the

98 For a reconstruction, see Rottmann, *Gestaltete Mathematik*, 2020, pp. 165–77.
99 Robert Morris, "Aligned with Nazca," *Artforum* 14, no. 2 (October 1975), pp. 26–39, here p. 39.
100 Here quoted in Rottmann, *Gestaltete Mathematik*, 2020, p. 294.
101 Quoted in ibid., p. 297.
102 See Shanken, "Art in the Information Age," 2002, p. 436.
103 Although he does not differentiate Conceptual Art, see ibid., p. 433.
104 See, e.g., Charlie Gere, *Digital Culture* (London: Reaktion Books, 2002), pp. 75–149.

promotion of interdisciplinary cooperations, for instance in art and technology movements like Experiments in Art & Technology (E.A.T.), were driven forward strategically on the part of industry and politics to serve an "instrumental creativity" in the course of economic and hegemonial competition.[105]

The discussed representatives of computer sculpture have to be described as technophile, if not techno-euphoric and, albeit it sounds chlichéd, assertive by trend. They even seem to have the belief in progress, e.g., when they praised (future) possibilities of computer work. This is also indicated by Csuri's first project grant, which was part of a National Science Foundation program to show the usefulness of computers, especially in art and design.[106] When the computer sculptors treated interaction and production—in particular of art—in the context of tackling the man-machine relationship they did it pragmatically and outcome-orientedly. But Minimal Art also behaved assertive toward technological and industrial society. This was explained by competition with Europe and a related stocktaking.[107] When a "mechanization of the artistic production," with an "equalizing technical working process" and a generating of non-relational artworks with numerical schemes, which were considered as objective and naturally inevitable, should help to reduce the belief in the artists' special position prevailing in Europe (especially since Kant), as Jutta Held has argued, this activity has to be understood as being based on the "American ideology of egality."[108] Finally, the theories of Minimal Art would be infiltrated by "American ideology," the belief in science and technological rationality, as well as in the superiority of American civilization due to technical leadership, and this would determine the forms of their "products."[109] Taking a subordinate role to technology would no longer be experienced as alienation, but as a natural historical development—Held also recalled Andy Warhol's statement "I want to be a machine."[110]

The situation turned out to be rather ambivalent. The aesthetics and politics of machination and automatization were also criticized, foremost in Minimal, Serial, and Conceptual Art. To say it paradoxically: this was done with machines against machines and with automatization against automatization—by the way, the different notions of the terms "machine" and "automatization" have so far been used because of a historical and disciplinary variance, which I am pursuing in my current research project "Automated Innovations." When Donald Judd, for instance, pursued with his numerical schemes a "one-shot" production,[111] this can be interpreted as a reaction against cybernetic feedback; together with Frank Stella,

105 See Claudia Mareis, "Kreatives Problemlösen: Entwurfsdebatten im Kontext von Designmethodologie und Kreativitätsforschung," in Mareis and Rottmann, *Entwerfen mit System*, 2020, pp. 25–120. Translation by the author.

106 See Freedman, "Oral History Interview," 1989, n.p.

107 See Held, "Minimal Art," 1995, pp. 458–59.

108 Ibid., pp. 457, 464–65. Translation by the author.

109 Ibid., pp. 458–59. Translation by the author.

110 Ibid., pp. 460–61. Translation by the author. See Gene Swenson, "What Is Pop Art? Answers from 8 Painters, Part I," *Art News* 62, no. 7 (November 1963), pp. 24–27, 60–63, here p. 26.

111 Quoted in Rottmann, *Gestaltete Mathematik*, 2020, p. 208.

who worked with systematic/automated draft methods, he debated the (fundamental) limits of such methods (in art and beyond).[112] The loss of control, intrinsic to the work with (self-chosen or created) machines or systems and related automations, was exercised and demonstrated by the artists; "control" was not least a key term in the discourse of creativity, which was also exploited politically. With the help of an aesthetics of surprise, artists like LeWitt brought home their thoughts about the moment of a fundamental uncontrollability in so-called rational, system-based and automatized processes and their limitations.[113] In Serial and Conceptual Art, the introduced work with machines and automatization can be understood, especially because it happened without commercial machines, not only as a critique of cultural production, but also of a social and economical one and its effects. We have to consider the fact that not only was production, as well as administration, automatized in the US, in particular for information processing. Jack Burnham called it the "automated state" in 1968, explaining that "power resides less in the control of the traditional symbols of wealth than in information."[114] Against this background, i.e., the development of an information society and a digital culture, LeWitt's activities were related to information technology.[115] It was quite rightly indicated that his concept of machine, which suggests mass production, is contradictory; the mathematical systems he used, like in *Incomplete Open Cubes* (1977), are anachronistic, inconsistent, and idiosyncratic (which LeWitt himself stressed again and again), thus his machines do not allow faultless, identical reproduction.[116] In the end, a gap revealed itself between predicted future possibilities and a technological possible reality. Until today, not everything can be automatized; this goes for the course of automated processes as well as for their necessary infrastructures, which must be installed before. When LeWitt characterized Conceptual Art as machine-like, which implicates a proximity to technology, and at the same time he warned that the idea could fall behind, a dilemma of the relationship of art and technology was called out.[117] An art that orients itself to technology could be criticized not only as "dominated by the materiality and spectacle of mechanical apparatus," as it was expressed for the art-and-technology movement, but also, when tending to materialization and work- and ware-likeness, that it could lose its anti-capitalist line of attack, and especially, with a view to Conceptual Art, its primacy of the idea.[118] Furthermore, negative aspects of technology could become part of art—for instance the development and use in the military complex (Vietnam War) or its instrumentalization in Cold War (space race).[119] Robert Smithson wrote very clearly: "To celebrate the power of technology through art strikes me as a sad parody of NASA. I do not share the confidence

112 See Rottmann, "Kalkulierte Innovationen," pp. 148–53.
113 Ibid., p. 185.
114 Burnham, "Systems Esthetics," 1968, p. 31.
115 See, e.g., Sabeth Buchmann, *Denken gegen das Denken* (Berlin: b_books, 2007).
116 See Rottmann, *Gestaltete Mathematik*, 2020, p. 342.
117 See Shanken, "Art in the Information Age," 2002, p. 436.
118 Ibid.
119 Ibid.

of the astronauts. The rationalism and logic of the engineer is too self-assured. Art aping science turns into a cultural malaise."[120]

Donald Judd also pleads for a separation of art and science, although he was academically trained and well informed about scientific issues, in particular those of mathematics.[121] He expressed his displeasure about Jack Burnham—to come back to it—who related the innovation of sculpture to the altered relationship of human and technology, in which objects would have regained their autonomy. Judd criticized this "sort of sloppy correlations of such highly different activities as science and arts" and Burnham's conception of history as thoughtless and deterministic.[122] Similarly, he was displeased by Burnham's prognosis, who saw only two ways for sculpture: "it can be fashioned as a reaction against technology or as an extension of technological methodology."[123] Certainly, one could discuss Burnham's and Judd's arguments, but the relationship of art and technology has become an issue with growing importance for sculpture in the (post-)digital age.

120 Robert Smithson, letter to Gyorgy Kepes (1969), in *Robert Smithson: The Collected Writings*, ed. Jack Flam (Berkeley/Los Angeles/London: University of California Press, 1996), p. 360.

121 See Rottmann, *Gestaltete Mathematik*, 2020, pp. 335–36.

122 Donald Judd, "Complaints: Part I," *Studio International* 182 (April 1969): 182–88, here 184.

123 Ibid.

Between the Virtual and the Physical: Material Reflections

Ursula Ströbele

Sculpting Digital Realities

Notes on Truth to Materials, the Aesthetic Limit, Site-Specificity and 3D-Printing

Abstract

Today, hybrid forms of reality coexist and overlap in techniques like augmented or mixed reality and open new avenues of perception. The gaze of the user is absorbed; the whole body is involved in an immersive corporeal (multisensory) experience. The expanded field of sculpture has also been impacted by digital technologies since the 1960s, such as CNC technology, VR, or 3D scans and prints, although an art history of digital sculpture is still developing. My paper aims to discuss what terminology in art history corresponds to these works, given their postmedium condition and infrastructural accessibility, their various materialities, immateriality or rather neomateriality (Christiane Paul), their aesthetic limit (Ernst Michalski), and interactive features, including real-time processes. Following the paradigm of *the sculptural in the expanded field* and by using artistic examples, among others Herbert W. Franke, Jeffrey Shaw, Banz & Bowinkel, and Morehshin Allahyari, I like to ask how media-specific parameters, such as truth to materials, scalability, and site-specificity, are altered when sculptures circulate as files online and can be printed in different sizes. What ontological status do such computer-aided works possess that can be experienced physically and virtually?

Key Words

Digital Realities, Virtual Sculptures, Truth to Materials, Plasticity, Aesthetic Limit, Site-Specificity, Siteness, Neomateriality, 3D-printing, Morehshin Allahyari, Banz & Bowinkel, Herbert W. Franke, Daniel Rourke, Jeffrey Shaw

Introduction

Today, hybrid forms of reality-construction coexist and overlap in techniques like augmented or mixed reality. They therefore open new ways of perception: the gaze of the viewer/user is absorbed; the whole body is involved in an immersive, corporeal, often multisensory experience.[1]

Though an art history of digital sculpture and the sculptural in the (post-)digital age is still developing, the expanded field of sculpture has been impacted by digital technologies since as far back as the 1960s. CNC technology (computer numerical control, e.g., automated control of machining tools, such as mills), 3D scans and prints, or Augmented/Virtual Reality have all made their mark on sculptural practice. So, we still have to ask what kind of art-historical terminology is suitable to these works, especially given their postmedium condition, accessibility, materiality, immateriality or neomateriality, aesthetic limit, interactive features, scalability, real-time processes, and nonlinearity. My paper aims to discuss how established sculptural concepts, such as "truth to materials" or "neomateriality" (Christiane Paul), plasticity and the ä*sthetische Grenze* (aesthetic limit; Ernst Michalski), multiperspectivity, and "siteness" configure our understanding of *the sculptural* in a postmedium condition.

Transforming traditional sculpture aesthetics, digital and virtual objects are characterized mainly by a visual presence—for example, simulations on the surface of a screen based on algorithms. Without sharing the same spatial conditions as its counterpart, however, they are characterized by a specific haptic, including different interfaces such as touch screens, controllers, or keyboards. The expansion into virtual space as well as the emergence of digital sculptures, which is already indicated in Jack Burnham's survey work *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (1968), became since then an essential form of *the sculptural* in the expanded field. Burnham is especially interested in artistic works whose individual components interact with each other and with their environment, works that are self-organizing, data-generating, and information-processing in real time.[2]

What potentials do these tool-based technologies, such as computer-generated, interactive Virtual Reality, Augmented Reality, or 3D-printing of a layered construction of material

1 Part of the following text is based on my habilitation *Erweiterung des Skulpturalen: Analysen und Theorien aktueller Grenzphänomene: "Non-human Living Sculptures" seit den 1960er Jahren. Hans Haacke und Pierre Huyghe* (2020), which is forthcoming. Sincere thanks are due at this point to Verena Kuni and Mara-Johanna Kölmel for their critical reading of my text and their valuable comments.

2 This kind of "bridge between the external plastic infinite and the internal plastic infinite," which "the objects never come to an end in themselves but intersect with infinite combinations," was already pronounced by Umberto Boccioni in his *Manifesto of Futurist Sculpture* (1912)—only partially realizing it in his own artworks during his short career. Umberto Boccioni, "Technisches Manifest der futuristischen Plastik" (1912), in *Umberto Boccioni: Futuristische Malerei und Plastik*, ed. Astrit Schmidt-Burkhardt (Dresden: Verlag der Kunst, 2002), pp. 237–49, here pp. 248–49.

accumulation, hold for current concepts of sculpturality?[3] Burnham assigned postformalist sculpture the status of a so-called *real-time system* in view of its experimental openness, kinetic characteristics, mechanization, and "form of biological activity":[4] "The machine, then, becomes the legitimate heir to the sculptural tradition of form creation."[5] Around ten years later, in her 1979 essay "Sculpture in the Expanded Field," Rosalind Krauss developed a *structural* understanding of sculpture beyond material-specific questions, thereby opening a postmodernist inquiry into the defining traits of *the sculptural* in a postmedium condition.[6] Following the paradigm of "Sculpture in the Expanded Field," and by using artistic examples, among others Herbert W. Franke, Jeffrey Shaw, Banz & Bowinkel, and Morehshin Allahyari, I would like to ask further how media-specific parameters, such as scalability and site-specificity, are altered when sculptures circulate as files online ubiquitously and can be printed in different sizes. Which forms of participation does the respective interface address? What ontological status do such computer-aided works possess that can be experienced both physically and virtually? Referring to the historical, established terminology of sculpture theory, my text aims to discuss which terms and concepts are still viable for these sculptural phenomena in the digital and virtual realm.

Herbert W. Franke and Jeffrey Shaw's Concept of *Virtual Sculptures* in the context of *Truth to Materials* and *Neomateriality*

In the 1960s, the scientist, science-fiction author, and artist Herbert W. Franke began working with computers and oscilloscopes and later also sought to expand the boundaries of sculpture toward virtual space. The absence of statuary and gravitation, the change of contour, an all-pervasiveness shaped by self-motion, and a time-based plasticity describe his "virtual sculptures," as Franke calls them. In contrast to "truth to materials," he insists on "objects" previously considered "impossible" to produce, including the ignorance of gravity, mechanical instability, and permeations: "Could the computer lead us also in new areas of sculptures? A way to find an answer is to ignore the mentioned conditions for physical realization and try to design not realizable 3D-forms."[7] By using computers, it became possible to simulate materiality and to create mobile, partly interactive digital sculptures using an enlarged repertoire of forms with an elastic scalability.

3 In German there is the terminological distinction of *Skulptur/skulptural* and *Plastik/plastisch*. While historically the two terms denote two modes of production, since with *Plastik* (Greek *platto* = to form) material is accumulated, while *Skulptur* (Latin *sculpere* = to cut, engrave, carve) requires a subtractive process, today *Skulptur* is often used synonymously. Due to its material accumulation, 3D-printing refers to *Plastik*.

4 Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: Braziller, 1968), p. 6.

5 Ibid., 314.

6 See Martina Dobbe and Ursula Ströbele, eds., *Gegenstand: Skulptur* (Paderborn: Wilhelm Fink, 2020), pp. 1–16.

7 See Herbert Franke's website, http://www.herbert-w-franke.de/VirtS1.html (accessed January 5, 2022).

Departing from an idealistic aesthetic and the primacy of the *idea*, with its sublimation or negation of materials, the "truth to materials" paradigm has moved from the Arts and Crafts to the fine arts since the nineteenth century; material has been assigned style-forming qualities.[8] According to Günter Bandmann, material is iconologically expressive and can be a carrier of information in itself. He refers to the etymological proximity between "justice/truth" and "appropriateness": "The material contributes something to the meaning of the image due to its specific natural or also attributed qualities, but sometimes only by differentiation from the neighboring material."[9] Changes in perspective occurred through John Ruskin, the Arts & Craft movement, and Gottfried Semper's materialist-positivist considerations. History is stored in the materials themselves, following Ruskin, who advocated traditional material processing and rejected imitation with substitute materials that became popular during the era of industrialization.[10] Werner Hofmann emphasizes that the demand for "truth to materials" in sculpture emerged during that time, when craft knowledge had become "lost in superficial virtuosity."[11] Henry Moore is a frequently quoted sculptor in this context: "*Truth to Material.* Every material has its own individual qualities .... Stone … should keep its hard tense stoniness."[12] Burnham himself is skeptical of "truth to material" and underlines its ambiguous premise: "Any forming or shaping must take advantage of the plasticity of each material, and, more importantly, no material will do what it is not meant to do."[13]

8 Günter Bandmann, "Bemerkungen zu einer Ikonologie des Materials," *Städel-Jahrbuch*, N.F. 2 (Frankfurt, 1969), pp. 75–100, here p. 77. See also Günter Bandmann, "Der Wandel der Materialbewertung in der Kunsttheorie des 19. Jahrhunderts," in *Beiträge zur Theorie der Künste im 19. Jahrhundert*, vol. 1, ed. Helmut Koopmann and J. Adolf Schmoll, gen. Eisenwert (Frankfurt am Main: Klostermann, 1971), pp. 129–57. See also Thomas Raff, *Die Sprache der Materialien: Anleitung zu einer Ikonologie der Werkstoffe* (Berlin & München: Deutscher Kunstverlag, 1994), pp. 18–32; Dietmar Rübel and Monika Wagner, and Vera Wolff, eds., *Materialästhetik: Quellentexte zu Kunst, Design und Architektur* (Berlin: Reimer, 2005).
Already in 1849 Gottfried Semper proclaimed truth to materials: "The material speaks for itself and appears, undisguised, and in the form, in the relationships, which are … tested. Wood [appears] as wood, iron as iron, each according to its own laws." See Monika Wagner, "Materialtäuschungen," in *Lust der Täuschung: Von antiker Kunst bis zur Virtual Reality*, ed. Andreas Beitin and Roger Diederen (Munich: Hirmer, 2018), pp. 127–68, here p. 131, translation by the author.

9 Bandmann, "Bemerkungen zu einer Ikonologie des Materials," 1969, p. 77, translation by the author.

10 Ibid. See also Nadine Rottau, *Materialgerechtigkeit: Ästhetik im 19. Jahrhundert* (Aachen: Shaker, 2012). In *Der Stil* (1860), for example, Semper praised the "absolute docility of the material" ("die absolute Gefügigkeit") of Kautschuk. Gottfried Semper, *Der Stil* (Frankfurt: Verlag für Kunst und Wissenschaft, 1860), p. 15.

11 Werner Hofmann, *Die Plastik des 20. Jahrhunderts* (Frankfurt am Main: Fischer, 1958), p. 21.

12 Burnham here quotes Moore after Herbert Read. Burnham, *Beyond Modern Sculpture*, 1968, pp. 95–96. Material in its function as information carrier and at the same time as medium, which has lost its neutrality since Niklas Luhmann's sociological system theory and his understanding of communication as a triad of information-communication-understanding, is also a profitable theory for the analysis of sculptural situations and system-aesthetic concepts. See Niklas Luhmann, *Soziale Systeme Grundriß einer allgemeinen Theorie* (Frankfurt am Main: Suhrkamp, 1984); Niklas Luhmann, *Die Kunst der Gesellschaft* (Frankfurt am Main: Suhrkamp, 1995). Henry Moore and Herbert Read use "material" in singular.

13 Burnham, *Beyond Modern Sculpture*,1968, p. 96.

Moore is concerned with hardness, compliance, elongation, and surface textures. In nature, he asserts, there is a diversity of forms and rhythms, enhanced by inventions such as the microscope and telescope (this is important to Burnham). He therefore seeks to evoke the richness of these forms. Burnham understands Moore's adherence to "truth to materials" as a reaction to the falsity of Neoclassical and Romantic carving, only setting up an antidote for the use of materials. The attraction to "truth to materials stems, according to Burnham, from its ring of moral equilibrium and natural propriety.[14] Referring back to the nineteenth century, Burnham considers this sculptural paradigm as an "overreaction to earlier excesses"[15]—even though this question is still crucial, especially for computer-based works. Krauss describes this relationship between artist and material as "alert responsiveness" and underlines that the idea cannot be separated from the artist.[16] Indeed, how can one evoke the haptic experience of the textures and surfaces of digital objects, such as Franke's, that are perceived visually and might be printed in different materials?

This embeddedness of the digital in the objects, images, and structures we encounter on a daily basis and the way we understand ourselves in relation to them seems to be an essential characteristic of the sculptural approaches that are here discussed. Christiane Paul's concept of "neomateriality" elucidates this expanded vision of materiality: neomateriality, according to Paul, "describe[s] an objecthood that incorporates networked digital technologies, and embeds, processes, and reflects back the data of humans and the environment."[17] Neomateriality reveals its own coded materiality and describes a twofold operation: first, the convergence of digital technologies in various materialities and second, how this fusion has changed our relationship with these materialities, especially sculptures. Verena Kuni's term "analogital" might be also understood as fruitful approach to describe these entanglements and "the transformations of analog and digital material(itie)s and media," exploring our culture's fluidity and nomadic character.[18]

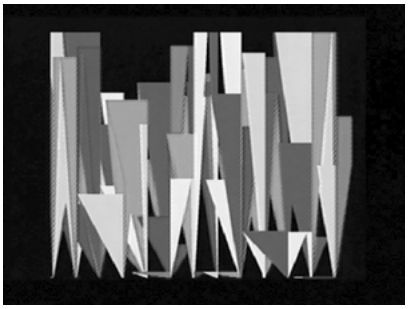
14 Ibid.

15 Ibid., p. 155. Monika Wagner traces the term back to Goethe's plea (1778) for the tortured stones of Milan Cathedral and his demand for empathy with the material itself. Monika Wagner, "'Materialgerechtigkeit': Debatten um Werkstoffe in der Architektur des 19. und frühen 20. Jahrhunderts," *Historische Architekturoberflächen: Kalk – Putz – Farbe/Historical Architectural Surfaces: Lime—Plaster — Colour*, ed. Jürgen Pursche (ICOMOS, Hefte des Deutschen Nationalkomitees XXXIX), no. 39 (2003), pp. 135–38, here p. 135. See also Monika Wagner, "Vom Ende der materialgerechten Form: Kunst im Plastikzeitalter," in *Stoffe: Zur Geschichte der Materialität in Künsten und Wissenschaften*, ed. Barbara Naumann, Thomas Strässle, and Caroline Torra-Mattenklott (Zurich: vdf Hochschulverlag AG an der ETH, 2006), pp. 229–46. Wagner, "Lemma zu Material," in *Ästhetische Grundbegriffe*, ed. Karl-Heinz Barck et al., vol. 3 (Stuttgart/Weimar: Metzler, 2001), pp. 866–82. Wagner does not discuss Moore and sculpture here. See also Wolfgang Kemp, "Material der bildenden Kunst. Zu einem ungelösten Problem in der Kunstwissenschaft," *GhK Gesamthochschule Kassel Prisma* 9 (December 1975): 25–34.

16 Rosalind Krauss, *Passages in Modern Sculpture* (Cambridge, MA: MIT Press, 1981), pp. 143–44. She mentions the same quote by Henry Moore.

17 Christiane Paul, "From Immateriality to Neomateriality: Art and the Conditions of Digital Materiality," in *Proceedings of the 21st International Symposium on Electronic* Art (2015), pp. 552–55, https://www.isea-archives.org/docs/2015/proceedings/ISEA2015_proceedings.pdf (accessed January 5, 2022).

18 See Verena Kuni about the analogital condition(s) of the sculptural in this volume.



1 Herbert W. Franke, ORCHID, 1984–1992, computer-based animation, screenshot, collection of the ZKM.

Franke's first works were written in QUICK BASIC and were presented on a monitor or on a television screen, an object whose sculpturality he considers part of the work.[19] *ORCHID* (fig. 1), for example, is interactive and connects his early computer graphics with more performative, participatory works: triangular color patches begin to form and overlap with each other from the bottom edge of the screen. With the keyboard, the user can shift the graphics *en bloc* to the top or bottom.

Significant, at least for Franke, are the detailed descriptions in catalogs and interviews of the technical approach in his early works, sometimes supplemented by functional drawings of the respective apparatus—for example in *Computerkunst, Computergrafik* (1971) and *Apparative Kunst. Vom Kaleidoskop zum Computer* (1973).[20] These publications document the still young art form of computer-based art, which pleaded for legitimacy and recognition and attempted to counteract the then unknown "mystery" of the computer. Many contemporaries doubted the artistic value of the exhibits because many of the protagonists belonged to the scientific-technical field. Similarly, today the processes of AI-based art are often perceived as a black box.[21]

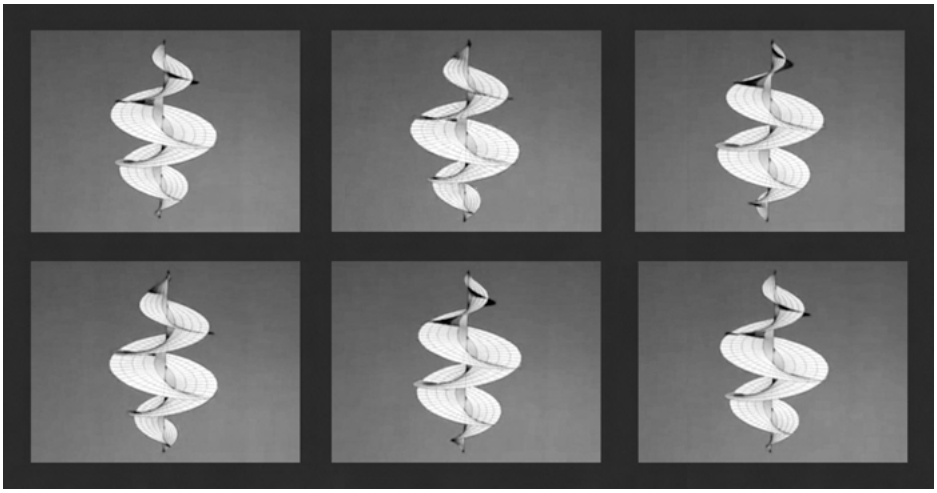
Franke writes: "Because the virtual reality will become increasing meaning in the art of tomorrow, the question of construction with material will become negligible."[22] He here raises the question of whether a "materially appropriate" digital sculpture even exists. His

19 Before early computers were available, Herbert W. Franke made experimental and generative photographs in the 1950s, which were followed by a series of oscillograms produced with the analogue technique of a cathode ray oscillograph. During 1971–73 and 1979–85, Franke curated the exhibition *Ways to Computer Art*, which was then exhibited in different Goethe Institutes worldwide.

20 Herbert W. Franke, *Computergraphik, Computerkunst* (Munich: Bruckmann, 1971). Herbert W. Franke and Gottfried Jäger, *Apparative Kunst: Vom Kaleidoskop zum Computer* (Cologne: Verlag M. DuMont Schauberg, 1973).

21 See Mercedes Bunz, "The Calculation of Meaning: On the Misunderstanding of New Artificial Intelligence as Culture," *Culture, Theory and Critique* 60, nos. 3–4, Culture & Technics: The Politics of Simondon's Du Mode (2019): 264–78, doi: https://www.tandfonline.com/doi/abs/10.1080/14735784.2019.1667255 (accessed May 3, 2022).

22 Herbert W. Franke, "Virtual Sculptures," in *Mathematics and Culture II*, ed. M. Emmer (Berlin/Heidelberg: Springer, 2005), pp. 145–49, here p. 149.



2 Herbert W. Franke, *Spindle*, 1993, loop.

geometric, sculptural formations are recognizably afflicted with the historicity of design and evidently differ from today's aesthetics of the digital: *Spindle* (1993) (fig. 2) is a helical, twisted, counter-rotating object, a sculptural mobile, which in its plasticity might be barely translated into established materials. Shown in rotation, it evokes an upward or downward screwing movement. *Donut* (1995) demonstrates his interest in unusual movements of pulsation and torsion. According to Franke, the virtual sculpture should still remain a uniform object with a concrete three-dimensional form, even if he underlines the inspiring challenge of "never seen objects and movements."[23] Despite of his mathematical-artistic interest in technological innovations, he still remains linked to the haptic translatability of sculpture and its object-based aesthetics. But one could also ask if here, in early digital sculpture on screens, addressing the sense of sight, a reversal of the sensory hierarchy manifests itself. After all, such artists explicitly refer to the concept of sculpture, but at the same time no longer create haptic sculptures. Since 2005, Franke has been using his own virtual *Z-Galaxy*, through which the user can walk with an avatar—a first kind of embodied interface—and take a closer look at the exhibits. Named after computer pioneer Konrad Zuse, the world is a virtual art exhibition.

The sculptural possibilities in the age of the digital are also discussed by Simon Penny in his critical reading of Burnham (1999): "The problematic discontinuity between the tangibility of sculpture and sculptural practice and the ephemeral temporality of informatics

23 Franke, "Virtual Sculptures," 2005, p. 149. "But … it [virtual sculpture] should—after all the transformations and movements—remain a uniform object, for instance based on the conception of cyclic processes or on random controlled deviations from the prototype. ... In the large field of computer art the virtual sculpture will be only a little facette, but here can [sic] originate fascinating results."

is a case study in the cultural phase-transition of our times."[24] Among the main new characteristics of the medium sculpture are disembodiment, deterritorialization, and the code as ephemeral structuring system, "a long step from the pragmatic materiality of sculpture." Penny concludes that despite these new "numerous explorations into virtual sculpture," no new aesthetics of the digital has yet emerged.[25]

The paradox of a virtual reality has been appropriated by the increasing digitalization since the 1990s, leading to a growing "media-induced softening of our understanding of reality," as Wolfgang Welsch proclaims.[26] Jean Baudrillard, for his part, equates virtuality and virtual reality.[27] He criticizes virtuality for aiming only at the erasure of the real through its double. The real and the virtual become indistinguishable on an ontological level. Etymologically, virtuality is borrowed from the Latin *virtus* (virtue, valor, efficacy). The French word *virtuel* means "capable of acting," "existing as a possibility according to its disposition."[28] Virtuality is consequently an entity that, though not physical, is present in its functionality or effect.[29] As Eva Wilson has precisely outlined, beyond this dualistic concept of reality and virtuality, virtuality opens up a field as an aesthetic, perception-theoretical category, departing from technical developments of the early optical physics, such as stereoscope, kaleidoscope, and photography.[30] Considering Thomas Aquinas and Henri Bergson, virtuality stands in relation to reality in temporal latency and recursive, iterative, and reflexive difference.[31] According to Bergson, the (continuously) updated-recognized image is the virtual image. Temporal dimensions of past experiences are thus included in the virtual image.[32] Following Thomas Aquinas, who equates *virtualiter* and *dynamis* as "possibility" in an Aristotelian sense, the history of the virtual leads from a possible force striving for actualization to an element temporally antecedent to reality. While the possible arises temporally after the real,

24 Simon Penny, "System Aesthetics and Cyborg Art: The Legacy of Jack Burnham," *Sculpture Magazine* 18, no. 1 (January/February 1999), https://sculpturemagazine.art/systems-aesthetics-cyborg-art-the-legacy-of-jack-burnham/ (accessed January 6, 2022). "Not only has CAD revolutionized drawing and modeling, but the utilization of computer-controlled milling, stereolithography, and so forth has changed the actual creation of conventional sculpture. More importantly, microprocessors have transformed the language of spatial art practice into a temporal and interactive practice. See also: Christian Wolf, "Skulptur Virtuell: Augmentierte und Virtuelle Realität in der Plastik," in *Skulptur Pur*, ed. Ulrike Lorenz, exh. cat. Kunsthalle Mannheim (Heidelberg: Kehrer, 2014), pp. 114–24.

25 Penny, "Systems Aesthetics and Cyborg Art," 1999.

26 Wolfgang Welsch, "Virtual Anyway?" in *Media and Social Perception*, ed. Candido Mendes and Enrique Larreta (Rio de Janeiro: UNESCO, 1999), pp. 242–85. Translation by the author.

27 Jean Baudrillard, *Die Illusion und die Virtualität* (Wabern-Bern: Benteli, 1994).

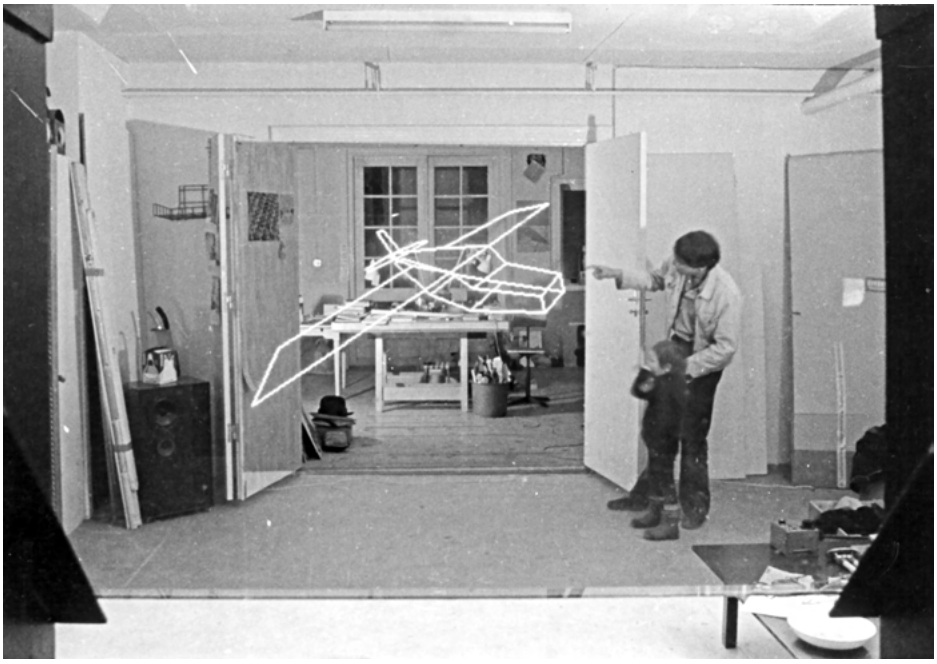
28 See *Historisches Wörterbuch der Philosophie*, vol. 11, ed. Joachim Ritter et al. (Basel: Schwabe, 2001), pp. 1062–67.

29 See Lambert Wiesing, "Virtualität und Widerstreit," in *Skulptur – zwischen Realität und Virtualität*, ed. Gundolf Winter, Jens Schröter, and Christian Spies (Munich: Wilhelm Fink, 2006), pp. 179–90.

30 Eva Wilson, "Hinter den Spiegeln: Virtualität, Rekursion und virtuelle Bilder im 19. Jahrhundert," in *Periphere Visionen: Wissen an den Rändern von Fotografie und Film*, ed. Heide Barrenechea, Marcel Finke, and Moritz Schumm (Paderborn: Wilhelm Fink, 2016), pp. 97–112, here p. 97.

31 Ibid.

32 Ibid.



3 Jeffrey Shaw, Theo Botschuijver, *Virtual Sculpture*, 1981, ZKM | Center for Art and Media Karlsruhe, ZKM-01-0162-02-03081.

the virtual exists temporally before the real.[33] Thus the virtuality of a form exceeds its actuality, or as Brian Massumi puts it: "In a word, experience is our virtual reality."[34] The virtual indicates the multitude of possible states that any entity may experience. One example of a virtual image is the reflection in a mirror, as the artist Jeffrey Shaw demonstrates. Virtual realities, as Sibylle Krämer has summarized, are a technique to enable interactive reflections of symbolic worlds, including the proprioceptive perception."[35]

In the field of art, this includes the question of the relationship between facticity, which refers to the actually given, and factuality, which refers to the actualization of the factual during the reception process and on the production-aesthetic side. Facticity is considered as one of the main media-specific criteria of sculpture, insisting on materiality, spatiality, and plasticity. While facticity refers to the hand- or machine-made, including its presence of

33 See, for example, Clara Völker, *Mobile Medien: Zur Genealogie des Mobilfunks und zur Ideengeschichte von Virtualität* (Bielefeld: transcript, 2010).

34 Brian Massumi, "Sensing the Virtual, Building the Insensible," in *Hypersurface Architecture,* ed. Stephen Perrella, *Architectural Design,* profile no. 133, vol. 68, nos. 5/6 (May–June 1998), pp. 16–24.

35 Sybille Krämer, "Zentralperspektive, Kalkül, Virtuelle Realität: Sieben Thesen über die Weltbildimplikationen symbolischer Formen," in Gianni Vattimo and Wolfgang Welsch, *Medien-Welten Wirklichkeiten* (Munich: Wilhelm Fink, 1998), pp. 27–37, here p. 32.

being, factuality expresses itself as time-based actuality, for example in the temporality of perception. Factuality, therefore, occurs in the reception process itself.

In 1981, Jeffrey Shaw realized his *Virtual Sculpture* (fig. 3) without any computer-aided accessories. Using a Fresnel lens and a semitransparent mirror, a stereometric image created the impression of virtually floating figures that move when the monitor is rotated. The figures can only be visually perceived through contour lines. Although the discrepancy between, for example, a Corten steel sculpture by Richard Serra and Shaw's floating objects could barely be greater, it is precisely this gap that demonstrates a provocative adaptation and questions conventional concepts of sculpture. The virtual and also digital sculpture is dependent from the position, the movement, and the perspective of the viewers, and thus it is closely intertwined with them. It is time-based and exists in a systematic aesthetic relationship with both its apparatus and the recipient. Whereas the digital concerns the medium itself, the virtual here primarily describes the relationship between the work and the viewers; the virtual *can* also be digital. Already in 1919–20, Naum Gabo described his *Kinetic Construction (Standing Wave)* as leaving the impression of a *virtual volume*, based on motion and optical effects. In relation to its etymological background, a virtual sculpture could be also imaginary, seen by the inner eye of a person.

Plasticity and the Aesthetic Limit (*ästhetische Grenze*) in VR-Sculpture

Recent examples of contemporary artists such as Mélodie Mousset (*HanaHana 花華*, 2017), Jon Rafman (*Sculpture Garden*, 2016), Banz & Bowinkel (*Mercury*, 2016), and Jeff Koons (*Lady Bug*, 2014; *Phryne*, 2017) demonstrate the artistic concepts to which technological developments can lead today.[36] AR elements are integrated into space-spanning works, as in Pierre Huyghe's *After ALife Ahead* (2017), where a moving, sculptural collage of black trapezoids appears on a stadium ceiling with the help of an app.[37] Today, one could ask whether new sculptural tools, such as AR, VR, Mixed Reality, like Marina Abramović's digital personal avatar in *The Life* (2020), or 3D-printing, like Karin Sander's pioneering *Body Scans* (1997–2020) will lose their self-reflecting potential once we are more familiar with these technologies.[38] Oliver Grau here speaks of "media competence" and the "effect relativity of illusionism media."[39]

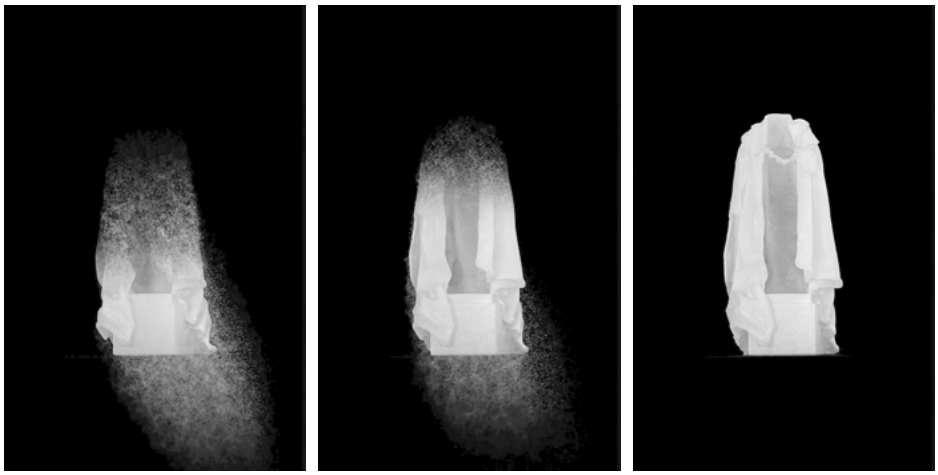
One could also think of holograms that have been welcomed by the arts in the 1970s and 1980s as a new image production method. Holograms were praised as "sculptors of

36 See https://www.radiancevr.co/artists/melodie-mousset/mousset-hanahana/; https://www.arsenalcontemporary.com/to/exhib/detail/jon-rafman; https://www.banzbowinkel.de/project/mercury/; https://news.artnet.com/art-world/jeff-koons-creates-virtual-sculpture-for-garage-magazine-91608; https://acuteart.com/artist/jeff-koons/ (accessed May 3, 2022).

37 See, e.g., https://www.skulptur-projekte-archiv.de/en-us/2017/projects/186/ (accessed May 3, 2022).

38 See, e.g., https://www.serpentinegalleries.org/whats-on/marina-abramovic-life/; https://www.karinsander.de/en/work/3d-bodyscan (accessed May 3, 2022).

39 Oliver Grau, *Virtuelle Kunst in Geschichte und Gegenwart: Visuelle Strategien* (Berlin/Bonn: Dietrich Reimer, 2001), pp. 212–13. Translation by the author.



4 Raqs Media Collective, *Hollowgram*, 2017, holographic projection, dimensions variable.

light" and "a wedding of sculpture and light," as "tangible and intangible," as shown in experiments by Simone Forti (*Angel*, 1977) or Bruce Nauman (*Making Faces*, 1968). The magazine *Holosphere* and the foundation of the Museum of Holography 1976 in New York were accompanying effects of this temporary popularity.[40] After a longer break, it seems that holograms reappear in contemporary (political) art, for example in 2017 with the *Hollowgram* by the Raqs Media Collective (fig. 4), which refers to an absent body and reminds to Auguste Rodin's *Robe de chambre de Balzac, étude* (1897).[41] Here, the lack of massiveness and stasis as well as the optically generated spatiality and plasticity are emphasized. Unlike VR, an optical, analog evoked space is created here; the illusion is only successful from a certain perspective. By means of media effects, holography produces space outside the image; the viewer is in front of the *dispositif*. Jens Schröter speaks of transplanar, planimetric images that are not based on linear perspective, for example three-dimensional images such as stereoscopic, holographic, virtual, and interactive or volumetric images.[42] But what is the materiality and mediality of such virtual, digital works and what is their ontological character as they are based on an apparatus (software and hardware)?

40 See Amy Greenfield, "Interview with Rosemary H. Jackson: Off the Wall," *Holosphere* (November 1973): 3–4. (Source: Archive MIT Museum, Collection of the Museum of Holography, New York).

41 See https://www.serpentinegalleries.org/whats-on/raqs-media-collective-hollowgram/ (accessed January 5, 2022).

42 Jens Schröter, *3D: Zur Geschichte, Theorie und Medienästhetik des technisch-transplanen Bildes* (Paderborn: Wilhelm Fink, 2009); idem., "Das transplane Bild: Raumwissen jenseits der Perspektive," in *Raum: Perspektive: Medium 2: Wahrnehmung im Blick*, vol. 2, ed. Yvonne Schweizer, Anna Quintus, Barbara Lange, Julica Hiller-Norouzi, and Philipp Freytag (Tübingen: reflex Tübinger Kunstgeschichte zum Bildwissen, 2010), idem., "Wie man Skulpturen rendern soll: Zur Geschichte der transplanen Reduktion," in Winter, Schröter, and Spies, *Skulptur – zwischen Realität und Virtualität*, 2006.

5 Banz & Bowinkel, *Mercury,* 2016–17, interactive virtual reality installation for HTC Vive.

Today, sculptural VR works enable an immersive-sensory "appropriation" of the recipient, who "wears" part of the apparatus, thus enters the digital image equipped with a head-mounted display (HMD) and moves through a virtual landscape, for example in Banz & Bowinkel's *Mercury* (2016) (fig. 5).[43] The users are confronted literally with a fragmenting, anticizing statue of Mercury that they perceive in multiperspectivity from different angles and distances, according to the individual use of the controller, offering successively changing viewing positions—or, in the words of Oliver Grau, "successively polyvariant gaze positions."[44] In contrast to traditional forms of sculpture viewing, here the avatar also can cross the statue, thus walking through it.

The *ästhetische Grenze* (aesthetic limit), as Ernst Michalski (1931) discussed it, seems to have disappeared or at least been reduced.[45] Even if his approach has been developed by looking at artworks from the eleventh century to Baroque sculpture, it seems to be a fruitful category to elaborate on within the context of digitality. Michalski understands the so-called ä*sthetische Grenze* as the "boundary that runs between formed art space and unformed free space."[46] The *Kunstraum* (art space) is the space that the artwork embraces and needs

43 One of the first head-mounted displays (HMD) has been developed since the mid-1960s by Ivan Sutherland and Bob Sproull).

44 Grau, *Virtuelle Kunst in Geschichte und Gegenwart,* 2001, p. 172. Translation by the author.

45 Ernst Michalski, *Die Bedeutung der ästhetischen Grenze für die Methode der Kunstgeschichte* (Berlin: Mann, 1996).

46 Ibid. p. 10.

by itself, by virtue of its own tendency, energy, and formal structure.[47] The unformed free space or *Realraum* includes the space of the viewer. The artwork can spill over into real space, for example in sculpture, by choosing a foot overlapping the base or a figure leaning out of the niche, such as in Gianlorenzo Bernini's figure of Gabriele Fonseca (San Lorenzo in Lucina, Rom, 1668–73). This kind of art form loses its autonomy in favor of its heteronomy. According to Michalski, one cannot speak of the "aesthetic limit" in view of architecture and arts and crafts, because they possess a reality that goes beyond the mere tangibility ("die reine Anschaubarkeit") of painting and sculpture.[48] With Bernhard Kerber, one could also think of Carl Andre's *Sculpture as Place*, which lacks a plinth and welcomes physical contact by walking on the sculpture, or of Franz Erhard Walther's performative and interactive textile sculptures.[49]

Here, in digital sculpture, one could argue that the aesthetic limit is significantly reduced in favor of its immersive character. Only eruptive image transitions and grainy resolution can disturb the spatial and pictorial illusion. Digital objects evoke different interactions in its virtual space, thus leaving pure viewability. In his analyses of early VR art works since the 1990s, Oliver Grau underlines the reduction of the aesthetic distance (*ästhetische Distanz*) and its increasing psychological, manipulative effect: "The more 'natural' the interfaces, the more pronounced not only the danger that the invisible part of the 'technological iceberg' remains closed and unconscious to its user, but above all the more intense the illusionary dissociation with the data space."[50] Or, as Derrick de Kerckhove puts it: "Through interactive media, the boundaries between what happens outside and inside our consciousness, outside and inside our body, become fluid, and soon we won't be completely sure where our body begins and where it ends."[51] In question is the border represented by our skin and the perception of digital art works, mediated by the appropriate (visual) apparatus, software, and interface. De Kerckhove has outlined touch as the essential sense of interactive media and each user's proprioception. His example is the scanning of the television screen (with the eyes) and the tactile features, such as the remote control and video recorder as historic precursors of VR. Due to multisensory responses, the whole body is addressed. According to, for instance, Gottfried Boehm, the sculptural space manifests itself tangibly on the surface of each work—the place of communication with the environment.[52] Johann Gottfried Herder's (1778) understanding of sculpture as bodily experience already indicates an increased sig-

47 Ibid., translation by the author.

48 Ibid.

49 Bernhard Kerber, "Nachwort zur Neuausgabe," in Michalski, *Die Bedeutung der ästhetischen Grenze*, 1996, pp. 287–302, pp. 295–96.

50 Grau, *Virtuelle Kunst in Geschichte und Gegenwart*, 2001, p. 183. Translation by the author. Here, he does not mention Ernst Michalski.

51 Derrick de Kerckhove, "Touch versus Vision: Ästhetik neuer Technologien," in *Die Aktualität des Ästhetischen*, ed. Wolfgang Welsch (Munich: Wilhelm Fink, 1993), pp. 137–68, p. 166.

52 Gottfried Boehm, "Plastik und plastischer Raum," in *Skulptur: Ausstellung in Münster*, vol. 1., ed. Klaus Bußmann and Kasper König (Münster: Landschaftsverband Westfalen-Lippe und Stadt Münster, 1977), pp. 23–44.

6 Banz & Bowinkel*, Palo Alto,* 2017–18, interactive virtual reality installation for HTC Vive.

nificance of plasticity in relation to the hitherto set-up hierarchies in the Paragone.[53] In the (optical) palpation of the surface, the recipients experience their own physical presence as subject and object at the same time. The binocular-stereoscopic, motion-sensitive, haptic, and corporal view also characterizes phenomenological concepts of the twentieth century. Thus, the nature of the surface—rough or polished—contributes to whether a sculpture opens or closes itself off to its surroundings. But in digital sculptures, the historically based separation and bipolar duality of the plastic-haptic and the optical-visual, as formulated by Hildebrandt and Herder, no longer applies.[54] It therefore makes a difference whether one takes an aesthetic-theoretical perspective or pursues a technical view that seeks to create mediating, cognitive, and affective interfaces.

Banz & Bowinkel's *Mercury* is only one example in which classical sculpture is used in the form of an art-historical quotation in the virtual realm. *Palo Alto* (2017) (fig. 6), another work of the artist duo, is determined by set pieces of reality, so-called *Realitätssplitter*, such as a virtual stonewall, which is juxtaposed to a blue concave-shaped mural element. Its color refers to the aesthetics of the blue screen and represents no architectural detail; rather, it annihilates a specific meaning and embodies the sitelessness or omnipresence of the internet. A general distinction must be made between the simulations of an aesthetic experience of

53 Johann Gottfried Herder, *Plastik: Einige Wahrnehmungen über Form und Gestalt aus Pygmalions Bildendem Traume,* in Herder, *Schriften zu Philosophie, Literatur, Kunst und Altertum 1774–1787*, ed. Jürgen Brummack and Martin Bollacher, vol. 4: *Johann Gottfried Herder, Werke in 10 Bänden* (Frankfurt am Main: Deutscher Klassiker Verlag, 1994), pp. 243–326.

54 Adolf von Hildebrand, *Das Problem der Form in der Bildenden Kunst* (Straßburg: Heitz & Mündel, 1910).

(a physically defined) reality and of walkable landscapes by means of a central perspective. One is reminded here of the ancient *agora*, or instead, fantastically designed spaces, including new virtual image worlds and orders without gravitational pressure.

One could ask to what extent these works reflect technological potential itself or whether they refer to an anachronistic concept of space and sculpture. Despite the dissociation between the almost non-existent movement of the viewer's body and the movement in cyberspace, the apparatus remains palpable; only the "visual aid" reveals the sculptural work. In the near future, features with haptic stimuli and collective experiences will become more developed. Nevertheless, our own knowledge and experiences of material properties, such as the stability and rigidity of marble (*Mercury*) or the rough surface of wood, still determine our perception of phenomena and sculptures in the virtual world and also determine how they affect us physically despite our consciousness of the digital illusion. This dynamic coupling of body and virtual space/image and the indiscernibility of perception and affection is an important aesthetic feature of VR.

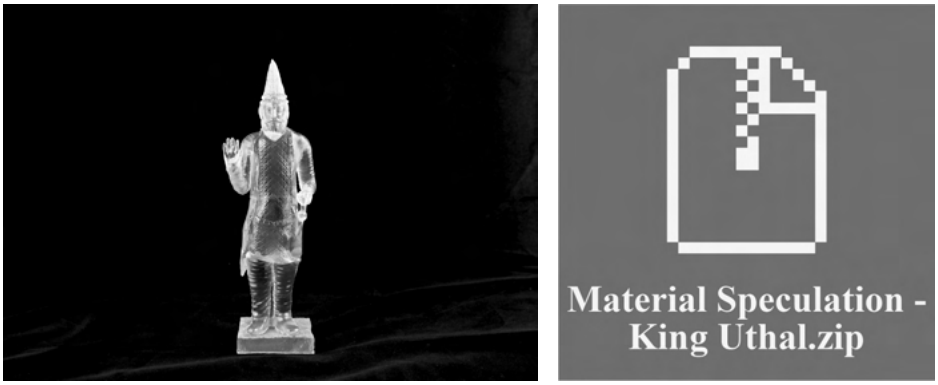
3D-Printing as Sculptural Tool: Morehshin Allahyari's *Material Speculation: ISIS* (2015–16) and *The 3D Additivist Manifesto* (2015)

Morehshin Allahyari is an Iranian, New York–based new media artist, activist, and writer. In her research-based series *Material Speculation: ISIS* (2015–16) she tried to reconstruct twelve of the artifacts at Mosul Museum in Iraq destroyed by ISIS members in front of the camera and spread worldwide in propaganda videos and press images (fig. 7). Thus, Allahyari created objects using digital modeling and 3D-printing. The Roman-period figure of *King Uthal* of Hatra, for example, is available for personal download.[55] Inside of the exhibited sculptures, Allahyari integrated a flash drive containing textual information, images, and videos about this endangered cultural heritage. Besides the lack of information, the problem of restricted access to relevant data due to commercial image policies was among the main challenges.

In her work, Allahyari explores the concept of "digital colonialism" and considers these reconstructed sculptures as "time capsules" trying to keep the memories for future societies.[56] She shows the technological and artistic potential of the restoration (and reimagination) of collective social, cultural memories within a meta-(speculative)-archeological intention. Her digital and printable simulated monuments raise questions about ethical, philosophical, and historical challenges when using automated means of investigation. Unlike "truth to materials," I would argue that these edition-like "digital monuments" interrogate established

55 See Paul Soulellis, "The Distributed Monument. New work from Morehshin Allahyari's 'Material Speculation' Series," *Rhizome,* February 16, 2016, https://rhizome.org/editorial/2016/feb/16/morehshin-allahyari/ (accessed January 5, 2022).

56 See http://www.morehshin.com/digital-colonialism-2016-2019/ (accessed January 5, 2022).



7 Morehshin Allahyari, *Material Speculation: ISIS*, *King Uthal*, 2015–16.

concepts of originality, site-specificity, and reproduction. Further, by allowing online data files (stereolithography CAD files, an early and widely used 3D-printing technology) to circulate, it loses its locality and "siteness."[57] The toppled artifacts seem to survive in their digital exile, originally printed in translucent plastic. Due to the translucent plastic, their ghost-like bodies seem to be determined by an absent materiality, evoking the visibility of the data file in the inner core of the figure. Here, 3D-processing and the posting and distributing of the files of the toppled artifacts represent a tool of artistic resistance, referring to the traditional sculptural aspect of *memoria*. Though in all likelihood it is mostly perceived by a Western public, the digital character of *King Uthal* at least allows for global perception when the corresponding infrastructures are available. What is demonstrated here is the fact that the destruction of the statues by ISIS itself generates "new" virtual statues in the form of Allahyari's an artistic response.[58]

3D-laser printing, with its simulation potential, plays a decisive role in digital sculpture: scanned three-dimensional images translated into binary codes, such as Allahyari's sculptural recreations of "digital statues" in miniature format, Karin Sander's sculptural full-body portraits, Tony Cragg's amorphous sculptures, and Matthew Angelo Harrison's 3D-printed African mask are translated back into physical facticity, into their sculpturality, in that they can be haptically experienced again when printed.[59] The location of the image is ubiquitously accessible with the appropriate apparatus, as Oliver Laric demonstrates with

57 See also the concept of nomadic monumentality as explored by Mara-Johanna Kölmel in this volume.

58 See also Ursula Ströbele, "Toppling Monuments—Media Strategies of Artistic Interventions (Alexandra Pirici, Morehshin Allahyari, Julius von Bismarck & Julian Charrière)," in *Toppling Things: The Visuality, Space and Affect of Monument Removal*, ed. Nausikaä El-Mecky and Tomas Macsotay, Brill, forthcoming.

59 See https://www.tony-cragg.com/works/sculptures/new-works/; https://www.kunsthallebasel.ch/exhibition/matthew_angelo_harrison/ (accessed May 3, 2022).

8 Morehshin Allahyari and Daniel Rourke, sound design by Andre Young, *The 3D Additivist Manifesto*, 2015, 10:11 min.

his downloadable data.[60] Reiner Maria Matysik, for his part, has been creating sculptural models of postevolutionary species since the mid-1990s.[61] His new monochrome models are 3D-printed. An included file allows reproduction of each creature. In some works, the viewer has access to an open-source data program and may change the form, thus advancing to a coauthor. These examples demonstrate the diversity of extended boundaries of tech-based sculpture in a systemic context and a relational field.

In cooperation with Daniel Rourke, Allahyari proclaims a new posthumanistic age in their film *The 3D Additivist Manifesto* (2015; 10:11 min) (fig. 8).[62] They use the 3D printer as a profound metaphor, as technology for channeling creative endeavor through digital processes. 3D-printing here embodies the primacy of creative, digital technologies, and also the simulation, synthesis, and the potentially utopian excess of algorithms that lead into a new material aesthetics of vibrant matter interfering with human organisms in a utopian way: "We call not for passive, dead technologies but rather for a gradual awakening of matter, the emergence, ultimately, of a new form of life."[63] Their manifesto is based on a

60 See https://threedscans.com (accessed May 3, 2022).
61 See https://reinermatysik.de/arbeitwork/sculpture-plastik/digital-sculpture-digitale-plastik/digitale-plastik-2/ (accessed January 7, 2022).
62 The video can be watched here: https://additivism.org/manifesto (accessed January 5, 2022).
63 See https://additivism.org/manifesto (accessed January 5, 2022).

text collage of quotations by futurists and theorists such as Donna Haraway, Rosi Braidotti, George Bataille, and Stanislaw Lem. It aims for a cybernetic interconnection of machine and human body. In the film one might find sculptural quotations and thus a significant reconnection to the history of classical sculpture, such as Marcel Duchamp's iconic ready-made *Fountain* (1917), which is representative of modern notions of art and authorship or the Hellenistic torso of the *Venus de Milo* (end of 2nd century BC), a symbol of figurative sculpture's traditional aesthetics. Departing from linear concepts in history, here, digitalized sculptural objects, industrial artifacts, technological residues, cyber bodies, and animalistic details, such as the octopus, coexist synchronously. They all float in the stream of oil, out of which they have been printed. This key material, thousands of years old, allows for innovative technologies, such as 3D-printing. Thus, the process itself refers to deep time processes. "#Additivism" is derived from "additive" and "activism" and, according to the artists, aims to disrupt existing categories, expanding the art project toward an online community, activism, ironic commentary, and revolutionary potential. Here, synthetic technology is the new modality of a biological posthuman medium, crediting intelligence to all kinds of matter.[64]

Conclusion

A number of theoretical approaches discuss the implications of the so-called "aesthetics of the digital," referring mainly to screen-based phenomena. Art history, however, pays little attention to sculptural works that are conceived and materialized using digital technologies. So, even if digital art has already its own history over a few decades, we still have to ask what terminology in art history corresponds to works, such as the above-mentioned examples. Their postmedium condition, infrastructural accessibility, and interactive features, and their various materialities, immateriality, or rather neomateriality, as well as Michalski's aesthetic limit and a form of elastic scalability, including real-time processes, are some of the main aspects that should be included in the discussion about the sculptural in the (post-) digital age.

Whereas Herbert W. Franke still uses the screen, which frames his virtual sculptures as a kind of digital canvas but already questions truth to materials, Jeffrey Shaw leaves this two-dimensionality of the display and opens his floating sculptures to the physical art space. In recent AR and VR works, the viewer is absorbed in an immersive experience with the interoceptive interiority of the body itself and travels—in the words of Wolfgang Welsch—similarly to a nomad between different forms of reality.[65] Digital sculptures, such as Banz & Bowinkel's *Mercury* and *Palo Alto*, are also characterized by spatiality, plasticity, multiperspectivity, and stasis versus temporality. However, they go beyond established sculptural parameters, questioning site-specificity and reproduction, losing their locality and "siteness."

64 Ibid.

65 Wolfgang Welsch, "Eine Doppelfigur der Gegenwart: Virtualisierung und Revalidierung," in Vattimo and Welsch, *Medien: Welten. Wirklichkeiten*, 1998, pp. 229–48, here p. 248. Translation by the author.

Computer-based 3D-printing and -scanning serve as a sculptural tool of growing interest, as well as a metaphor, such as displayed in Morehshin Allahyari's and Daniel Rourke's work. To create 3D-printed sculptures, complex translation processes take place. They operate while shifting between different forms of materiality and reality. A physical object is touched in a contactless way and scanned to allow its transfer from a digital file back to a haptic, physical object. As the examples here have demonstrated, the references to classical sculptures function as the conscious setting in relation to tradition and its discursive frame. Despite of the primacy of the visual, touch advances again to an essential sense of digital sculptures in interactive media. After all, the history of digital and virtual sculptures is a history of a media story that describes how modes of perception (still) change.

Verena Kuni

(IM)MATERIALS—(IM)MATERIALITIES—(IM)MATERIALIZATIONS

Some Thoughts on the Analogital Condition(s) of the Sculptural

Abstract

This essay explores contemporary conditions of the sculptural with a special focus on the relationship, the tensions, and the transformations of and between both analog and digital material(itie)s and media. It proposes to capture these conditions with the overarching term and concept "analogital." After a more general introduction and discussion of both key terms and concepts (analogital, sculptural), a third and likewise dynamic term and concept is introduced with "(im)materials," inspired by Jean-François Lyotard's considerations of "the immaterials" (Les immateriaux, 1985). To further explore the analogital conditions of the sculptural, a special focus is set on the dynamics of (im)materializations and on the multiple relationships and entanglements between digital and material features and qualities of concepts, tools, working processes and results, addresses and (re)presentations, and selected examples of artists' projects from the mid-1990s to present are discussed. Finally, further research avenues for the analogital conditions of the scuptural in the expanded field of (im)materials, (im)materialities, and (im)materializations are proposed.

Key Words

Analogital, digitality, materiality, sculptural, (im)material

This essay aims to explore contemporary conditions of the sculptural with a special focus on the relationship, the tensions, and the transformations of and between both analog and digital material(itie)s and media—in brief: with a focus on the analogital.[1] While I will further

1 It should be mentioned that rather than simply proposing "analogital" as an alternative term for what others call "post-digital," my focus is on concepts and practices for which I would consider the former term as a more precise denomination (although I would also admit that for these very reasons it also helps me to nail down my opinion on our topic much better than a term that is as widely and divergently used as post-digital, not to mention my chronic hesitations about the prefix "post-"; see Verena Kuni, "Was postdigital war," in *War postdigital besser?*, ed. Martin Conrads and Franziska Morlock [Berlin: Revolver, 2014], unpaginated). For a more detailed discussion of the term "post-digital," as well as of the related concepts and research, see the introduction to this volume by Ursula Ströbele and

expand on the term and the concept in more detail in the next section, let me start with some more general remarks on my approach. I am deeply convinced of the inextricable entanglement of media and matter, the very basis of our material and media cultures. For this very reason I also consider it important to delve deeper into the structures and the effects of these relationships, in order to better understand them in more detail. And I think it is a great fortune that there are artists who already have done and are doing a lot of promising work in this area—so it makes sense to do our research not only *on* art, but also *with* art as a companion, providing concepts, methods, and insights itself (and if I did not know about the ongoing debates and neoliberal appropriations of the phrase "artistic research" that make it critical to mention it without stressing further arguments and debates around it, I would rightly call it by its name).

Regarding the subject of this essay, this is probably especially true for what has been called "net art" or "net.art," an art form, or perhaps more precisely: an approach characterized by a considerably high degree of critical "self-", media and context reflection—and, very soon, also by a keen awareness of its very own instability and evanescence. I would claim both aspects as good reasons for developing a certain affinity for materializations, and also for the analogital. But actually, the latter was out there anyway, with sometimes fictive, sometimes very real extensions of projects genuinely conceived for digital media into object matter. To mention but a few: Olia Lialina's *My Boyfriend Came Back from the War* (1996),[2] Vuk Cosic's *classics of net.art* (1997),[3] Eva Wohlgemuth's *EvaSys* and *BodyScan* (1997),[4] and Blank & Jeron's *Dump Your Trash* (1998).[5] And from early onward there were projects explicitly putting the connectedness of digital networks and analog spaces, digitality and materiality, on the agenda,[6] like Eva Grubinger's *Netzbikini* from 1995.[7]

In our everyday culture, transfers of material practices into the digital were already established early on anyway, ranging from screen icons (like a sheet of paper for text documents, scissors and eraser for digital procedures, an envelope and a post box for email)

Mara Kölmel, to whom I also owe great thanks for the inspiring exchange, their critical reading of this essay, and their valuable comments.

2 See http://www.teleportacia.org/war/ (accessed March 20, 2022).

3 See http://www.ljudmila.org/~vuk/books/ (accessed March 20, 2022).

4 The original project (at thing.at/bodyscan) is not online any longer; for basic information and impressions, see https://web.archive.org/web/19981206211538/http://thing.at/bodyscan/, http://www.medienkunstnetz.de/works/eva-sys/ and http://www.medienkunstnetz.de/works/body-scan/ (accessed March 20, 2022).

5 The original URL is defunct; for more information go to http://blankjeron.com/sero/dyt/ (accessed March 20, 2022).

6 Although perhaps needless to say, I would like to emphasize that, both as concepts and as conditions, digitality and materiality should neither be separated nor set into opposition, but rather be understood as deeply entangled in many ways. I should also mention that this more general perspective is—for that very reason—not aiming to buy into the debates around already historical understandings of "the digital" (see, e.g., Nicholas Negroponte, *Being Digital* [New York: Alfred A. Knopf, 1995]), but rather to widen the latter.

7 The original URL is defunct; for a reconstruction, see https://www.evagrubinger.com/netzbikini/ (accessed March 20, 2022).

to whole processes and applications (see e.g., procedures and filters in photo manipulation software). Partially inspired by these transfers, and also on the absurdity some of them would necessarily render visible literally at a glance (e.g., "the paperless office"), and for sure also partially pushed forward by the mentioned instability of digital media,[8] there came a whole wave of artistic reflections on contemporary media cultures and contributions to a media archaeology of the present, including material emulations of digital objects and practices—for example Aram Bartholl's paper cutouts of video game items, Stephanie Syuco's materializations of digital database images, the analog arcade games based on slide projection crafted by the Swiss artists and filmmakers collective Mobiles Kino, or a hacked knitting machine transforming credit card data into Pac-Man ghost patterns (Fabienne Blanc and Patrick Rüegg).[9]

I will also come back to some of these projects and/or artists later, but the main emphasis of the following section will be on a systematic perspective and on the possibility of applying the latter to analogital in-formation of contemporary art(ists) work(ing) *in* and *with* the third dimension. Starting with two sections dedicated to the fundamental terms and concepts of (the) ANALOGITAL and (the) SCULPTURAL, I will then proceed to the eponymous (IM)MATERIALS, (IM)MATERIALITIES, and (IM)MATERIALIZATIONS, discussing the latter by taking a closer look at selected projects, to finally end up with … well, probably an open end with open perspectives.

Analogital

In the first place, "analog" and "digital" are technical terms that describe different ways to measure the state of a system and its variations, of signal acquisition, and communication. While analog systems and signals are captured as continuous variations of physical quantities, in digital systems and signals this is done in discrete numbers.

However, both terms have meanwhile found their way into the languages of everyday culture, and into the arts (and thus into the disciplines concerned with the latter), and although the termini as such are obviously applicable to objects/systems and processes in

8 For me, this instability has been a motivation for thinking about the (im)materiality and (im)materializations of net culture and of web-based art in the expanded field; see e.g., Verena Kuni, "Re-Enactments from RAM? On Working in the Ruins of a Virtual Museum and on Possible Futures of a History of Web Based Art," in *Image-Problem? Media Art and Performance Within the Current Picture/Image-Discussion*, ed. Dawn Leach and Slavko Kacunko (Berlin: logos, 2007), pp. 113–29; "Why I Never Became A Net Art Historian," in *Net Pioneers 1.0. Contextualizing Early Net-Based Art*, ed. Dieter Daniels and Gunther Reisinger (Berlin: Sternberg Press, 2009), pp. 181–97.

9 For a more detailed discussion of these examples, see below (Bartholl, Syjuco) and Verena Kuni: "Wenn aus Daten wieder Dinge werden – From Analog To Digital And Back Again?" in *Die Sprache der Dinge: Kulturwissenschaftliche Perspektiven auf die materielle Kultur*, ed. Elisabeth Tietmeyer, Claudia Hirschberger, Karoline Noack, and Jane Redlin (Münster: Waxmann, 2010), pp. 185–93; Verena Kuni, "(F) ANALOGITAL," in *Post-digital Culture*, ed. Daniel Kulle, Cornelia Lund, Oliver Schmidt, and David Ziegenhagen (Hamburg: University of Hamburg, 2015), http://post-digital-culture.org/kuni/ (accessed March 20, 2022).

these areas, they have also been charged up (ah, another tech metaphor!) with a broader spectrum of meanings. In consequence, "analog" is often used for (almost) everything "outside the computer," and "digital" for (almost) everything "inside the computer" and made accessible by computers (and what is nowadays called "digital devices"). So, what is probably true for signal processing is obviously wrong when absorbed in a generalized and generalizing perspective on the processes and systems involved.[10] Yet, while the generalization is problematic, as it renders important parts and agencies of processes and systems invisible, it can nevertheless make sense to discern analog and digital features and qualities, including the consequences these bring about for and within past, present, and probably also future entanglements of technology and culture.[11]

From this background, the term "analogital" points us to these entanglements, and to the broad, diverse, and variable spectrum of transfers and transformations between analog and digital features, systems, processes, functions, and agencies we may encounter here.

These can be transfers and transformations of analog features, systems, processes, functions, and agencies into digital ones—and/or also the other way round: transfers and transformations of digital features, systems, processes, functions, and agencies into analog ones. Moreover, just as our analog past has paved the way for digital technologies and culture, dealing with and experiencing digital technologies and digital culture also changes the way we are dealing with and experiencing analog technologies and culture—thus, in a broader perspective, we might even say we are living in an analogital culture, featuring not only the analog and the digital, but, together with the transfers and transformations in both directions, also a spectrum of hybridizations, some of which are probably even decisive for both the present and for future developments of our (techno-)natureculture.[12] After all, what has been changing and is changing are the questions we are asking, and the tools, methods, and strategies we can use whenever we do our research.

Now, before asking to what extent this is relevant for contemporary approaches to and understandings of sculpture and the sculptural, we should of course take a closer look at these terms as well.

10 This applies both to the tech itself (see e.g., analog computers and computing, hardware, etc.) and—even more so—to the technical and socio-technical systems in which computers are integrated.

11 Still recommendable for both the basics as well as for further considerations of this are the contributions in Jens Schröter and Alexander Böhnke (Zons), eds., *Analog/Digital – Opposition oder Kontinuum? Zur Theorie und Geschichte einer Unterscheidung* (Bielefeld: transcript, 2004); digital open access edition (2015): https://doi.org/10.14361/9783839402542 (accessed March 20, 2022).

12 Here, I am not only thinking of Donna Haraway's fundamental contributions, but, with regard to the analogital, also of the above-mentioned processes of becoming (becoming object, subject, actor, matter, etc.) that also may include both metaphorizations and thingifications of metaphors; on the latter see, e.g., Sue Thomas, *Technobiophilia: Nature and Cyberspace* (New York: Bloomsbury, 2013).

Sculptural

In art history there is a long and ongoing debate concerned with the definition of sculpture, and in order to not break the mold, we should probably waive any attempt to recap it here. However, it will nevertheless be important to at least mention some of the aspects relevant for our more specific issues—and this will probably prove to be complex enough in consequence.[13]

While the term "sculpture" in English (just as *Skulptur* in German) can be applied to singular pieces of work as well as to a genre, "sculptural" almost immediately points us to features and qualities related either to the former and/or the latter.[14] Some classic definitions of "sculptural" as a quality resulting from the application of related techniques to matter will make an important difference compared to other techniques of plastic arts: in sculpture, matter is carved away rather than added. According to this definition, just as we can discern "sculpting" from "plasticizing" and other additive techniques, like "molding," "modeling" or "mounting," we could theoretically state that casts, ceramics, and/or assemblages should not be called "sculptures." But are they lacking sculptural qualities? Obviously, this humble question can already tell us we are delving into a complicated subject matter.

Now, if our next steps lead us into the realms of the digital, of digital media and digital technologies, our classical definition based on techniques rather than resulting qualities makes even less sense: whoever "pushes pixels" or, to switch from the metaphor to the application, uses programs to create visualizations that our human eye identifies with three-dimensional objects is creating simulations of the latter.[15] While in the process of creation lines of code are added somewhere and/or numbers are filled into spaces, on the layer of the code this visualization-simulation is not based upon addition and/or subtraction of any substance (and for sure not of something like "pixels"). On the level of visualization,

13 With regard to these, for more general perspectives on the relations between "sculpture" and "media"/"digital media," still recommendable are the contributions of, among others, the editors in Gundolf Winter, Jens Schröter, and Christian Spies, ed., *Skulptur – zwischen Realität und Virtualität* (Munich: Wilhelm Fink, 2006).

14 For a more detailed and concise discussion of core dimensions of the sculptural (some of which will be addressed in this essay only later), see Martina Dobbe and Ursula Ströbele, "Gegenstand: Skulptur," in *Gegenstand: Skulptur*, ed. Martina Dobbe and Ursula Ströbele (Paderborn: Wilhelm Fink, 2020), pp. 1–16.

15 In technical terms, so this is to be taken literally—while at the same time it is important to keep in mind that simulations, including digital ones, do not "reproduce" existing objects. Moreover, digital simulation is about providing certain dimensions, certain functions, and a "look" (as in "look and feel"); there is actually no need to match the latter with any analog object(s). That is, of course, one of the powers of digital objects (including objects discussed here as "sculptural").

however, it depends on the designs chosen for display.[16] Here, everything is literally a matter of interpretation.[17]

Thus, we might even come back to discerning processes of addition and/or subtraction, and to looking for sculptural qualities (if not "the sculptural"). And, as we will soon see, this is especially the case within the realms of the analogital as defined above, encompassing approaches from within analog as well as digital space(s), and thereby also leading to new processes, practices, and perspectives for (inter-)actions with and between objects and subjects in the third dimension.[18]

At the same time, we should not proceed too fast: obviously, it is relatively easy to imagine, for example, VR spaces with simulations of objects that look like a bronze cast, a ceramic or a carved stone. Likewise, we can identify Aram Bartholl's steel cutout signs from *Map* (2006–19)[19] as "sculptural" while calling Morehshin Allahyari's 3D-printed objects from a project like *Material Speculation: ISIS* (2015–16)[20] "plastic." But in both cases our categorization is limited to objects in the narrow sense, while the projects themselves are reaching much further, stressing dimensions and faculties of the analog, the digital, and the analogital. And, speaking of these very dimensions in the plural: What could be more exciting than taking a closer look at projects including objects and/or agents that are themselves in transformation and metamorphosis, as in the work of artists like Ed Atkins or Ian Cheng?[21]

Actually, it seems like all these projects acknowledge, cherish, and/or problematize past concepts of analog sculpture and the sculptural as defined in analog dimensions, to do the very same for and within digital dimensions at the same time. Moreover, the way(s) they are doing it point us toward the multiple and multifold entanglement of these dimensions within an analogital culture. While some of art history's standard categories and systems of

16 See, e.g., the different designs for desktop icons that—just to link even more directly to our overall subject matter—show different levels of figuration and of abstraction playing on a considerably broad scale of simulations between 2D and 3D in relation to the objects they are referring to.

17 In stating this, of course, I do not want to relativize the fundamental importance of techniques and technologies in any way; rather, it is about acknowledging not only the technological impregnation of culture, but also the cultural impregnation of technology. At the same time, whenever we communicate with machines, interpretation is at the core of our communication. On the basic level, computers "speak" in zeros and ones—and even this is already an interpretation of "offs" and "ons." Thus, even coding is based on interpretation.

18 For a detailed discussion of the latter, with focus on a different, yet related subject, see Jens Schröter, *3D: Zur Geschichte, Theorie und Medienästhetik des technisch-transplanen Bildes* (Munich: Wilhelm Fink, 2009.

19 See https://arambartholl.com/map/ (accessed March 20, 2022).

20 See https://morehshin.com/material-speculation-isis/ (accessed March 20, 2022). For a more detailed discussion see Ursula Ströbele's essay in this volume.

21 For good reasons, this essay has to keep the focus on the sculptural; however, a discussion of analogital objects and/as agents (including together with metamorphosis also analogital animation and animism) should include these two artists; see related work documented and discussed in publications like Thomas Trummer and Kunsthaus Bregenz, eds., *Ed Aktins*, exh. cat. Kunsthaus Bregenz (Cologne: Walther König, 2020); Joseph Constable, Rebecca Lewin, and Veronica So, eds., *Ian Cheng: Emissaries Guide To Worlding,* exh. cat. Serpentine Galleries, London (Cologne: Walther König, 2018), and on Ian Cheng's website, http://iancheng.com (accessed March 20, 2022).

classifications are losing grip, others, like material(ity) and technique/technology, remain important. That is what I want to claim at least, and what I hope to illuminate in more detail in the following sections, starting with some thoughts on (im)materials and *(Les) immatériaux*.

(IM)MATERIALS and *LES IMMATÉRIAUX*

Now, while standard dictionaries will have entries of "material," of "immaterial" (the latter not only as the counterpart of matter, but also signalizing insignificance), and of "materials" (in the plural), there is obviously no such entry for "immaterials," as if immateriality, as a concept, should remain one, almost literally a singularity. Indeed, "immaterials" is first of all a translation of the French *immatériaux*. However, in case you try to spot the latter in a French dictionary, you will soon find out that just like in English, there are *matériaux* and there is *l'immatériel*, but no such "things" like *immatériaux*. *(Les) immatériaux* is a neologism created by the French philosopher Jean-François Lyotard, who, in 1985, together with the curator and design scholar Thierry Chaput, made an eponymous exhibition for the Centre Pompidou in Paris.

It would certainly break the mold to go into more detail on the show itself, characterized by John Rajchman as "the creation of a kind of 'environment' for the enactment of ideas."[22] Yet, it should be mentioned that it is probably no coincidence but exactly for reasons rooted in its highly conceptual, systematic approach that both the project and its accompanying publications have gained renewed attention from art history and media studies in general, and especially among those concerned with the very issues associated with what is often captured by the term "post-digital,"[23] or, as I'd prefer to put it, the "analogital."[24]

Indeed, the core questions posed by the project were about the relations between and entanglements of technological, epistemic, social, and aesthetic transformations unleashed and brought forward by digital media and technologies, as well as the conditions and consequences of these transformations—transformations we not only experience or encounter as something "brought to us," but that we are actively designing, creating, and pushing forward whenever we engage with media and/as matter.

22 John Rajchman, "Les Immatériaux or How to Construct the History of Exhibitions," in *Tate Papers*, no. 12 (2009), https://www.tate.org.uk/research/publications/tate-papers/12/les-immateriaux-or-how-to-construct--the-history-of-exhibitions (accessed May 5, 2021).

23 See above, and, as already mentioned there, for a more detailed discussion of the term, the concept, and its aspects, also the editor's introduction as well as the other contributions to this volume.

24 For both a more general approach and further research, see the collection of resources as well as the valuable contributions provided by Andreas Broeckmann and his *Immatériaux Research Project*, https://les-immateriaux.net/ (accessed March 20, 2022); for a direct link to post-digital and analogital perspectives, see the exhibition *Zum Beispiel Les Immatériaux*, Kunstverein für die Rheinlande und Westfalen, Düsseldorf, April 5–August 10, 2014; the former Kunstvereins director and co-curator of the show, Hans-Jürgen Hafner, provides a PDF of the exhibition brochure in his online archive, https://www.hjhafner.de/archiv.html (accessed March 20, 2022).

In a "communication diagram" conceived by Lyotard and distributed in the so called *Petit journal*[25]—actually a kind of exhibition guide—we find a map-like model that is built from terms (and concepts, respectively) all starting with an "m," and based on an amalgamation of then already classic communication models by Harold Lasswell, Claude Shannon, and Norbert Wiener that was, as Anthony Hudek appropriately put it, "hardly rigorous," but rather "an epistemological short-circuit between heterogeneous discourses—the one poetic, the other scientific"[26]:

> "N'importe quelle réalité est prise comme un message. A partir de la racine 'mât' on dit :
> le matériau est le supporte de message
> la matrice est le code du message
> la matière du message est son référent (ce dont il est question, comme dans 'table de matière')
> la maternité désigne la fonction du destinateur du message."[27]

However, even more telling than Lyotard's prominently printed comment is the diagram itself. The core element is the message, *message* originating from *matérnité* (maternity), neatly embedded in *matériau* (materials), surrounded by *matrice* (matrix) below and *matière* (matter) above the message-within-the-materials-complex, and finally followed by *materiel* (a material in singular, and, probably even more important, the related qualities), the material basis for the storage of the process.[28] Thus, we find all elements of this communication concept deeply rooted in different aspects of matter, material, and materialization, and therefore the whole concept considerably far from rendering communication as something immaterial or dematerialized. If considered from this perspective, the exhibition title, *Les immatériaux*, is rather to be read with a pause, *(Les) im-matériaux*, hinting us toward both the intended and unintended disappearance of matter(s) and materialities in communication processes—and it seems all the more logical that the exhibition itself was built upon objects. It was indeed in the tension between concept(s) and object(s), academic theories and everyday practices, the latter both continuously dealing with re-/de-mediation(s)[29] and

25 See *Les immatériaux: Petit journal* (Paris: Editions du Centre Georges Pompidou, 1985). The diagram is on p. 2 of the *Petit journal*, and only there, as it is not included in the main publication, the exhibition catalogue (2 vols.).

26 Anthony Hudek, "From Over- to Sub-Exposure: The Anamnesis of Les Immatériaux," in *Tate Papers*, no. 12 (2009), https://www.tate.org.uk/research/tate-papers/12/from-over-to-sub-exposure-the-anamnesis-of-les-immateriaux (accessed May 5, 2021); revised version in *30 Years after Les Immatériaux: Art, Science & Theory*, ed. Yuk Hui and Andreas Broeckmann (Lüneburg: Meson Press, 2015); digital open access edition: https://meson.press/books/30-years-after-les-immateriaux/ (accessed March 20, 2022), pp. 71–91, here pp. 74–75.

27 Jean-François Lyotard, "Avant-propos," in *Petit journal*, 1985, p. 2.

28 Translation by the author; Hui and Broeckmann provide a different translation than mine, see Yuk Hui and Andreas Broeckmann, "Introduction," in Hui and Broeckmann, 2015, pp. 9–24, here p. 11 (figure 1).

29 While I appreciate the concept of remediation developed by Bolter and Grusin—see Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge, MA: MIT Press, 1999)—and while its discussion especially in the context of memory studies can be of interest here, I would indeed

re-/de-materialization(s), and creating them, that makes *Les immatériaux* not only historically important, but also appealing for our present perspectives on the analogital in general, and on the analogital conditions of (the) sculptural.

If, how, and to what extent reflections of this dynamic mélange should directly draw from Lyotard's communication model may remain open, if not debatable. Now, as before, it seems a good choice to take up his considerations about the mutual interpenetration of media and matter, material and immaterial, with what the philosopher tried to capture with his (in)famous neologism *immatériaux*. We will probably find that these interpenetrations—rather than "the" media in general and/or "the" digital media respectively, as some would still suggest[30]—have indeed altered the relationship between human beings and material(s), and that this alteration is an ongoing process. However, as we do so, we should also ask if and how "immaterials," including those related to, processed, and/or produced by digital technologies (and thus with technologies that at least partially can be classed among this category as well), change our relationship with the sculptural and its (im)materialities. Moreover, we will certainly have to assume dynamic relationships, potentially between all elements, parts, and processes involved.

But what does that mean in concrete terms?

To answer this question, let us take another look at some of the projects mentioned above. The signs from Aram Bartholl's *Map* are monumental materializations of Google Map's iconic pins, placed at positions in urban space equivalent to those that the search engine marks as the center of a city. However, the transfer from digital to analog spaces, places, and practices is only one part of a whole that is more than its parts. Also, the aerial photographs capturing the installation process as well as the sculptures on site are of importance: the latter blur the border between imagination and image, digital and analog realities—due to their perspectives, they could almost pass as screenshots of Google Maps' photo mode. The former, however, work toward a disillusion and invite us to rethink the powerful entanglements between these realities.

Morehshin Allahyari's 3D-printed plastic models of artifacts from the Mosul Museum Baghdad that were destroyed by ISIS can be immediately recognized as objects related to and relating to the originals, both as placeholders and as (micro-)monuments.[31] The material qualities, almost all of the craft and workmanship invested in the original sculptures, have vanished; the raw surface of the printed models makes the loss even more visible and almost painfully tangible. At the same time, a good part of the reference and the memory has

also propose to take likewise the complementary concept of "demediation" into account; see the fundamental approach (on books transformed into artwork) taken by Garrett Stewart, "Bookwork as Demediation," in *Critical Inquiry* 36, no. 3 (2010): 410–57.

30 There are indeed good arguments to "blame" digital media for being a driving force of this process; however, I would nevertheless claim that the interpenetration is decisive for the dynamic mélange as such, and for the analogital culture resulting from it.

31 For more insights into a broader concept of monumentality, see Mara Kölmel's contribution to this volume.

become an (in)visible ingredient of the models. Embedded in the models are memory sticks that contain data gathered by Allahyari as part of her research, text and image documents about the destroyed artifacts: Storage devices as material containers for digital repositories that, due to their inaccessibility, are questioning their own status; subjective collections, fragmented and partial, unstable media and unstable matter(s), and above all also unapproachable—because they are accessible only at the price of destroying the models they are contained within. At the same time, they provide us with a considerably precise description of the cultural status quo of the destroyed sculptures, and they are also an appropriate answer to the machismo gesture of the demolition, documented on and staged for video, in advance of the world-wide circulation as digital images. Alas, another disillusion, and another invitation to rethink the relations and entanglement between material and media realities.

In both cases, however—this is for the signs as well as for the models—the interrelations and entanglements no longer allow a strict divide between analog and digital: as with the dynamics of the former, the latter are not only merging into each other; but it rather becomes clear that they have already merged. In both cases, it is decisive that the projects are unfolding under analogital conditions that are characteristic for our present.

(IM)MATERIALIZATIONS

After decades of making all kinds of efforts in transforming our calculating machines into digital multi-tools providing us with programs that can pass as lookalikes of their analog predecessors (e.g., digital text and image processing, digital cameras, emails, messaging, etc.) and/or hide in shells mimicking them, it is actually anything but surprising that materializations of digital media, applications, and objects have become matters of course.[32]

Art has trained this relatively early, starting with the desire to print computer graphics that otherwise would have remained on screen, although it should be pointed out that we find computer graphics and their materializations already in the time of analog computers.[33] Just like early plotter printing, artistic 3D-printing started as an experimental genre before the professional technology had been soaked into everyday culture, with artists like Karin Sander or Eva Wohlgemuth (the latter also a pioneer of net.art) as early adopters. But what is even more important is that quite generally both a materialization and a spatialization of digital objects, be it as/in imagination(s) and/or simulation(s), were present in computer-based art from early on. And, as pointed out in the introduction, mentioning only some of the more prominent works of that decade, we can likewise notice an increasing importance of related concepts and projects especially from the mid-1990s onward, together with an

32 See Kuni, "(F) ANALOGITAL," 2015.

33 See e.g., as a prominent example, the work of Frieder Nake, such as Frieder Nake, *Ästhetik als Informationsverarbeitung* (Vienna: Springer, 1974).

increasing accessibility and popularization of digital art via personal computers and "the" internet.[34]

While debates about digital art often focus on digitalization as a dematerialization of material culture, we actually find many aspects of reverse processes that are not limited to digital reimaginations and reconstructions of material objects and their uses (e.g., the envelope symbol for emails, paper planes for sending them, a nostalgic tin mailbox for the digital inbox), but rather ask for the materiality of digital media. Actually, the popular prominence of digital metaverses from the time of early cyberpunk fiction up till today's business plans should anyway not obscure the fact that the majority of digital applications are directly connected to material realities in many ways, and that digital and analog handling, digitalization, and materialization work hand in hand: we scan documents to send them and print out documents we receive as digital files on paper; a CAD program does not make too much sense if it is not used to build something that materializes, for example a building or a car, which in turn are controlled by interacting with their digital simulations.

This points us to two aspects that we probably should keep in mind when further exploring analogital cultures: first, there is a strong connection between everyday uses of technology and their reflections both in the arts and in everyday culture. And second, probably for that very reason, while there is an immediate link between digital presents and analog pasts that enables and also reinforces a movement from analog to digital and back again, the latter turn of this movement is not necessarily and not only driven by nostalgia—although the longing to touch, to grasp, and to keep "things" seems to play a role.[35] Rather, it is again the intertwinement and entanglement of analog and digital technologies, objects, structures, and practices that matters. While materialization and memorizing, materiality and monumentality can be mutually interrelated, this is not mandatory; both memorizing and monumentality are not necessarily bound to material(s) and/or materialization. Likewise, the relations between analog and digital are not limited to the processes of de-/re-materializations, but are far more complex—and so when we want to understand them in detail, we will have to take a closer look at each case. And what is probably most important: these processes are not to be understood as "technical" or "technological" only, but within the social and cultural frameworks that have produced and brought forward the very technologies in use.[36]

34 Of course, the first wave of this process was in the 1980s; however, I'd suggest that just as it needed a popularization of personal computers for the move from command shells to desktop icons, it needed broader access to the internet, and to the World Wide Web, for developing the latter to a "user-friendly interface," and to a system that allowed the display of images and attractive multimedia content.

35 See for the nevertheless important aspect of nostalgia Dominik Schrey, *Analoge Nostalgie in der digitalen Medienkultur* (Berlin: Kulturverlag Kadmos, 2017); for a broader scope on the latter-mentioned aspects, Kuni, "Wenn aus Daten wieder Dinge werden," 2010, Kuni, "(F) ANALOGITAL," 2015, and Kuni, "Medien zu Monumenten, Daten zu Dingen," in *Medienrelationen: Von Film und Videokunst bis Internet*, ed. Cornelia Gockel and Susanne Witzgall (München: Kopaed, 2011), pp. 119–38.

36 Among the areas in which such transfers have been commonplace for a long time is, for example, needlework; see Verena Kuni, *Ha3k3ln + Str1ck3n für Geeks: Von gehäkelter Mathematik bis zum Strickmaschinen-Hack. Wissenswertes, Ideen & Inspirationen* (Cologne: O'Reilly, 2013).

Indeed, all artistic projects mentioned so far can be understood as reflections of the tension generated by the interrelations of analog and digital, and the (im)materializations taking place within this field—and they immediately point us to the considerably broad spectrum of cultural practices and frameworks that are to be found even within a certainly limited cultural geography. But what does this mean for our subject, sculpture? Obviously, it makes a difference whether it is about embodiment or about objectivity, mattering or matter, memory or representation, in the first instance, even in case in the next moment we might see these aspects intermingling again: our task is to disentangle the different strands, and to ask for the directions and purposes of their entanglements in order to proceed with finding answers to our questions. So let us try to do so for some of the projects mentioned above:

Dump Your Trash by (Joachim) Blank & (Karlheinz) Jeron (1998) is first of all a "classic of net.art" (to abuse the title of Cosic's project from 1997).[37] The landing page asks people to enter their email addresses as well as the URLs of their homepages (or another website if they don't have one); the data of the latter are used to generate a graphic simulation of a personalized epitaph that is then sent to the email address together with the invitation not only to take a look at the "DYT" page's gallery, where the digital epitaph can be contemplated together with the epitaph's of other homepages, but also to order the analog version of the epitaph carved in stone. Later, Blank & Jeron added a variation of this concept by engraving Alexei Shulgin's and Natalie Bookchin's *Introduction to net.art* (1994–99) into monumental marble slabs.[38] Both projects relate to the traditional format of the epitaph to point out that the lifetime of digital technologies, of objects created with and distributed by digital media, and in consequence also the memory of net.culture, is limited. To this end, the projects use materials and techniques, gestures and functions of the sculptural: the monumentalization of digital objects (in this case: html documents)—the marble epitaph is literally a materialized metaphor of both the process and its result—points us to the unsolved problems of unstable media, oscillating between ridiculous exaggeration and tragic sadness of an impossibility to save major parts of net-based cultural history from oblivion. The projects address core dimensions of the sculptural without leaving the surface logic and aesthetics that are characteristic for their digital roots.

The latter is indeed important, also generally for the approach taken here and thus not only applicable to Blank & Jeron's early contributions to the field. About a decade later Stephanie Syjuco takes digital images of objects found on popular platforms like eBay or Thingiverse as both the material and conceptual starting points for projects dealing with communities, markets, and cultures deeply informed by digital transformation. In her installation *Everything Must Go (Grey Market)* (2006), there are photographs of home electronics

37 See, again, http://blankjeron.com/sero/dyt/ and http://www.ljudmila.org/~vuk/books/ (accessed March 20, 2022).

38 See https://bookchin.net/projects/introduction-to-net-art/ and http://www.easylife.org/netart/ (accessed March 20, 2022).

like TVs, hi-fi systems or game consoles taken from rather dubious offers found on eBay and Craigslist; in *RAIDERS: International Booty, Bountiful Harvest (Selections from the Collection of the A____ A__ M_____)* (2011) there are photographs of pottery taken from a prominent Asian arts and antiquities museum's website and online database, a mode of representation that is often also an involuntary documentation of the inhomogeneous and sometimes also fragmentary provenance of the objects.[39] In both cases, the digital "found footage" photographs have been printed "lifesize" true to scale mounted on flat panels (in one case Styrofoam, in the other plywood) and installed on platforms (in one case pedestals, in the other wooden pallets). As a consequence, photographs of the installations could be mistaken for showing three-dimensional objects—wouldn't there be the pixelated surfaces, blurs, reflexes, and highlights unveiling the two-dimensional image sources. "Lifesize" turns out to be the result of a blow-up, an unforeseen and inadequate (re-)materialization that is, in the end, not even a (re-)materialization, but rather the demonstration of transformations that take place with(in) digital technologies, and the effects these have on material objects and the material world.

To finally cross another decade, and thereby also reach the epoch that saw the term "post(-)digital" finally enter our discourses about the transforming and transformed relations between analog and digital cultures (and art) on a broader front:[40] Katja Novitskova's installative work from the 2010s onward encompasses a whole range of three-dimensional elements and objects—and it is not by chance that her projects are almost always named whenever the term "post-digital" is connected to "art."[41] Indeed, her signature aesthetics from that decade are characterized by visual material drawn from the internet: gifs from digital folklore are meeting blown-up micro-, macro-, and telescope photography, 3D-printed into PETG or on aluminum dibond, and arranged like stage sets.[42] The combination and composition of familiar, but at the same time also strange transformed or mutant images generated from nonhuman and/or artificial source materials and technologies creates literally sur-real spheres that can become spaces for imagination and reflection.

Of course, this cannot be about direct comparisons between conceivably different projects and bodies of work. However, when it comes to our topic, and if we ask about

39 See https://www.stephaniesyjuco.com/projects/everything-must-go-grey-market and https://www.stephaniesyjuco.com/projects/raiders-international-booty-bountiful-harvest-selections-from-the-collection-of-the-a-a-m (accessed March 20, 2022).

40 Of course, the term as such has been traded much earlier and slowly entered into academic discourse from the 2000s onward; and already in 1998 there was an exhibition in San Francisco titled *Sub-techs: The New Post-Digital Sculpture* (at Lab Space, curated by Charles Gute, featuring, among others, Gebhard Sengmüller's *VinylVideo*—and thus a project perfectly fitting the broader framework of "analogital," although its labeling as "sculpture" should perhaps remain susceptible to debate, even when taking the now somewhat outdated concept and term "video sculpture" into account), see https://www.vinylvideo.com/ (accessed March 20, 2022). However, the bigger wave of debates, initiatives, and publications came after 2010.

41 See https://www.katjanovi.net/ (accessed March 20, 2022).

42 See, e.g., Novitskova's series *Pattern of Activation* (since 2014), https://www.katjanovi.net/patternofactivation.html (accessed March 20, 2022).

the analogital condition(s) of the sculptural specifically, then it can be noted that all these projects are (re-)calling core qualities of the latter and at the same time negating them, for example by simulating a view from all angles (*Allansichtigkeit*) in three dimensions, and at the same time disappointing related expectations, as we are thrown back to their "deep surfaces."[43] They literally materialize the impact of "the digital" on our perception, and together with the mattering of digital media they also demonstrate their materiality, a materiality of becoming, and one that has always been there, and that has always been "real." Gestures quite similar to those already found in Aram Bartholl's *Map*, and at the same time quite different in each case, as each project is about different functions and operations of digital images and their referents or references in analog space and its material(itie)s. And also gestures that can lead us back to Lyotard's "communication diagram," and to the more general perspectives of *Les Immatériaux* on the intertwinements and entanglements of technological, social, and aesthetic conditions (in)forming the analogital condition of the sculptural. Indeed, the transfers and transformations of digital matters are probably not the only option, but for sure not by chance a more prominent one to articulate (the) sculptural within (the) analogital logic. They can point us to the mutual in-formation of the (im)materials involved—a process that is both taking place in and mirrored by the interplay between planes and bodies, surfaces and spaces, material(itie)s and media.

PERSPECTIVES

In emphasizing that this is only one option for articulating these conditions, I deliberately acknowledge there are others—and also this one certainly deserves a more intense discussion than I was able to offer here. However, I'd still like to mention some of the aspects that I would have looked at more closely had the given framework allowed it.[44]

Among these would be MODELING, a track we could follow from the mid-nineties up till today, from projects by Eva Wohlgemuth (as already mentioned: *EvaSys* and *BodyScan*, 1997) and Karin Sander (*3D Body Scans*, since 1997)[45] to those of Morehshin Allahyari (e.g., her *Material Speculation: ISIS*, 2015–16, as already discussed above), Nora Al-Badri (e.g.,

43 Both literally (as plain code is used to create 3D spaces and objects) and with reference to the metaphor; for the latter and for an overview over the ongoing debate especially in cultural and comparative literary studies, see Hans Jürgen Balmes, Jörg Bong, and Helmut Mayer, eds., *Tiefe Oberflächen: Neue Rundschau* 113, no. 4 (2002); Timo Heimerdinger and Silke Meyer, eds., *Äußerungen: Die Oberfläche als Gegenstand und Perspektive der Europäischen Ethnologie* (Vienna: Selbstverlag des Vereins für Volkskunde, 2013); for an attempt to explore the metaphorology of digital surfaces, see also Verena Kuni, "Auf den Planken des Bateau Ivre durch die Phönix-Asteroiden: Der Surfer: Versuch über ein Mythologem," in Bernhard Balkenhol and Holger Kube Ventura, eds., *Surfing Systems: Die Gunst der 90er. Positionen zeitgenössischer Art*, exh. cat. Kasseler Kunstverein (Basel and Frankfurt: Stroemfeld, 1996), pp. 209–16.

44 Actually, these perspectives (and projects) shall be discussed in more detail in a book publication I am preparing on the subject matter of analogital culture and art that is still work in progress.

45 See https://www.karinsander.de/en/work/3d-bodyscan (accessed March 20, 2022).

The Other Nefertiti, 2015; *HOW AN AI IMAGINES A DINOSAUR*, 2017),[46] and Oliver Laric (e.g., *threedscans.com*, 2015, and *Photoplastik*, 2016),[47] to name but a few.[48]

And, of course, AUGMENTATION, drawing a bow from early VR (virtual reality) simulations to recent AR (augmented reality) projects, from Monika Fleischmann's and Wolfgang Strauss's *Home of the Brain* (1991–92) with its "philosophical sculptures"[49] over meanwhile likewise "classic" projects realized for Second Life (e.g., Eva and Franco Mattes's *Reenactments*, 2007–10, and *Synthetic Performances*, 2009–10),[50] up till the presentations of artists like Sabine Gross, Nasan Tur, or Neda Seedi in the framework of the *New Viewings* hosted by Barbara Thumm Gallery, Berlin;[51] from Jeffrey Shaw's *Golden Calf* (1994)[52] to the AR-sculpture projects by artists like Jeff Koons (*Augmented Reality Lenses for Balloon Dog (Yellow), Balloon Swan, Rabbit, Popeye & Play-Doh*, 2017)[53] or Brian Donnelly, aka KAWS (*Expanded Holiday* and *Holiday Space*, 2020).[54]

A section on MODELING would have offered to further explore not only the entanglements, common features, and differences of and between (the) sculptural, sculpture, and (the) plastic, but also the relations between body/embodiment and model/modeling, between becoming and abstraction, original and copy, prototype and depiction, idol and image, inviting us to find out if and how artists deal with classic categories under analogital conditions in new and unexpected ways. Or just to find out how differently 3D-printing can be used in contemporary art.

With a section on AUGMENTATION we might have returned to Lyotard as the most prominent philosopher of the "postmodern condition," and, together with Jean Baudrillard,

46 See https://www.nora-al-badri.de/works-index (accessed March 20, 2022).

47 See http://oliverlaric.com/, https://threedscans.com/, and http://oliverlaric.com/photoplastik.html (accessed March 20, 2022). For his exhibition of *Photoplastik*, Laric also conceived a book publication that encompasses the related perspectives of the media history laid out and discussed in more detail by Jens Schröter (Schröter, 2009); see *Oliver Laric: Photoplastik*, ed. Gudrun Ratzinger, exh. cat. Secession, Vienna (Berlin: Revolver, 2016).

48 For an in-depth discussion of digital (and post-digital) augmentations, see Mara Kölmel's dissertation, *Sculpture in the Augmented Sphere: Reflections at the Intersection of Corporeality, Plasticity and Monumentality* (Leuphana Universität, 2022), which I learned of only after having written this essay.

49 The VR simulation imagined four rooms dedicated to four prominent scholars in media theory: Vilém Flusser, Marvin Minsky, Paul Virilio, and Joseph Weizenbaum, each room furnished with virtual "sculptures" and floating quotes. See https://www.fleischmann-strauss.de/works-werke and http://www.medienkunstnetz.de/works/home-of-the-brain/ (accessed March 20, 2022).

50 See https://0100101110101101.org/reenactments/ and https://0100101110101101.org/synthetic-performances/ (accessed March 20, 2022).

51 See https://newviewings.de/ (accessed March 20, 2022).

52 See https://www.jeffreyshawcompendium.com/portfolio/golden-calf/; for a recent "remake," *Encompassing the Golden Calf* (2019), https://www.jeffreyshawcompendium.com/portfolio/encompassing-the-golden-calf/ (accessed March 20, 2022).

53 In cooperation with Snapchat; see http://www.jeffkoons.com/artwork/projects/snapchat-augmented-reality-world-lenses, and for Snapchat's AR project background, see https://ar.snap.com/ (accessed March 20, 2022).

54 In cooperation with Acute Art, a company specialized in AR projects by contemporary artists; see https://acuteart.com/ and https://acuteart.com/artist/kaws/ (accessed March 20, 2022).

probably one of the most prominent inspirations for media artists of the 1990s.[55] Perhaps we would have not only taken a closer look at the more recent developments, with whole exhibitions and even sculpture biennials based on AR technologies,[56] but also mused about whatever might have happened to Lyotard's distrust in meta-narratives in times like today with big companies creating these kinds of narratives with the help of digital technologies in order to furnish their versions of the metaverse—actually in ways considerably different from what critical writers like Neil Stephenson would have been thinking at that time. Finally, we would probably have returned to some of the "classics" of art history, finding that when it comes to the sculptural the most appropriate description of this perspective is to be found in Rosalind Krauss's "Sculpture in the Expanded Field."[57]

Moreover, in moving from the fringes of this expanded field to its very center, we probably would have been discussing two related, alternate (yet sometimes also combined) ways to and for work(ing) with(in) three dimensions: that of ASSEMBLAGE, in the very tradition of political collage and montage established in the decades of the late nineteenth to early twentieth centuries—as found in e.g., Addie Wagenknecht's *Liberator Vases* (2016) or in Matthew Plummer-Fernandez's *Every Mickey* (2017).[58] And of course, coming back to some of the musings of an earlier section of this essay, we could take a closer look at aspects, techniques, and technologies of the PLASTIC, leading to the sculptural without sculpting in a more narrow sense. Here, it could be especially fruitful to include, in allusion to and also in correlation to the *informe* (Rosalind Krauss after Georges Bataille),[59] an IN:FORME that by the way of its digital in-formation—of a digital fluidity, porosity, and malleability[60]—is opting for an analogital condition of the sculptural to be found not only in VR and AR projects, but also in material work and in the way(s) materials are being incorporated.

Last but not least, we should—also in a more general perspective—think about the aesthetics of today's *immatériaux*, the aesthetics of (IM)MATERIALS, (IM)MATERIALITIES, and (IM)MATERIALIZATIONS we find relevant for the analogital condition of the sculptural. These will probably inherit what we already know as digital aesthetics: morphing, torsions, glitches—and of course both give rise to surface aesthetics like glossiness, smoothness, shadings, and their diffractions; operations like copy, rotation, mirroring, shearing;

55 Jean-François Lyotard, *La Condition postmoderne: Rapport sur le savoir* (Paris: Ed. minuit, 1979), trans. Geoffrey Bennington and Brian Massumi, *The Postmodern Condition: A Report On Knowledge* (Minneapolis: University of Minnesota Press, 1984).

56 See, e.g., the AR Biennale, Düsseldorf, August 22, 2021–April 24, 2022, https://www.nrw-forum.de/ausstellungen/ar-biennale (accessed March 20, 2022).

57 See Rosalind Krauss, "Sculpture in the Expanded Field," *October*, no. 8 (1979): 30–44.

58 See https://www.placesiveneverbeen.com/works/liberator-vases and https://www.plummerfernandez.com/works/every-mickey/ (accessed March 20, 2022).

59 See Yves-Alain Bois and Rosalind Krauss, ed., *L'Informe: Mode d'emploi*, exh. cat. CNAC Centre Georges Pompidou (Paris, 1996); translated as *Formless: A User's Guide* (New York: Zone Books, 1997); and Rosalind Krauss, "*Informe* without Conclusion," *October*, no. 78 (1996): 89–105.

60 For an in-depth research on related aspects of digital information, see Mara Kölmel, *Sculpture in the Augmented Sphere* (forthcoming).

modularity and generative sequencing—all of the latter also already known to a (pre-)digital, mathematically informed art that can be easily traced back to earlier centuries and cultures. The former, however, can indeed not only point us back to the sensual qualities of the (pre-)digital *informe*, and thus (re-)connect more recent creations to the *longue durée* of what is probably one of the genuine qualities of the sculptural: the evocation of a desire to touch. It can also lead us to an important insight for understanding the contemporary: if, as Ursula Ströbele puts it, "in digital sculptures, the bipolar duality of the plastic-haptic and the optical-visual no longer applies,"[61] this is even more true for the analogital.

With regard to the ASSEMBLAGE, we may assume that together with the modeling the transformations and hybridizations of bodies and objects will play a major role. With regard to the PLASTIC and to the IN:FORME, it is probably not only the flowing and the fluid, the evanescent and volatile, but also the fluctuating versatility of IM:MATERIALS, (IM)MATERIALITIES and (IM)MATERIALIZATIONS that is important.[62]

In any case, however—and this is true for everything sculptural we find within the "expanded field," be it in its center or at its margins—it is within the tension of (IM)MATERIALS, (IM)MATERIALITIES, and (IM)MATERIALIZATIONS of the SCULPTURAL that the ANALOGITAL condition of our present becomes tangible and graspable here.

61 See Ursula Ströbele's essay in this volume.

62 See on the one hand, e.g., the work of artists like Pamela Rosenkranz, Karla Black, and Annika Yi for an analogital condition that is prone to an "immaterializing"/"immaterialization" (of) matter—and on the other, as already mentioned, for an analogital condition that is more inclined to materializing "immaterials," e.g., the work of artists like Ed Atkins and Ian Cheng.

Sasha Sobrino

Considering Skawennati's Celestial Trees

Sculpture Between the Virtual and the Physical

Abstract

Skawennati tackles themes of futurity, history, and change as both an urban Kanien'kehá:ha woman and a cyberpunk avatar in her multimedia art. She is well known for her work in virtual environments and as co-founder of Aboriginal Territories in Cyberspace (AbTeC), though her practice moves fluidly across the digital and physical divide.

This paper examines a collection of Skawennati's Celestial Tree sculptures—both virtual and physical—and explores how these works challenge traditional understanding of sculptural materiality and accessibility. Lead by Skawennati's avatar "xox," I traveled to AbTeC Island and beyond, engaging with these sculptures and the worlds in which they are installed. Considering art that has been created to be experienced exclusively in the virtual prompted conversations on embodiment and imaginative experience, further nuanced by Skawennati's practice of simultaneously creating in the physical realm. Furthermore, building within an immersive social virtual world introduces possibilities for community and viewer engagement unique to the post-digital period.

Key Words

Digital materiality, machinima, sculpture, Celestial Tree, accessibility, virtual environments

The membrane between the virtual and the physical is permeable, a truth that is overt when engaging with Skawennati's work. The artist tackles themes of futurity, history, and change as both an urban Kanien'kehá:ka woman and cyberpunk artist in her multimedia art. Born in Kahnawà:ke Mohawk Territory, Skawennati belongs to the Turtle clan and holds a BFA from Concordia University in Montreal, where she resides. Considered a forerunner in the field of new media arts, she is best known for the works she has created in virtual environments. However, her practice moves fluidly back and forth between the virtual and the physical, calling into question the relationship between materiality and sculpture.

For the purposes of this essay, Skawennati and I decided to take a closer look at several of her *Celestial Trees*. These works have had various iterations, appear in a number of the

artist's films, and have been installed in both virtual and physical exhibition spaces, displaying Skawennati's nuanced and complex use of digital materiality. Her work challenges notions of accessibility in digital environments and prompts a consideration of how the sculptural operates within the context of public art—both virtually and physically. By visiting the environments where these pieces are installed, I was confronted with the inherently participatory nature of digital art, as well as the sense of embodiment that is characteristic of so much of Skawennati's sculptural work.

Visiting AbTeC Island

I sign into my long-neglected Second Life account (in truth used solely for research purposes) and I see that my last visited coordinates have already populated the navigation bar. It is rare that I go anywhere other than AbTeC Island in this virtual world, so I press enter and hope for the best. Familiar gallery walls load around me. I'm here! But I can't move and I have no idea why. I see "xox," Skawennati's avatar, walking toward me. I struggle to walk backward, forward, jump up, fly—anything. No luck. My avatar looks like she's panicking. Or maybe it's just me panicking. It takes me a while to understand what's going on. I soon realize that I'm stuck *in* a wall. We both calm down and I direct my avatar to jump up, over and over again, until we're free. I'm off to a rocky start.

An avatar is a representative of the self in the virtual realm. This could be the stock character you choose to play in a video game, or the profile picture you use for your messaging application, or the preloaded emoji in your phone that you've personalized to look like you. In the case of Second Life, your avatar is a highly customizable (and usually humanoid) body that you use to navigate within the world. Not only does your avatar allow you to appear as you would like to be seen, it also performs the physical and emotional actions you direct it to. Xox is Skawennati in the virtual world. Her virtual body as she has constructed it, wearing a little black tutu and big clunky boots, is ultimately an extension of herself. Over time, xox has developed tangentially from Skawennati, growing into a separate character of sorts. Skawennati refers to her avatar interchangeably as "her" and as "I."[1] Xox, and the relationship Skawennati has with her, is present in much of the artist's work (fig. 1).

It's been a little under one year since I've last visited the island, longer still since I've updated the physical appearance or wardrobe of my avatar. She's still wearing the same outfit I dressed her in years ago. I spent hours combing through the free clothing available in the Second Life store, choosing a "Rocker Chick" skirt and a black leather jacket. I had also struggled to alter her physical appearance. Though I opted to customize her body to look like mine, I added a few enhancements; I changed, for instance, the color of her hair with a single click.

1 Sasha Sobrino, "Virtuosity and Virtuality: A Conversation with Skawennati," *Studio* 16, no. 2 (Fall/Winter 2021): 52.

1 Skawennati, *Dancing With Myself*, 2015. Diptych: machinimagraph and photograph.

"We're going to need to do something about your feet," says xox. My feet? I zoom out so I can get a full look at myself. My feet are sticking out from underneath the black combat boots I'm wearing. It looks as though I'm wearing them as some sort of ankle bracelets. "It happens all the time with new people," she comments. I am not familiar with digital environments and, unbeknownst to me, I had been loudly announcing that fact to everyone around me. How embarrassing. I'm reminded of my first few journeys into Second Life in 2014 when I was initially learning how to move around in the world. I had been an obvious

newcomer and I had received numerous mocking messages from people walking by. As Karyne Levy has described it, Second Life had entered a postapocalyptic, or postutopian, state by then, with the world seemingly reserved for an elite group of true inhabitants.[2] Years had passed and I was still a newbie. I make a mental note of xox's comment and decided to worry about "fixing my feet" later. We set off to look at a number of the sculptures installed on the island—specifically two of Skawennati's *Celestial Trees*.

AbTeC Island is the name of the space in Second Life owned and operated by Aboriginal Territories in Cyberspace (AbTeC), an Indigenously determined research-creation network co-founded and codirected by Skawennati and her partner, Jason Edward Lewis. Its mission is to encourage Indigenous presence in the web pages, online environments, video games, and virtual worlds that comprise cyberspace. One of their biggest projects is the *Skins Workshops* in Indigenous storytelling and digital media, through which they teach Indigenous Youth how to become producers, not just consumers, of digital media.[3] AbTeC Island, their headquarters in cyberspace, was established as a location where aspects of these workshops could take place, as well as a persistent site where Skawennati could build and film her machinimas.[4] Over the fourteen years of its existence, it has evolved to become a community hub of creation and engagement. It now includes two galleries, numerous sets from Skawennati's machinimas, and many nooks and crannies for visitors to explore. AbTeC also hosts the weekly *Activating AbTeC Island*, a scheduled time where members of the AbTeC team are inworld to greet the public as tour guides, educators, or simply as someone to hang with in Second Life.[5]

Second Life is above all else a social virtual world. Though the online platform is often classified as a massively multiplayer online role-playing game (MMORPG), there is nothing fundamentally game-like about it. There is no such thing as winning or losing. There are no levels to achieve, no bosses to beat, and no objectives to meet. One simply exists and makes of their second life what they wish—even being social is not a requirement. Activities in Second Life include, but are not limited to: customizing your avatar, building three-dimensional items with their in-world tools, shopping, attending concerts and exhibitions, visiting people, exploring hundreds of different environments, and having cybersex. This

2 Karyne Levy, "Second Life Has Devolved Into A Post-Apocalyptic Virtual World, And The Weirdest Thing Is How Many People Still Use It," *Business Insider*, August 1, 2014, http://www.businessinsider.com/second-life-today-2014-7?op=1 (accessed October 21, 2022).

3 AbTeC has run the Skins Workshops since 2006, sharing their unique curriculum, expertise, and experience with Indigenous youth on reserves and in urban centers. See https://indigenousfutures.net/workshops/ (accessed October 21, 2022).

4 Machinimas are films shot in virtual environments (machine + cinema). Machinimagraphs are images captured in virtual environments (machine + photograph).

5 Presently, members of the AbTeC team greet the general public every Wednesday from 1 : 30–3 : 30 p.m. EST. Visitors need a Second Life account. See https://indigenousfutures.net/other/activating-abtec-island/ (accessed October 21, 2022).

connection to what Helen Kennedy refers to as "offline contexts"[6] is what sets Second Life apart from other MMORPGs such as *World of Warcraft* or *Minecraft*.[7] While these fantastical open-world online games offer a certain degree of social interaction for their players, achievements and objectives remain fundamental to gameplay. They do not connect as directly to the actual world as Second Life.

Second Life does not fit the definition of a MMORPG in other crucial ways. It matches all six of Betsy Book's characteristics of a "social virtual world."[8] Some are obvious, such as that of shared space and the immediacy of a resident's actions. Most interesting is the quality of *persistence* as defined by Book, which references the world's ongoing existence regardless of whether individual users are logged in or not. This is a stark contrast to most virtual games, where the environment's existence is dependent on the presence of the gamer. Second Life exists whether the user is present or not. As is the case with the physical world, it never turns off.

When Second Life was launched in 2003 by Linden Research, Inc., there was one key element that differentiated it from other online platforms: users had the ability to construct and modify absolutely everything in the environment. In addition, Linden also permits users to own the intellectual property rights to anything they create. Using the tools that the Second Life platform provided, Skawennati could build the sets and characters for the stories she wanted to tell. She had found the medium that she had been seeking. Her movies made in virtual environments are known as machinimas.

It took some time for Skawennati to realize that AbTeC needed their own island. One of the challenges of creating in Second Life is directly connected to its unique persistence. When Skawennati and her team first learned how to build in the environment, they would do so in "sandboxes"—designated areas sprinkled around the virtual world (called the "grid") where people have full permission to build. When they would log out for the day, what they had built had to be either dismantled and packed up, or run the risk of being moved or deleted by another user (called a "resident").

To make matters more complicated, the sandboxes themselves were frequently moved or deleted. Often Skawennati and her team would return to the coordinates of a sandbox they had been using and find it disappeared. They would spend a significant part of their days searching for a new one to inhabit, and then even more time rebuilding. It was an impractical and frustrating way to work, an example of the difficulties and intrinsic limitations of working with a game engine as a medium.

So AbTeC purchased their own island in Second Life, in the educational institutional neighborhood of the grid. The irony of Indigenous folks using real money to purchase

6 Helen Kennedy, "Technobiography: Researching Lives, Online and Off," *Biography: An Interdisciplinary Quarterly* 26, no. 1 (Winter 2003): 120–39.

7 *Minecraft* surpassed 140 million active players in 2021 and *World of Warcraft* follows with just under 5 million subscribers.

8 Betsy Book, "Moving Beyond the Game: Social Virtual Worlds," *State of Play* 2, nos. 1–13 (2004).

virtual land is not lost on Skawennati.[9] While beginning to build in the virtual environment represented new possibilities for Skawennati's artistic practice and a shifting understanding of the sculptural in the context of the digital, it also sparked conversations on digital rights and ownership in relation to creating within a virtual territory.

Digital Materiality: The First Celestial Tree

Xox and I walk out to the central plaza. This is where people usually show up when they use the up-to-date coordinates for AbTeC Island. I see the *Celestial Tree*, which is the point, as it has been placed in this prominent spot on the island so that it greets all visitors. Lofty and towering, with a twisted trunk, the tree is massive. Brightly colored and illuminated blossoms are scattered throughout its long branches, and the whole thing glows with an iridescent light, an otherworldly quality (fig. 2).

One of the most significant sculptural installations on AbTeC Island, it is the same tree created for the machinima *She Falls for Ages* (2017) and the virtual installation *A Slice of Skyworld* (2021). Here on the island, it serves as a center for activity in the environment, perhaps a meeting place or a space to commune, as suggested by the benches that surround it.

Prior to the construction of this sculpture in the virtual, Skawennati sculpted a three-dimensional sketch of it out of Playdoh in the physical world. While Second Life often functions as a sketchbook and a staging area for the artist, many examples of the reverse can be found in her practice. Skawennati's practice flows freely back and forth between the two worlds, with single works often being created simultaneously in both.

At the dawn of the digital revolution in art, Timothy Binkley argued that when working with traditional materials, the long process of creation leaves little room to explore alternate ideas. The artist working in virtual environments, though, can have it all. With this limitless potential, the creative powers are enhanced, and the realization of a work can keep pace with an artist's imagination.[10] Theorists writing at this time saw the utopian qualities of the virtual in art and imagined the complete freedom that could come with these new materials.[11] To them, the virtual represented above all a release from the restraints of the physical.

However, physical materiality and traditional sculptural practices remain intertwined. Sculpture continues to be largely accepted and understood as consisting of three-dimensional, tactile objects. Though the understanding of the sculptural has expanded to encom-

9 Elizabeth LaPensée and Jason Edward Lewis, "Call it a Vision Quest: Machinima in a First Nations Context," in *Understanding Machinima: Essays on Filmmaking in Virtual Worlds* (New York: Bloomsbury Academic, 2013), pp. 187–206.

10 Timothy Binkley, "The Quickening of Galatea: Virtual Creation without Tools or Media," *Art Journal,* 49, no. 3 (1990): 236.

11 See Binkley (1990); Suzanne M. Marchese and Francis T. Marchese, "Digital Media and Ephemeralness: Art, Artist, and Viewer," *Leonardo* 28, no. 5 (1995): 433–35; Anna Ursyn, "Planks, Programs and Art: Computer Graphics as a Sculptural Tool," *Leonardo* 26, no. 1 (1993): 29–32, doi: https://doi.org/10.2307/1575776.

2 Activating AbTeC Island, 2018.

pass found objects and machine-built objects (3D-printing is an example of this), and contemporary artists are increasingly challenging the canonical tradition, physical materiality remains foundational. Is Skawennati sculpting when she creates work shown exclusively in the virtual world? If this is not sculpture, then what is it? If an object is built using a computer program rather than a tangible material, is it no longer a sculpture?

The notion that the virtual is an inherently immaterial space has itself been challenged. Johanna Drucker has argued that a binary has been falsely imposed on recent debates theorizing materiality as it relates to the digital, suggesting that the physical *matter* of the *real* has been placed in opposition to the virtual.[12] Furthermore, anything created within the virtual realm is done so using digital materials, which leaves traces as material as any object crafted in the physical. As Matthew Kirschenbaum has pointed out, discussions on digital materiality often omit any mention of this, as the use of electronic data is conventionally understood to be different than other forms of physical record.[13] Considering materiality, what does it mean to have a sculptural practice that exists apart from the physical? What is it called when I can walk through the gallery on AbTeC Island and move around a virtual sculptural installation? The virtual installations are not graphic art. I have to walk around

12 Johanna Drucker, "Entity to Event: From Literal, Mechanistic Materiality to Probabilistic Materiality," *Parallax* 15, no. 4 (2009): 7–17.

13 Matthew G. Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2012).

them. I can sit on them. I can fly over them. What defines them? Perhaps this is the fundamental question.

When describing the rapid evolution of digital media in art in the mid-1990s, Marchese and Marchese argued that "in the future, computer art will be elevated to the mainstream with other media assuming a craft status."[14] We are not in that predicted future yet, though Skawennati's work is an example of contemporary art that both challenges and disrupts existing understandings of traditional materiality. As our lives become increasingly intertwined in the virtual, a new understanding of sculptural material continues to emerge. With the growing dominance of the virtual, technologically derived mediums have grown in number.

Indeed, technological developments have been rapid in recent decades and remain ongoing. Therese Tierney argues that this, in conjunction with the trend of new theories of representations, has resulted in an unprecedented dematerialization of the art object and an ensuing ontological crisis.[15] When considering Skawennati's work, the ontological crisis described by Tierney is best placed in relation to the dilemma of materiality. To recognize the sculptural in the virtual is to shift one's understanding of sculptural materiality itself. Furthermore, to engage with this work is to affirm the art experience as nonmaterial.

I would argue that the digital materiality of Skawennati's practice, specifically the use of a virtual environment as a medium and the embodied qualities this affords for the viewer, contributes to the material permanence of her work. Moreover, I would argue that her work challenges both the equating of the digital with immateriality and the notion that virtual art contributes to an enduring dematerialization. Moreover, as Christiane Paul describes, the perceptive shift in the relation between virtuality and materiality has generated discourse on art that is created in digital spaces yet manifests in some capacity in the material realm.[16] While the terms "post-digital" and "New Aesthetic" art have been established in an effort to frame this new era of materiality, I am inclined to employ Paul's concept of "neomateriality"[17] when engaging with Skawennati's work. Not only does this concept address the ingrained confluence of digital materials present in the art, it also describes the viewer's relationship and engagement with the work as a function of this materiality.

Much of the built environment on AbTeC Island is sculptural material and sets from Skawennati's machinimas. Anyone familiar with her work will notice this immediately as they explore the island. You'll see Hunter's apartment from *Time Traveller*™ (2007–13),[18]

14 Suzanne M. Marchese and Francis T. Marchese, "Digital Media and Ephemeralness: Art, Artist, and Viewer," *Leonardo* 28, no. 5 (1995): 433–35.

15 Therese Tierney, "Formulating Abstraction: Conceptual Art and the Architectural Object," *Leonardo* 40, no. 1 (2007): 51–43.

16 Christiane Paul, "From Immateriality to Neomateriality: Art and the Conditions of Digital Materiality," in *Proceedings of the 21st International Symposium on Electronic Art* (2015), pp. 1–4.

17 "Neomateriality describes the embeddedness of the digital in the objects, images, and structures we encounter on a daily basis and the way we understand ourselves in relation to them." Ibid., p. 2.

18 For a list of episodes of *Time Traveler*, see https://www.timetravellertm.com/episodes/ (accessed October 21, 2022).

3 Skawennati, *Celestial Tree*, 2017. Machinimagraph from *She Falls for Ages.*

the Residency of the Guardian of the Celestial Tree from *She Falls for Ages* (2017),[19] and the spaceship from *The Peacemaker Returns* (2017).[20] The island serves as a space where all of these filmographic landscapes intersect. While it does grant viewers the opportunity to engage with her work in a different and nearly tangible way, the space also serves as an archive. This combination of offering the viewer an embodied experience of her art, while simultaneously collating an environmental or geographical record of it, illustrates Skawennati's mastery of digital mediums and her understanding of how viewers engage with them.

Skawennati has long imagined bringing one of her *Celestial Trees* out of the virtual realm and into the physical. The *Celestial Tree* installed in the center of AbTeC Island is the one that she always envisioned building as a three-dimensional sculpture.[21] Certain factors relating to materiality have impeded this. The size of the tree is crucial and intrinsic to the piece. It towers over the viewer in the space. To reduce its scale would be detrimental to its very concept. Considering this, physical materiality itself becomes an obstacle to constructing this piece in the real world. The larger *Celestial Tree* installed in the central courtyard of AbTeC Island, for instance, is granted aesthetic characteristics that would simply not be possible outside of the virtual. For example, the luminescence of its branches and foliage, the distinct shimmer, could very well be near-impossible to achieve using traditional materials (fig. 3).

I consider this juxtaposition of materiality as I guide my avatar around the *Celestial Tree*. We walk up close to the base of the trunk, and I tilt my head up to look at the branches.

19 Viewable at https://www.skawennati.com/SheFallsForAges/ (accessed October 21, 2022).
20 Viewable at https://vimeo.com/657110527 (accessed October 21, 2022).
21 Skawennati, personal interview, January 26, 2022.

Would I feel differently looking up at such a tree in the physical world? I'm not entirely certain. Some environmental factors are different: it's cold outside right now in the "real" world, and I'm pretty comfortable sitting inside the warmth of my apartment. The tree glows and glistens. I'm aware of its physical relationship to my avatar and I understand that I must move around it, that I am sharing space with it. How would my interaction be different if I encountered this sculpture out in the world somewhere? My avatar takes a few steps back from the tree and takes a good look before I get her to fly straight up into the air. I stop when we're high above the tree and looking down at its dazzling blossoms. Well, this is clearly a difference.

If a Tree Falls in the Virtual …

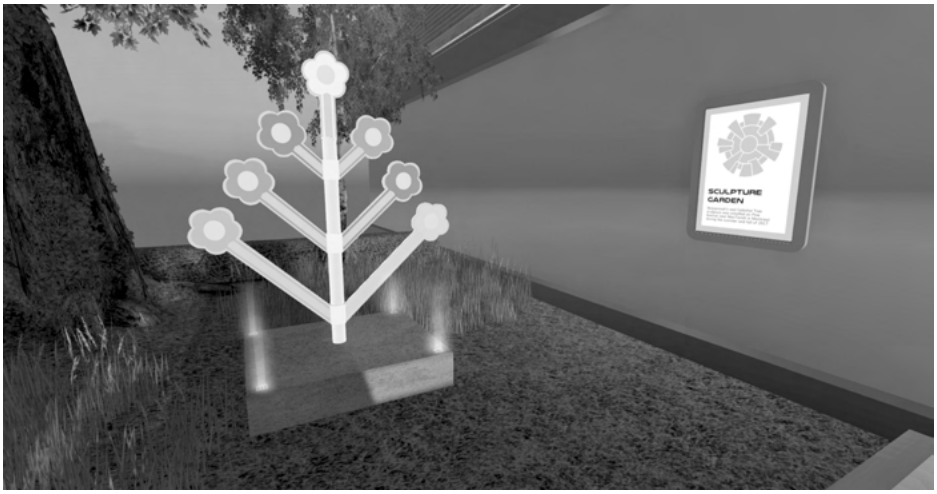
Xox wants to take me to see another *Celestial Tree* installed on the Island, but she can't quite remember where it has been moved to. I follow her lead as we fly above the landscape below, where she can get a bird's-eye view. We find it on a small patch of grass nestled between the far wall of AbTeC Gallery and the building that houses the costume gallery and photo studio.[22] Once standing on the ground next to the sculpture, I have a limited view of the rest of the island. Behind me is a great expanse of nothingness—the edge of the island. This *Celestial Tree* stands upright on a pedestal in the grass, a stark contrast to the few "natural" trees and bushes scattered nearby (fig. 4).

This sculpture is one that I have never noticed on the island before. It is much smaller than the one found in the central plaza and is aesthetically very different. It stands close in height to my avatar and is strikingly flat. It has six branches in total and a smooth white trunk with no indication of bark. At the tip of each branch there is a single brightly colored blossom. A distinct quality of this piece is its flatness. It has a pictorial, symbolic quality to it. Xox was particularly interested in showing me this sculpture, as it is an example of a work that was meant to exist exclusively in the digital and was never intended to be what it eventually grew into.

The tree looks flat because it was originally designed by Research Assistant Erica Perrault as the logo for the machinima *She Falls for Ages* (2017). Skawennati loved it so much that she felt the logo should be incorporated into the movie. And indeed, it can be found all throughout. Once you look for it in the film, you will see the motif worked into the furniture, the clothing, and even the characters themselves.[23] You'll notice it on the invitation to the party celebrating the 3,000th anniversary of the *Celestial Tree*, on the banners decorating the interior of the palatial residence of the Guardian of the *Celestial Tree*, and paved into the grounds. In the machinima, it is ultimately a two-dimensional graphic (fig. 5).

22 The costume gallery and the photo studio are in the base of the tall building that houses Hunter's apartment from *Time Traveller™* (2007–13). Hunter's apartment is accessible only by flight.

23 Viewable at https://www.skawennati.com/SheFallsForAges/ (accessed October 21, 2022).



4 The *Celestial Tree* installed in the Sculpture Garden on AbTeC Island.

5 The Celestial Tree logo from *She Falls for Ages*, 2017.

Soon after completing the machinima, Skawennati was commissioned to create a public art piece for the *Path of Resilience*, an outdoor exhibition mounted along the Promenade Fleuve-Montagne in Montreal, Canada, during the summer of 2017, the year of the city's 375th anniversary. Given the short deadline, the curator, Cheryl Sim, and Skawennati determined that the piece should be conceptually rooted in existing work. With the knowledge that this would be a public artwork, Skawennati decided that the *Celestial Tree* logo, with its message of sustainability, diversity, and peace, would be appropriate. This sculpture was installed in front of the Royal Victoria Hospital, located at the highest altitude of the Promenade Fleuve-Montagne.[24] The path and its installations are promoted as a destination for

24 Chloë Lalonde, "The Celestial Tree inspires visions of collective action," *The Concordian*, September 5, 2017, http://theconcordian.com/2017/09/the-celestial-tree-inspires-visions-of-collective-action/(accessed October 21, 2022).

6 Skawennati with her sculpture *The Celestial Tree* on the Promenade Fleuve-Montagne for the *Path of Resilience* exhibition in 2017.

art enthusiasts, and its public nature allows for pedestrians to happen upon the works and historical sites, greatly expanding the scope of the work's audience.

The materials used to construct the public art sculpture are explicitly industrial and were chosen to invoke the urban environment in which the piece was displayed. The trunk is made of a thick steel pole, the kind that would be used for a stop sign. Likewise, the branches and flowers are fabricated using the same aluminum and retro-reflective sheeting that standard road signs are made of. The tree features six large and colorful flowers at the tips of each of its branches. A monochromatic white flower adorns the tip of the trunk. Each of the six colors represent a skin tone used in *She Falls for Ages*, invoking a sense of unity and shared humanity (fig. 6).

Skawennati retained the aesthetic quality of the logo when building both the virtual and physical versions of this sculpture. Her choice to maintain the flat and graphic quality of the tree, even as it was moved to the physical world and constructed with three-dimensional materials, communicates the roots of the piece. Furthermore, it forces the viewer to engage with the interrelation of virtual and physical that exists in all of the artist's work. This particular tree exists across multiple environments and in multiple mediums.[25] Its various iterations and locations for installation challenge the understanding of how sculptural works can be viewed and experienced by a public audience (fig. 7).

25 The three-dimensional sculpture was purchased by the Peabody Essex Museum and is now in their collection, providing viewers with a different context in which to engage with the work.

7 Skawennati, *The Celestial Tree*, 2017. Steel, aluminum, and retro-reflective sheeting.

Unique to this particular piece is the fact that Skawennati moved this tree from the virtual to the physical (and back again). It's true that the metal tree sculpture is identical to the digital sculpture installed on the patch of grass on AbTeC Island that xox showed me, but it is not a replica of the virtual installation. The street sign *Celestial Tree* was the first of the two sculptures. The tree was built first as a physical sculpture based on a graphic design, and secondly as a digital sculpture based on the physical, and then lastly installed in a virtual world.

As with any traditional exhibition space, audiences choose to visit AbTeC Island to experience the work on display. With the public installation of the tree in a physical urban environment, a new audience was given an opportunity to engage with it. Was this installation actually more public—and therefore more accessible—than those exhibited in the virtual environments? One could argue that displaying sculptural work in a virtual environment allows an exponentially larger number of viewers to experience it and engage with it. However, discussions concerning the accessibility of digital exhibition spaces are ongoing, decidedly muddying the answer to that question.

Digital Sculpture and Accessibility

Since the fall of 2021, Skawennati's piece *A Slice of Skyworld* has been on display at New Art City,[26] a virtual art space. This digital exhibition platform exists solely in cyberspace and features a variety of virtual environmental installations by contemporary artists. *A Slice of Skyworld* is one of nine works currently on display. Visitors are invited to enter these virtual environments and explore the worlds within, using their keyboards to walk around. With only an internet connection and a device with which to connect, you can visit this gallery and engage with the exhibited art from anywhere in the world.

Once inside Skawennati's installation, you find yourself in a misty pink world. The floor is made of large white hexagonal tiles, giving the impression that you may be in a space somewhere between indoors and outdoors. It could be a circular courtyard of sorts. You are immediately drawn to the large Celestial Tree that sits in the center of the space, towering so high you have to look up to see the top. Colorful flowers bloom from its craggy branches, and it glows with an iridescent purple light (fig. 8).

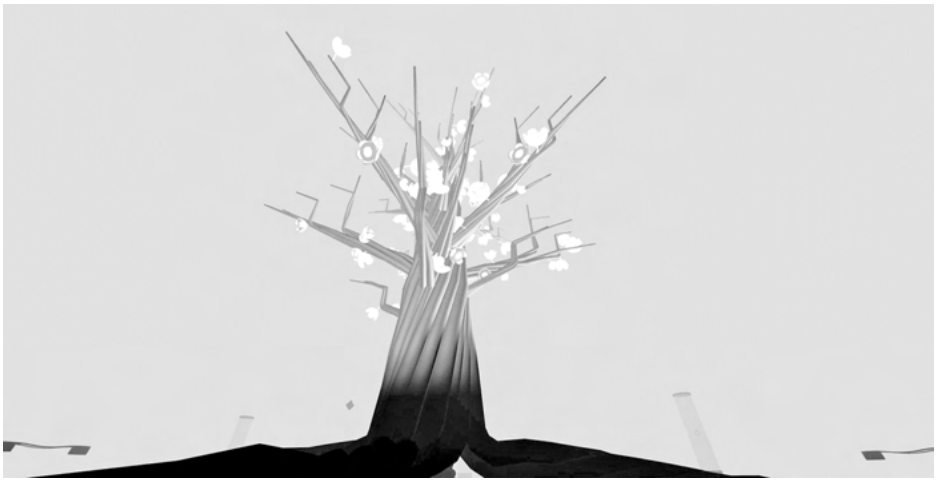
Lining the perimeter of the space is a series of alternating benches and tall cylinders. As you approach the cylinders, you recognize them as wide glass tubes, the kind you might see in a science-fiction movie, perhaps in a top-secret government lab holding a preserved alien specimen. Except instead of a humanoid creature suspended in formalin, there is a single flower from the tree floating in the tube and slowly spinning. The benches are also floating, casting light on the tiles where one might expect to see shadow.

Anyone who has travelled to AbTeC Island will recognize this sculpture. This is the same *Celestial Tree* that is installed in the central plaza. In fact, *A Slice of Skyworld* is a remix of one of the sets used in the machinima *She Falls for Ages* (2017). With this installation, Skawennati is again inviting her audience to engage with both the sculpture and the machinima in an entirely new way. Similar to what visitors of AbTeC Island might experience, or pedestrians strolling the Promenade Fleuve-Montagne, viewers have the opportunity to physically explore a part of the film rather than simply watching it on a screen.

When considering accessibility, the potential that creating and displaying art in virtual environments is also illustrated by AbTeC Island. This territory in cyberspace acts as a space for artistic practices and conversations—a virtual studio—as well as a gallery space in which viewers can interact with completed works. AbTeC Gallery opened on the island as a virtual exhibition space in 2020 and has mounted six group exhibitions to date.[27] With AbTeC's initiative *Activating AbTeC Island*, Skawennati and her team have further increased the accessibility of this world. By inviting the public into the territory, new possibilities for community-building and engagement have emerged.

26 "A Slice of Skyworld by Skawennati," https://newart.city/show/gaf2021-room-8, 2021 (accessed October 21, 2022).

27 "AbTeC Gallery," indigenousfutures.net, n.d., https://indigenousfutures.net/other/abtec-gallery/ (accessed October 21, 2022).



8 Skawennati, *A Slice of Skyworld*, 2021. Virtual installation.

The concerns of the late twentieth century regarding the inability to truly experience art through digital means have faded. We experience and engage with art in digital spaces constantly in our daily lives. These spaces have also become where we learn, work, play, and connect with others. Virtual environments like Second Life elevate this engagement. They facilitate immersive community spaces that exist in parallel with the "real" world. As is the case with all community spaces, virtual community spaces have the ability to shape collective memory.[28] When people visit AbTeC Island, they are not just looking at art and exploring the built environment. They are interacting, speaking, learning, and sometimes even creating. This experience requires real engagement and participation from the viewer, and it is often communal in nature. Recognizing the power and possibility in the virtual environment is central to much of Skawennati's work. Indeed, her oeuvre is not composed of just sculptures and machinimas, but also the very environments in which these works are created, and the inclusion of the viewer within them.

New media art exclusively available to be viewed on the internet is growing in popularity, and the replacement of the physical gallery by the computer screen is radical. It not only threatens the hegemonic qualities of the "white cube" space, an often intimidating and exclusive space, but also calls into question the supremacy of traditional materiality itself. In this way, virtual exhibitions challenge understandings of the accessibility of contemporary art. In point of fact, the practice of art being displayed exclusively in the virtual has increased significantly throughout the current global pandemic, emphasizing the accessible nature of

28 Analays Alvarez Hernandez, "The Life and Death of the Monument in the Era of Social Networks: New Communities of Memory," *RACAR: Revue d'art Canadienne / Canadian Art Review* 46, no. 2 (2021): 75–84.

the medium. Quite simply, online exhibitions enable audiences to access and interact with art from any physical location. Creating work that is accessible on an individual level from a comfortable space actively increased viewer engagement. Viewing is an act in and of itself, facilitating a transformation of meaning and understanding within both the artwork and its spectator.[29]

Though the rise of the virtual exhibition space has contributed to the increased openness of these institutional environments, familiar concerns surrounding the accessibility of museums and art galleries in general have carried from the physical world to the digital. As Theopisti Stylianou-Lambert and Elena Stylianou argue with regard to the virtual art museum, accessibility measured by the ease and sense of confidence with which an audience views and engages with work is not reliant on the exhibition space being either virtual or physical.[30] The art gallery persists as a space where certain viewers are privileged based on their familiarity and comfort levels in such environments. To me, this represents one of the most significant barriers to accessibility in the digital context. In considering AbTeC Island specifically, I would argue that Skawennati and her team are working to dismantle this barrier—redefining the virtual exhibition space as an open and welcoming environment.[31]

There is one last factor on the topic accessibility that is often not mentioned when considering traditional sculptural practices: the financial cost of the physical materials themselves. Constructing large three-dimensional sculptures using traditional materials takes a great deal of financial resources, resulting in a profound barrier. Artists are often reliant on funding or patronage for large-scale projects, a reality that is arguably further constrictive when considering works created in the physical world. While the labor, time, and resources required to sculpt in the digital are plentiful,[32] immediate financial costs are significantly lessened. The development of digital sculpture, and virtual art practices more broadly, have released artists from long-established economic restrictions regarding materiality.

Cybrid Art and Embodiment

Xox suggests that we sit down somewhere for a chat and asks me if I've visited the palatial residence yet. I hadn't, so we head in that direction. The palace is a huge structure on the central plaza and is a set piece from *She Falls for Ages*. There are stairs wrapped along the exterior that provide access to the upper floors. The stairs don't have a railing, so I carefully direct my avatar to climb them and hope that she doesn't topple over the edge to the

29 Jacques Rancière and Gregory Elliot, *The Emancipated Spectator* (London: Verso, 2009).

30 Theopisti Stylianou-Lambert and Elena Stylianou, "A Third Space: Reconsidering Issues of Neutrality and Accessibility in the Virtual Art Museum," *Electronic Visualisation and the Arts (EVA 2010)* (2010): 66–71, doi: 10.14236/ewic/EVA2010.12.

31 My experiences visiting AbTeC Island as a new user of Second Life and the *Activating AbTeC Island* initiative are examples of this.

32 There do exist very real technological limitations when creating in the virtual. Skawennati herself has discussed the common fallacy that digital art takes less resources than more traditional modes of creation.

ground below. We enter the magical room that takes up the entire top floor of the palace (it happens to be the bedroom of the Guardian of the *Celestial Tree*) and settle into two large armchairs positioned on either side of a low table. With xox sitting across from me, I find myself thinking about this world that Skawennati has built and the materials she has used to do so.

Timothy Binkley has argued that a computer should be thought of not as a tool or medium, but rather as a "manager of complexity that can be summoned to be active creative partners."[33] He goes on to consider the virtual object and artists working in virtual spaces, arguing that the virtual artist is faced with problems completely different from artists working in traditional media. Namely, artists of virtual reality must question not what to portray as an appearance, but what to describe as an environment.[34] This is in reference to the intrinsically participatory nature of the virtual space. When Skawennati is sculpting in the digital realm, the piece extends beyond traditional aesthetic and conceptual considerations: the sculpture is also an immersive and often interactive, social experience. I argue that this is especially true of the sculptural works created in social virtual worlds.

In 2009, Patrick Lichty outlined four modalities of art being produced in virtual worlds.[35] The first is Transmediated, meaning work that is basically traditional art translated to the virtual. Evergent art is physical work that is realized from virtual origins. Client/Browser (this he defines as virtual itself) is designed entirely for the client/browser experience. And lastly, Cybrid is defined as work that exists concurrently between various modalities. My impulse is to categorize Skawennati's work as Cybrid art. However, this label seems insufficient. I can think of pieces that fit with each of the four, or move back and forth between multiple. While Skawennati has worked with the concept of transmediation throughout her career, her practice is too multi-layered and complex to fit comfortably within this category.

Elaborating on Lichty's four modalities, Denise Doyle presents a framework for the emergent imagination that is particular to user-generated and avatar-mediated virtual spaces, such as Second Life. Doyle argues that the vectors of movement among the four modalities can be considered to denote the directions and creations of meaning between the physical world and the virtual world, or within virtual spaces themselves. These movements, or spaces in transition, generate meaning and could be considered movements of the imagination. Doyle's emergent imagination framework comes into view in these transitional spaces, and the conditions for its appearance are both in the act of creating and the outcome of the creative act itself.[36] When considering Skawennati's work through this framework, the vectors of movement and transitional spaces become apparent.

33 Timothy Binkley, "The Quickening of Galatea: Virtual Creation without Tools or Media," *Art Journal* 49, no. 3 (1990): 234.

34 Ibid., 237.

35 Patrick Lichty, "The Translation of Art in Virtual Worlds," in *The Oxford Handbook of Virtuality* (Oxford University Press, 2014), p. 444.

36 Denise Doyle, "Art, Virtual Worlds and the Emergent Imagination," *Leonardo* 48, no. 3 (2015): 244–50.

9 xox (left) and I chatting in the bedroom of the Residency of the Guardian of the Celestial Tree, 2022.

Though I understand the pieces that I am viewing in virtual worlds to be digital sculpture, the classification feels too limited. Doyle's framework is of particular interest when considering embodiment and imaginative experience in virtual art: "Within the framework of the emergent imagination, the experience of embodiment and the associated imagination of the senses may explain the visceral and material responses to the phenomenological experience in virtual space."[37] When I engage with Skawennati's work in a virtual environment, when I stand beneath *The Celestial Tree* on AbTeC Island, or have a conversation with another avatar, what I am experiencing is distinct from watching one of her machinimas, or from seeing one of her pieces in the physical world. I am both a viewer and a participant (fig. 9).

Back to the Island

I returned to AbTeC Island several times while writing this essay, often alone and at odd hours. I spend time flying around and looking at the ground below. I walk to the edges of the environment and look around the nooks and crannies. I visit every building meticulously and come across installations by different artists that I had never noticed before. I have some quiet moments in the spaceship by myself. I start to notice when small changes are made—things move around in between my visits. Just as it is when I walk around my neighborhood in the physical world, the environment here is not static.

I visit the two *Celestial Trees* on AbTeC Island and think about their material similarities and aesthetic differences as I move around them. Both of them—in fact this whole environment and my body within it—are the product of a digital materiality still not entirely defined. I consider the fact that I did not travel to Montreal during the summer of 2017 and

37 Ibid., 249.

walk along the Promenade Fleuve-Montagne. I never saw that tree installed in the physical world, on display for the passing public, and I wonder how it might have felt to do so. Would it feel different? I think of Skawennati's desire to bring the tree from the central plaza out of the virtual and into the physical. Will I get to experience that one day?

Above all else, I think of the accessibility of this place. I think of what it was like the first time I visited the island. Some of it consisted of learning how to walk and fly, falling off of the edges of structures, and getting stuck in walls. But it also involved exploring and engaging with a built environment filled with art and community, all from the comfort of my home. To move around the island, and to engage with the sculptures installed on it, is to understand myself as a part of it. As a viewer, as a subject, and as an avatar, it is clear that I am intrinsically connected to the digital materiality of this world. This materiality is immersive, interactive, and experiential by nature. With these sculptures, Skawennati has conceived an entirely new framework for how viewers engage with art.

These digital sculptures are all rooted in Skawennati's expanding machinima catalogue. Her machinimas are powerful narratives that handle themes of futurity, decolonial history, and feminism, all with an undercurrent of utopic possibilities and joy. Her films show us futures that celebrate Indigenous sovereignty and cultures, challenging and dismantling colonial narratives, and imagining a better world for all of humanity. Skawennati has built the worlds she imagines using the creative possibilities afforded by Second Life. With this virtual world as a medium, these possibilities are not limited to building film sets and making art. However, she is not just physically pulling the viewer into the virtual; she is breaking out of cyberspace and building that world in the physical environment as well.

Alexandra Weigand

When the Virtual becomes Tangible

Tracing Design, Architecture, and Art at the Beginning of the Twenty-First Century

Abstract

With the end of the twentieth century, technological change has led to an immense shift in our collective perception and experience of "reality," creating a powerful "cultural impact of computerization as a new digital virtuality" (Shields, 2003). How are the new digital technologies shaping the aesthetics of contemporary visual and material culture? Rather than looking at virtual space itself, this essay draws attention to the feedback loops that arise from the increasing digitization of visualization and design processes in the last decades and their impact on the material world. At its heart is a phenomenon that became viral in the first decade of the twenty-first century: a shift of aesthetic qualities in which *physical* artifacts began to display the aesthetics of the (digitally) virtual. As the phenomenon of "virtual aesthetics" pervades material culture widely, the examination of artworks such as the *Phantom Truck* by Iñigo Manglano-Ovalle shown at Documenta XII (2007) will be expanded to include design and architecture, with a focus on works that occupy a space between the virtual and the physical, between simulation and facticity.

Key Words

Feedback loops, virtual aesthetics, material culture, simulation, new spatial qualities, unmonumental

What is your position as the world begins to represent itself to you this way … as the world is now completely sophisticated, an almost seamless fabrication.[1]—*Iñigo Manglano-Ovalle*

With the end of the twentieth century, technological change has led to an immense shift in our collective perception and experience of "reality," creating a powerful "cultural impact of computerization as a new digital virtuality."[2] How are these new digital technologies

1 Interview with Iñigo Manglano-Ovalle, February 2008. See also Philipp Messner, "Locating Positions—In Conversation with Iñigo Manglano-Ovalle," in *Virtual Aesthetics: Considering Perception at the Dawn of the 21st Century* (Innsbruck: Kyrene, 2008), pp. 47–62, here p. 60.

2 Rob Shields, *The Virtual* (London/New York: Routledge, 2003), p. 18. For a discussion of the terms "virtual" and "real," see "Chapter 2: The Virtual and the Real," pp. 18–44.

shaping the aesthetics of contemporary visual and material culture? Rather than looking at the virtual itself, this essay draws attention to the feedback loops that arise from the increasing digitization of visualization and design processes of the last decades and its impact on the physical, material world. At its heart is a phenomenon that became viral in the first decade of the twenty-first century: an aesthetic shift in which physical artifacts began to display aesthetic qualities of the (digitally) virtual. I will refer to this phenomenon as "virtual aesthetics," a term coined for earlier research that I conducted with design journalist and art historian Simona Heuberger and artist Philipp Messner on the significant change of aesthetic qualities in design, architecture, and art in the years 2007 and 2008, resulting in a publication with the eponymous name.[3]

In this essay, I will discuss not only art works such as the *Phantom Truck* (2007) by Iñigo Manglano-Ovalle and *La Produzione della Costruzione* (2007) by Philipp Messner but also positions in design and architecture. As the two latter disciplines were early adopters of computer graphics software and computer aided design, they were also the first to inscribe virtual aesthetics into the shapes and materials of physical artifacts. The designs I will refer to are early works in this field, circulating in galleries, exhibitions, and design weeks, such as the work of Ronan and Erwan Bouroullec, Julian Mayor, and Front Design, or architectural works in the context of contemporary art such as the New Museum in New York built by SANAA (Sejima And Nishizawa And Associates). What all the works have in common, as will be shown, is that they not only question our habits of perception, but also challenge us to redefine our position in relation to materiality, objects, and space.

According to sociologist and anthropologist Rob Shields, "[d]igital virtualities are synonymous with simulation, a process which was argued to be a liminoid genre, both standing outside of materiality of everyday and embodied life."[4] When these properties of the virtual, which Shields defines as "liminal, betwixt and between," are translated into the physical world, a new condition of the physical results.[5] This new condition can be described as a hybrid between the virtual and the physical: we are confronted with materialized, tangible objects to which their virtual generation is aesthetically inscribed. As highlighted in the work of Manglano-Ovalle and Messner (albeit from different angles), simulation, which is an essential part of these new aesthetics, cannot be separated from the notion of "fabrication" or "construction." Both works engage with the ambiguous relationship between fact and fiction, a phenomenon referred to as "post-truth" or "truthiness" in the late twentieth and

3 See Ekkehart Baumgartner, Simona Heuberger, Philipp Messner, and Alexandra Weigand, *Virtual Aesthetics: Considering Perception at the Dawn of the 21st Century* (Innsbruck: Kyrene, 2008). For the definition of the term "virtual aesthetics," see Alexandra Weigand, "Virtual Aesthetics—Contemplating Images," in ibid., pp. 33–45, here p. 33. For notions of the virtual preceding the digital see, for example, Shields, *The Virtual*, 2003, Anne Friedberg, *The Virtual Window* (Cambridge, MA: MIT Press, 2006), and Jens Schröter, *3D: History and Theory of the Transplane Image* (New York: Bloomsbury, 2014). I owe the last two references to Elisabeth Anne Johnson, and I also want to thank her for her thoughtful comments and advice on the first draft of this essay.

4 Shields, *The Virtual*, 2003, p. 79.

5 Ibid., p. 49.

early twenty-first century.[6] As this is a discourse of the same period, the political connotations are therefore also important in considering the extent to which digital simulation (and its technologies) affects reality. Embodying this overlap, or rather fusion, of digital virtuality and reality, how can works such as the *Phantom Truck* or *La Produzione della Costruzione* be categorized?

Sculpture is "a historically bounded category and not a universal one," writes Rosalind Krauss in her 1979 essay "Sculpture in the Expanded Field."[7] Krauss's notion of the expanded field of sculpture in the 1960s and 1970s can be understood as a spatial expansion, as new spaces such as vast landscapes, for example, have been opened up by artists like Robert Morris, Robert Smithson, Mary Miss, Robert Long, and others. In addition, Land Art and Process Art can also be considered in terms of their temporal dimension, especially with regard to the sculptural actions of the artists as well as the changing processes of reception that unfold on the basis of structural premises.[8] Along with this expansion, Martina Dobbe and Ursula Ströbele propose to extend the classical (essentialist) concept of "sculpture" toward the "sculptural" as a postmodernist perspective, pointing to the fact that "it is no longer a matter of a limited conception bound to a medium or a form."[9] For my essay, I will take up this concept of the sculptural to explore the new condition of the virtual manifesting itself in the physical. As the phenomenon pervades material culture widely, I will expand my inquiry to include design and architecture, with a focus on works that occupy a space between the virtual and the physical, between simulation and facticity. What I am interested in is the response of these formative disciplines to a new technological paradigm that not only massively impacts the process of creating and producing artifacts but also leads to new aesthetic qualities.

Lev Manovich notes that whether we speak of "information society," "knowledge society," or "network society" to describe this "new dimension of contemporary existence," we must acknowledge that "all these new dimensions are enabled by software," adding that "[i]f we don't address software itself, we are in danger of always dealing only with its effects

6 According to the Oxford English Dictionary, the term "post-truth" was brought up by Serbian-American playwright Steve Tesich for *The Nation* in 1992. American author Ralph Keyes used the term "post-truth era" for his book *The Post-Truth Era: Dishonesty and Deception in Contemporary Life* (New York: St. Martin's Press, 2004). In 2016, the Oxford Dictionaries made "post-truth" its word of the year. The term "truthiness" was coined by American satirist Stephen Colbert in 2005.
For Manglano-Ovalle's *Phantom Truck*, this discourse also provides the context for later exhibitions of the work. Since its premiere at Documenta XII, the *Phantom Truck* has been exhibited in group shows such as *Image Battles: 2,000 Years of News from the War* (Kunsthalle Dominikanerkirche Osnabrück, April 22–October 4, 2009), *Seeing is Believing* (Kunstwerke Berlin, September 11–November 13, 2011), or *More Real? Art in the Age of Truthiness* (Site Santa Fe, July 8, 2012–January 6, 2013, and Minneapolis Institute of Arts, March 21–June 9, 2013) to name but a few.

7 Rosalind Krauss, "Sculpture in the Expanded Field," *October*, no. 8 (Spring, 1979): 33.

8 See Martina Dobbe and Ursula Ströbele, "Gegenstand: Skulptur," in *Gegenstand: Skulptur*, ed. M. Dobbe and U. Ströbele (Paderborn: Wilhelm Fink, 2020), pp. 1–16, here p. 3.

9 Ibid., p. 4. Translation by the author.

rather than the causes."[10] The beginnings of computer graphics software can be traced back to the early 1960s, with the first pioneers being found in both computer science and art. It was Ivan Sutherland, an electrical engineer, who developed the first interactive design program, a software called Sketchpad (1962), which formed the basis for the commercial use of 3D models.[11] Sutherland also pioneered the "type of new media that can be called 'navigable 3D virtual space,'" and toward the end of the same decade, in 1968, he also created the "head mounted-system," the first ever virtual reality (VR) headset.[12] In the field of arts, Charles Csuri was one of the first to experiment with computers for the creation of images and even animations, starting in 1963. In the context of this essay, it should be highlighted that Csuri plotted 3D surfaces and made factual sculptures in wood by using a computer-driven milling machine.[13] Thus, he pioneered the transfer of digital graphics physically into the tangible world.[14] In the following decades, digital codification of data left the laboratories of scientific, military, and corporate institutions to find a home in commercial desktop applications. Parallel to the increasing integration of digital visualization technologies, the development of digital communication technologies and user-generated spaces began to evolve. Major platforms and technologies were founded in the first decade of our century: Wikipedia in 2001, Myspace and the virtual world of Second Life in 2003, Flickr in 2004, YouTube in 2005, Facebook in 2006,[15] Twitter in 2007, the first iPhone in 2007, Instagram in 2010.[16]

It is this decade that my essay will draw attention to, a period characterized by an emerging (but not yet evolved) permeation of the virtual and the physical, before the breakthrough, or rather explosion, of social media—a moment in digital culture just before the mass uptake of the smartphone and before the emergence of "post-internet" art and what

10 Lev Manovich, *Software Takes Command* (New York: Bloomsbury, 2013), pp. 8–9.

11 Ivan Sutherland, "Sketchpad: A man-machine graphical communication system," *Technical Report*, no. 574 (September 2003), https://www.cl.cam.ac.uk/techreports/UCAM-CL-TR-574.pdf (accessed January 15, 2022). The report is based on Sutherland's dissertation submitted January 1963 to the Massachusetts Institute of Technology. Also see Martin Lister, Jon Dovey, Seth Giddings, Iain Grant, and Kieran Kelly, *New Media: A Critical Introduction* (London/New York: Routledge, 2009), pp. 112–14. For a detailed chronology of virtual reality technologies see, for example, Shields, *The Virtual*, 2003, pp. 55–56.

12 Manovich, *Software Takes Command*, 2013, p. 63.

13 See for instance Charles Csuri and James Shaffer, "Art, Computers and Mathematics," *AFIPS—Conference Proceedings,* vol. 33 (Ohio State University, 1968), https://ohiostate.pressbooks.pub/app/uploads/sites/45/2017/09/FJCC-Csuri.pdf (accessed January 15, 2022).

14 On early pioneers in computer art such as Charles Csuri and Robert Mallary also see Michael Rottmann's essay in this publication.

15 Facebook was originally founded in 2004 but was only accessible to Harvard students at that time. The platform opened to 800 colleges in 2005, and to the public in 2006.

16 See Lauren Cornell and Ed Halter, "Hard Reboot: An Introduction to Mass Effect," in *Mass Effect Art and the Internet in the Twenty-First Century*, ed. Lauren Cornell, Ed Halter, Lisa Phillips, and Johanna Burton (Cambridge, MA: MIT Press, 2015), pp. xv–xxxiv, here p. xx.

James Bridle termed "the New Aesthetic."[17] I will borrow the term "feedback loops" from the technical field, which defines feedback as a general principle in which the result of a process acts back on the original process, thereby changing the properties of a given system, to look at the feedback loops that occur when simulating materials, objects, and space in 3D programs on 2D monitors. In a second step, I will look at what happens when the resulting computer graphics and renderings are transferred back into the physical world. As this is an investigation into still-evolving phenomena, the text itself will take the form of an exploratory journey through the first years of the twenty-first century. Research in the field of art, architecture, and design, including interviews, visits of exhibitions, and fairs, as well as architectural works will form the basis of an analysis of the virtual becoming tangible.

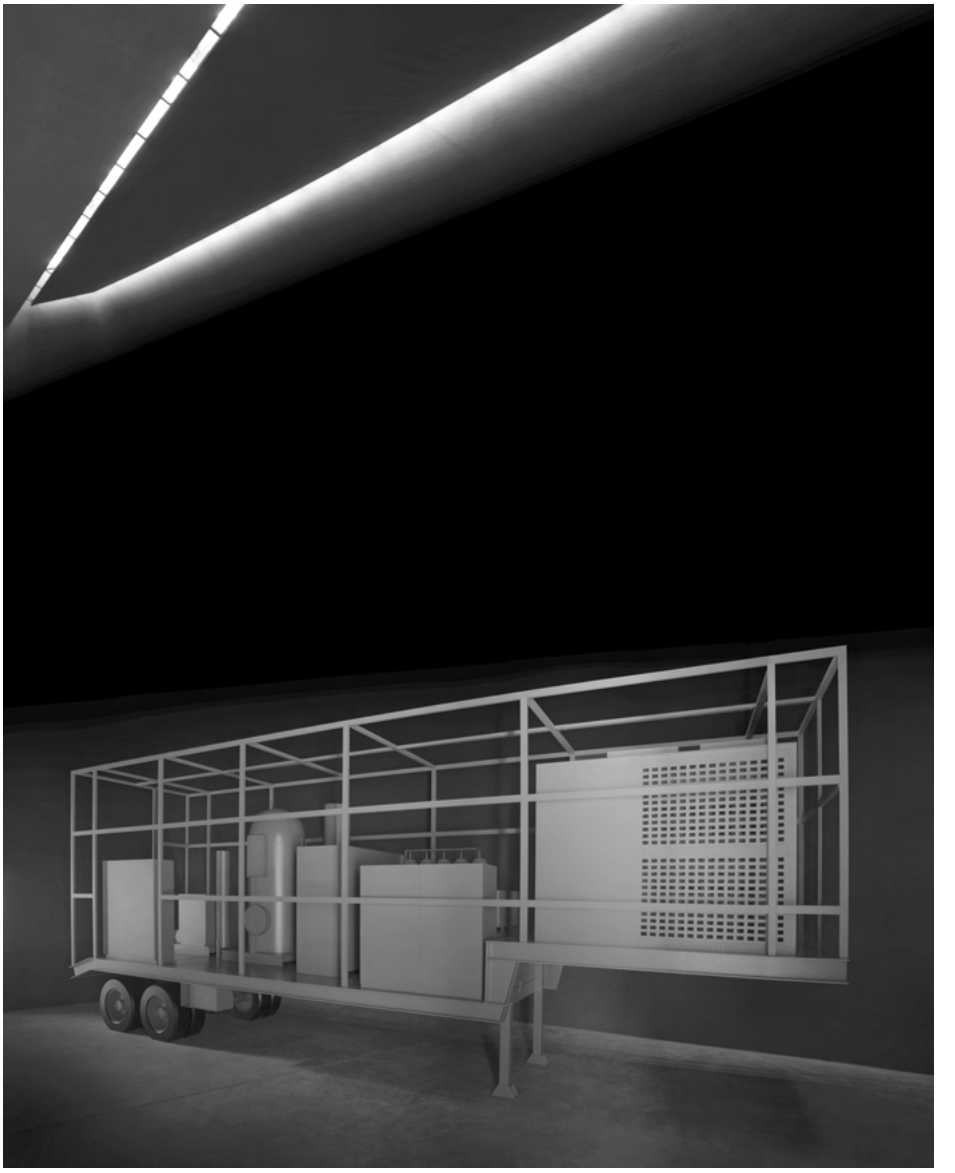
The Fuzzy Flatness of Facts and Things

When you enter one particular room at the Documenta Hall in 2007, a room shaded in diffuse nuances of gray, something makes you stop. It is not merely the lighting situation that your eye has to adjust to; it is rather the attempt to make sense of what is unfolding in front of you. A kind of trailer truck emerges from the darkness and hovers in space, more an appearance than an object. Its materiality evokes the notion of something metallic, but more in the sense of a simulation, and the blurry flatness of the artifact makes you wonder about its corporeality. The monochromatic, dark, grayish color of the space's floors, walls, and ceiling blurs the room's spatial dimensions. Although huge in scale, the object does not seem to touch the floor—rather, it appears to float in space, like a projection. Not knowing whether this object is real or not, you move cautiously in its direction.

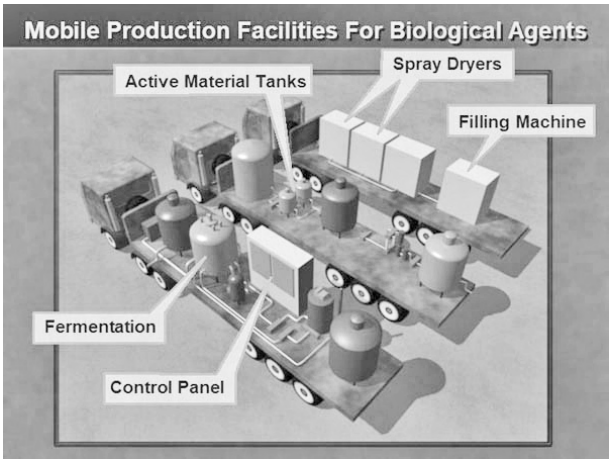
The installation on display is Spanish, Chicago-based artist Iñigo Manglano-Ovalle's *Phantom Truck*, created for Documenta XII in Kassel, Germany, in 2007 (fig. 1). It is a true-to-scale replica of computer-generated renderings used by the former US Secretary of State Colin Powell as justification for the US invasion of Iraq in 2003. His February 2003 speech to the United Nations Security Council was illustrated by a PowerPoint presentation that posed "sort of cartoonish" computer-generated images of mobile "bioweapons laboratories" as reliable information.[18] Drawing on these renderings, as well as photographs of actual trucks found in Iraq after the invasion, Manglano-Ovalle materializes what was presented as "evidence" but turns out to be a phantom, incapable of producing biological weapons. With the *Phantom Truck*, Manglano-Ovalle raises questions about truth and fiction and points to

17 See Cornell and Halter, "Hard Reboot," 2015, pp. xv and xxvi. For "post-internet" see also Artie Vierkant, "The Image Object Post-Internet" 2010, https://jstchillin.org/artie/pdf/The_Image_Object_Post-Internet_a4.pdf (accessed January 20, 2022). For "The New Aesthetic," a research project started in 2011 by James Bridle, see https://new-aesthetic.tumblr.com and his essay "The New Aesthetic and its Politics," *booktwo.org*, June 12, 2013, http://booktwo.org/notebook/new-aesthetic-politics/ (accessed January 20, 2022).

18 Interview with Iñigo Manglano-Ovalle, February 2008. See also Messner, "Locating Positions," 2008, p. 54.



1 Iñigo Manglano-Ovalle, *Phantom Truck*, 2007. Installation view at Documenta Halle, Kassel, Documenta XII, 2007.



2 Slide 21 of the "Remarks to the United Nations Security Council, Secretary Colin L. Powell, New York, February 5, 2003," U.S. Department of State Archive.

the digital fabrication of "realities" that can even trigger wars. When read in the context of Documenta XII and its focus on the migration of form, the work also represents a migration from virtual to physical space.[19]

The renderings that Powell used for his presentation were simple 3D-generated computer infographics.[20] The twenty-first slide, titled "Mobile Production Facilities For Biological Agents," shows three stylized trucks standing side by side in an undefined space; its dusty brownish color dissolves the outlines of the trucks, which are only slightly darker in hue (fig. 2). The open loading areas of the vehicles are filled with container-like forms in various sizes and different shapes. Color-highlighted labels such as "Control Panel," "Fermentation," or "Active Material Tanks" point to the single objects and name their function.[21] Given the state of the art, the renderings that Powell presented in 2003 were of low quality, using only the basic features of the program.

Therefore, to manifest this "phantom truck" as a physical object, Manglano-Ovalle could only recreate these renderings by adopting their typical aesthetics. But what are the typical aesthetics? Manglano-Ovalle speaks of a "fuzzy flatness" inherent to digital renderings, which had to be translated into the physical space.[22] He is referring here to the generation of computer images that are digitally encoded "by uniformly subdividing the picture plane into a finite Cartesian grid of cells (known as pixels)," whereby "unlike photo-

19 Documenta XII was curated by Roger M. Buergel and Ruth Novak. For further information see Roger M. Buergel, Ruth Novak, Documenta GmbH, and Museum Fridericianum, *Documenta Kassel 12, 16/06–23/09, 2007* (Cologne: Taschen, 2007).

20 "Remarks to the United Nations Security Council, Secretary Colin L. Powell, New York, February 5, 2003," US Department of State Archive, https://2001-2009.state.gov/secretary/former/powell/remarks/2003/17300.htm (accessed November 30, 2021).

21 Ibid.

22 Interview with Iñigo Manglano-Ovalle, February 2008. See also Messner, "Locating Positions," 2008, p. 57.

graphs, fine details and smooth curves are approximated to the grid, and continuous tonal gradients are broken up into discrete steps."[23] "Fuzzy flatness" thus encompasses a number of interrelated aspects: a textural flatness of the objects, blurred surfaces and edges, and the lack of spatial depth of both virtual objects and virtual space. To achieve the dissolution of spatial depth and the immaterial, detached atmosphere characteristic of computer renderings, the space was painted completely in black, creating a seamless transition between floor and wall:

> When you are in the black room with the truck, behind the truck, you cannot see where the floor hits the wall. And the architecture of the space, which existed before the truck, had a kind of slight curve. So … the space is not completely locatable. So even if you are standing still, you don't know exactly where you are standing. So there is a little bit of instability within the space already, which is then affected by the fact that the wall are painted dark. So dark that you don't know how far it is. The space is made almost infinitely deep and flat at the same time.[24]

As for the surface of the truck, Manglano-Ovalle was looking for a materiality that had no texture but was not completely flat either. Choosing an epoxy paint to cover the truck's aluminum structure would allow him to obtain a homogeneous matte surface that nevertheless had a metallic character, imitating the texture of simulated metal in renderings with its particular kind of fuzziness. For the floating effect of the truck—it is another aspect of the virtual space that the objects seem to levitate, never really touching the ground—Manglano-Ovalle had the wheels placed on thin, invisible pedestals. The only source of light was above the installation: a narrow, elongated window in the ceiling, illuminating the room according to the weather conditions outside. It is this atmospheric lighting that supports the simulated as well as animated effect of the *Phantom Truck*. By making a digital rendering physical, Manglano-Ovalle fabricated an object that oscillates between pictorial flatness and spatial depth in a seemingly infinite space—an object that "is more real than the virtual but not as real as reality."[25]

The *Phantom Truck* thus represents a critical position, as already indicated by its title: "We usually understand the word phantom as an illusion or a ghost, but in its original meaning as a Greek word it means 'to make visible, to make appear.'"[26] As a hybrid between the virtual and the physical, the sculpture covers the whole notion of fabrication: "Fabrication in terms of fabricating a story, fabricating an illusion, fabricating a lie, dismantling the fabrication, knowing that it is not real and yet fabricated, so the sculpture is a literal fabrication of what is, in its very inception, a fabrication itself."[27] The manifestation of digitally generated images in physical space expands the field of the sculptural toward a new spatial

23 William J. Mitchell, *The Reconfigured Eye: Visual Truth in the Post-photographic Era* (Cambridge, MA: MIT Press, 1992), p. 5.

24 Interview with Iñigo Manglano-Ovalle, February 2008. See also Messner, "Locating Positions," 2008, p. 58.

25 Ibid., p. 54.

26 Ibid., p. 55.

27 Ibid., p. 54.

experience, that of a materialized, walkable "virtual" space. The "virtual," according to the *Cambridge Dictionary* and in the context of computer programming, means "created by computer technology and appearing to exist but not existing in the physical world."[28] At the beginning of the twenty-first century, however, computer-generated images had begun to leave the monitor. While the perception of digitally rendered images is largely limited to the sense of sight, Manglano-Ovalle's installation allows instead a physical experience of the virtual, a bodily confrontation with what he calls "speculative objects"—objects, in other words, with which we have no experience.[29] At Documenta, he could observe this phenomenological aspect in the reactions of the visitors:

> I found that a lot of people were going in there and then when they felt comfortable, they got closer to it. And I had to talk to the Documenta organizers saying, this is going to happen, let them do this. Touch it. See if it was real. And then, when they touched it, they felt that it was aluminum. There is a certain coldness [to] painted aluminum. And they thought: Oh my God, it is actually real! There is a moment in this sort of apprehension, which is completely optical but also phenomenological. Which can only be confronted by the tactile. The virtual always remains virtual until you touch it.[30]

The encounter with the phantom truck therefore evokes a contradictory, bodily experience in which our habitual perception of space is suspended. We find ourselves exposed to a three-dimensional space in which the spatial retreats to the two-dimensional, in which the factual sculpture appears to be a simulation. A dilemma that can only be overcome by another bodily experience—the haptic sensing of factual materiality. It is this opacity, this inaccessibility of what unfolds in front of us, that is characteristic of virtual aesthetics.

"The consequence of the computational nature of all digital worlds," states Martin Warnke, "is their detachment from the familiar," which leads to operating within a new set of possibilities that challenge established perceptions of images and spaces.[31] Manglano-Ovalle's manifestation of Powell's rendering creates a new experience by enabling a physical experience of a simulated space otherwise confined to the monitor.[32] Here, the sense of touch is needed to break the dominance of the visual, in order to verify what cannot be "grasped" by the eyes, and to uncover the twofold fabrication. That way, "[w]e are drawn … into a poetic awareness of the invisible forces that shape the contemporary

28 "Virtual (Computer)," *Cambridge Dictionary*, https://dictionary.cambridge.org/de/worterbuch/englisch/virtual (accessed December 2, 2021).

29 Interview with Iñigo Manglano-Ovalle, February 2008. See also Messner, "Locating Positions," 2008, p. 59.

30 Ibid., p. 57.

31 Martin Warnke, "Aesthetik des Digitalen – Das Digitale und die Berechenbarkeit," *Zeitschrift für Aesthetik und Allgemeine Kunstwissenschaft* 59, no. 2 (2014): 278–86, here 279: "Die Folge der Berechnetheit aller digitalen Welten ist ihre Ablösung vom Gewohnten." Translation by the author.

32 Shields points out that in digital culture "'virtual' comes to equal 'simulated,'" see Shields, *The Virtual*, 2003, p. 46.

world,"[33] or, more dramatically, "we engage with the Phantom Truck … by realizing we have never left the monitor."[34]

The Fiction of Facticity

While Manglano-Ovalle renders a computer image into the physical world by imitating its virtual attributes, Italian artist Philipp Messner explicitly draws on materials displaying features of the virtual for his work.[35] The installation *La Produzione della Costruzione* (The Production of Construction) was shown in early 2007 in Bolzano, Italy, and is part of a body of work that also deals with fabrication—the fabrication of man-made structures, such as nations, and their visual, identity-generating representations (fig. 3). Symbols taken from national flags such as the star, the crescent moon, the cross, and others are transformed into large three-dimensional hollow bodies and piled on top of each other. For the space-filling sculpture, Messner chose an industrial composite material made of an anodized aluminum layer on the one side and a mirroring surface on the other. *La Produzione della Costruzione* is a visually complex work; its reflective interior surfaces immediately captivate the viewer upon entering the space, while the matte exterior of the work shows the same elusive materiality as does the *Phantom Truck*. The mirroring interiors create kaleidoscopic effects, which multiply through reflection and seem to expand into infinity. They invite the viewer to an "experimental examination of the observer's perception regarding the fiction of the surface."[36]

Messner's choice of material is based on his observations that the early years of the twenty-first century saw the development of materials associated with simulation and a focus on the surface. The principle of "surface" applicable to virtual objects, namely that "the surface exists … as a visible marker within a universal code structure," is rendered physical in Messner's installation.[37] Frieder Nake, a pioneer of computer art, suggests distinguishing between "surface" and "subface": "The surface stands for all those aspects of the entity that make it perceivable. The surface is oriented towards us. The surface stands for all those aspects of the entity that make it computable. The subface is oriented towards

33 Buergel, Novak, Documenta GmbH, and Museum Fridericianum, *Documenta Kassel*, 2007, p. 280.

34 Interview with Iñigo Manglano-Ovalle, February 2008, also see Messner, "Locating Positions," 2008, p. 58.

35 Ibid.

36 Sabine Gamper, "Philipp Messner: Die Produktion der Konstruktion: Ausstellung 31.3.–26.5.2007," https://www.argekunst.it/en/2014/02/15/la-produzione-della-costruzione/ (accessed December 10, 2021).

37 Christian Spies, "Formen skulpturaler Bildlichkeit: Spezifisches Objekt zwischen Skulptur und virtuellem Objekt," in *Skulptur – zwischen Realität und Virtualität*, ed. Gundolf Winter, Jens Schröter, and Christian Spies (Munich: Wilhelm Fink, 2006), pp. 75–100, here p. 89: "Und schliesslich muss sich hier auch das veränderte Verhältnis im virtuellen Objekt abzeichnen, wo die Oberfläche nur noch als sichtbare Markierung innerhalb einer universellen Codestruktur vorliegt." Translation by the author.

3 Philipp Messner, *La Produzione della Costruzione*, 2007. Installation view at ArGe Kunst, Bolzano, 2007.

the computer"—toward a dematerialized world of information and code.[38] The composite material chosen by Messner draws on what Nake calls "entities that are generated in algorithmic ways": the surface of the hollow bodies displays the characteristics of the virtual generation to the outside, while the subface creates self-referential codes within a closed system.[39] *La Produzione della Costruzione*, as the title suggests, refers to the fabrication of man-made artifacts, both conceptual and physical, to unmask the fictional quality of both.

Messner's work, like the work of Manglano-Ovalle, embodies this new condition of the physical which is linked to the notion of fabrication: Manglano-Ovalle materializes post-truth narratives by implementing the notion of fabrication, of simulation, within the materiality itself, while Messner explicitly uses existing industrial materials that carry the notion of the virtual, of simulation, to point to their omnipresence in our everyday lives. With their work, both artists manifest a hybrid condition between the virtual and the physical. By using virtual aesthetics as aesthetic politics, as means to an end, they tease out the political dimension of the current predominance of simulations. Furthermore, they draw attention to the presence of this development in our built reality, in which design and architecture have been inscribing virtual aesthetics into materials and forms since the beginning of the century.

38 Frieder Nake, "We Find the Aesthetics in Between: A Remark on Algorithmic Art," *Zeitschrift für Ästhetik und Allgemeine Kunstwissenschaft* 59, no. 2 (2014): 287–88, here 288.

39 Ibid.

Three-Dimensional Images, Two-Dimensional Bodies

Looking at designs in the early 2000s, the growing impact of 3D design software on forms, materials, and surface textures becomes evident, enhanced by new digital production techniques such as 3D-printing. In this process, the spatial qualities of the physical objects are also subject to a transformation in the direction of their digital (two-dimensional) template, so that they now move between image and object.[40] This phenomenon of visually flat three-dimensional objects, forms made of mesh-like structures, and materials with surfaces that appear to be simulated, I suggest, is part of a new condition of the physical resulting from feedback loops that occur when physical bodies are imitated first by means of simulation technologies and then by transferring these simulated bodies back to the physical world as materialized objects. Like a pendulum swinging back and forth, the different worlds it oscillates between are reciprocally influenced.

As early as 2001, the French designers Ronan and Erwan Bouroullec designed the *Console with Vase and Bowl* made of Corian (fig. 4). Corian is a mineral-synthetic composite material, originally developed in the 1960s, which has experienced an upswing at the beginning of the twenty-first century. Indeed, its properties meet the requirements of the time: it has a homogeneous, smooth surface that can take on translucent qualities and it can be processed like wood or thermally shaped two- or three-dimensionally. Objects made of Corian appear optically seamless, as unified entities. Taking advantage of these features, the vase and bowl are integral parts of the sculptural object, appearing to grow out of the surface of the table. This "impression of a single, carved block" in combination with the shiny white surface of the material flattens the three-dimensionality of the object and visually transforms it into a silhouette.[41] "Virtual spaces have an elusive quality which comes from their status as being both no-place and yet present via the technologies that enable them," so Shields.[42] Displaying this oscillation between 2D and 3D, it is difficult to tell whether the image of the console is a photograph of a physical object or if it is the computer rendering of the digital design.

While the *Console with Vase and Bowl* appears flat and schematic, like a sketch, and thus as a two-dimensional "body," British designer Julian Mayor creates objects that manifest as three-dimensional computer images. The project *20 Years 20 Chairs*, which he started in 2000, explores the multiple sculptural options offered by digitally generated designs and their transfer into physical, handcrafted objects. It plays with the various possibilities of

40 At this point it is important to note that not all designs or architectural projects that exhibit virtual aesthetics must necessarily have been created with the help of 3D software. During my research, I have come across quite a number of design and architectural projects that display virtual characteristics, even though they were designed using analogue methods. I suggest that the disciplines of design and architecture, as early adopters of various types of software that have enabled 3D-modeling and digital image production since the 1970s, have long integrated these aesthetics as part of their visual culture.

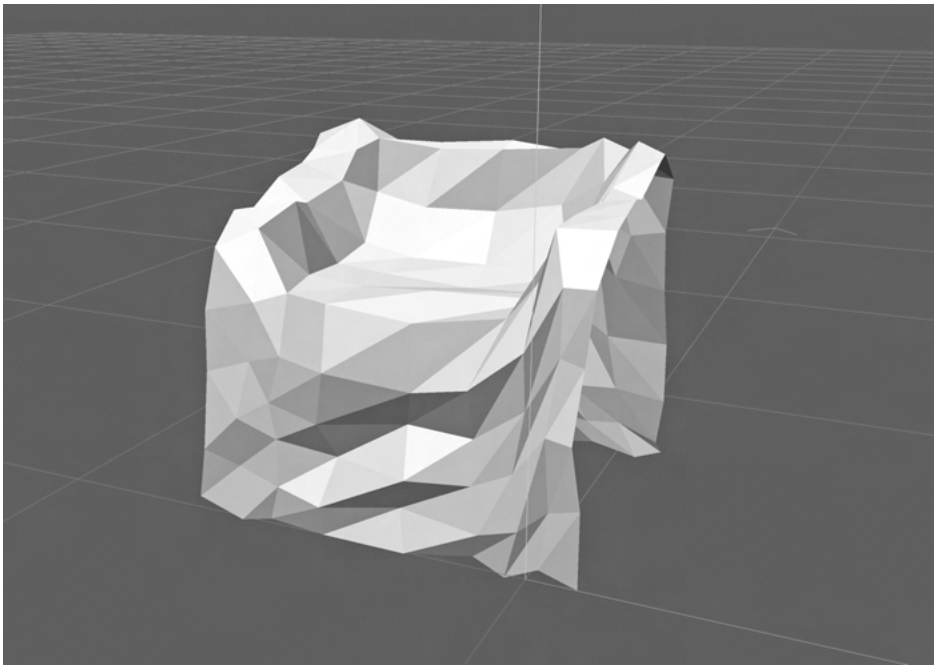
41 "Erwan & Ronan Bouroullec, Corian Console 2001," https://www.bouroullec.com/?p=44 (accessed December 15, 2021).

42 Shields, *The Virtual*, 2003, p. 50.

4 Erwan and Ronan Bouroullec, *Console with Vase and Bowl*, 2001 for Italian design company Cappellini.

generating forms resulting from the technical features of computer graphics software. Part of this series is the *General Dynamics* chair designed in 2004, an armchair based on the parameters of modeling freeform three-dimensional shapes using polygonal meshes. Since the development of computer graphics in the 1970s, 3D models have been created on the basis of mathematically computable surfaces to which a texture can be added.[43] With the help of a polygonal model that uses geometric faces, Mayor created a multifaceted surface, which forms the chair (fig. 5a). As a result, surface and form are one, an actual body does not exist, only its outline. The digital design's physical counterpart is handcrafted from fiberglass (fig. 5b). The shiny white faceted surface oriented to the viewer (while the "subface" remains untreated) explicitly addresses the object's digital origin: "The chair was created to look like a three-dimensional sketch, with the idea of technology having a character of its own. Like a computer visualisation, the form gives clues, but it needs the viewers

43 Computer graphics technology dates back to the first half of the 1970s when the University of Utah—where Sketchpad creator Ivan Sutherland was teaching—became an important center for research on computer graphics. In 1975, computer graphics researcher Martin Newell created the first 3D image, the *Utah Teapot*, using a wire frame to which a surface texture could be added, which became a benchmark model for all subsequent 3D software. The original data set of the Utah teapot can still be freely downloaded from the internet. For the history of software see, for example, Manovich, *Software Takes Command*, 2013, p. 63.



5a Julian Mayor, 3D-computer rendering of the *General Dynamic* chair, 2003–04.

5b Julian Mayor, *General Dynamic*, 2004.

imagination to complete the surfaces."[44] With the use of polygon structures for the *General Dynamics* chair, Mayor refers to the basic features of digital design software. He is thus one of the first designers to reflect on the radical changes caused by the transfer of the design process from analog to digital. The virtual aesthetics of the chair, however, are created by the interplay of the color white, with its ability to reflect light, and the glossy surface, with its ability to shine.[45] Shine creates a hybrid state between two conditions; it "oscillates between the material and immaterial, the sensual and transcendent, the present and absence"—in our case, between digital data and factual materiality.[46]

It is "only in the beginning of the 21st century that data leaves professional domains to become of interest to society at large," notes Lev Manovich, pointing to the fact that "visualizations of data" also enter exhibitions of major museums such as the Museum of Modern Art (MoMA) in New York.[47] Here, he refers to the exhibition *Design and the Elastic Mind*, showcased in early 2008. The show highlighted the role of innovative technologies and its future potential and positioned design as a "bridge between the abstraction of research and the tangible requirements of real life."[48] The exhibits ranged from nano devices, appliances, and interfaces to objects designed and manufactured using the latest digital technology. One of the most visually striking design projects of the latter category was *Sketch Furniture* by the Swedish design collective Front Design, first prototyped in 2005 (fig. 6b). A set of furniture consisting of chairs, tables, and lighting was generated completely digitally: in a "happening" performed by the designers, they sketched the single objects in the air with their fingers as if with a pen, while their movements were recorded with motion-capture video technology. They then digitized the objects into a 3D computer model and materialized them through rapid prototyping (fig. 6a). A video of the project shows how during the 3D-printing process, in which a laser beams ultraviolet light into a bath of liquid resin to harden it layer by layer, three-dimensional objects grow out of the milky surface of the bath, making their way from the virtual to the physical world.[49] The completely digital data materializes in fluid, tubular forms, the surfaces shining in glossy white, as if the light beam

44 "Julian Mayor, 20 Years 20 Chairs 2000–2022, General Dynamic," http://www.julianmayor.com/20-years-20-chairs/ (accessed January 20, 2022).

45 In the beginning of the twenty-first century, the color white plays a key role in contemporary design. It is therefore no coincidence that all the design works discussed are white. The other important color of this period is gray, or rather the grayish-silver color of metal, as seen in the artworks discussed and in the building of the New Museum. See also Weigand, "Virtual Aesthetics—Contemplating Images," 2008, p. 37.

46 Antje Krause-Wahl, Petra Löffler, and Änne Söll, "Introduction," in *Materials, Practices, and Politics of Shine in Modern Art and Popular Culture*, ed. Antje Krause-Wahl, Petra Löffler, and Änne Söll (London/New York: Bloomsbury, 2021), pp. 1–19 , here p. 1.

47 Manovich, *Software Takes Command*, 2013, p. 30.

48 Glenn D. Lowry, "Foreword," in *Design and the Elastic Mind*, exh. cat. the Museum of Modern Art (New York, 2008), pp. 4–6, here p. 4. The show was on display from February 24–May 12, 2008, and curated by Paola Antonelli.

49 Front Design, *Sketch Furniture by Front*, YouTube video, 3:24 min., uploaded by "frontfilm," April 18, 2007, https://www.youtube.com/watch?v=8zP1em1dg5k (accessed December 15, 2021).

6a Front Design, *Sketch Furniture*, 2005, design process.

6b Front Design, *Sketch Furniture*, 2005.

with which the objects were digitally mapped had solidified into matter. Presented against a neutral background, the exhibits appear familiar and alien at the same time. We would rather expect them to appear on a screen than in our material surroundings.

"Computer screens, currently our portals to cyberspace, will grow, and they will continue to absorb the surfaces and volumes of the rooms, in which we live," wrote artist and "trans-architect" Marcos Novak already in the early 1990s.[50] His investigations into the potential of computer-generated architectural designs had led him to what he called "liquid architecture": immersive and virtual three-dimensional formations that had no counterparts in the physical world. Limited to the canvas of the computer screen at that time, these fluid forms and simulated surfaces have since left the confines of the screen.[51] The mutual permeation of virtual and physical spaces increasingly manifests itself in our everyday lives: "With the advent of digitally generated image forms, the medial preconditions of perception have changed. Familiar forms of perception have been expanded by new ones and the established categories of description have to be reconsidered. One aspect of these new types of images is always particularly striking: throughout, there is a new emphasis on spatial image parameters and perceptual values."[52] Designs as discussed embody these new parameters by combining forms that result from the features of digital software with surfaces that evoke virtual aesthetics. As a consequence, the perceptual values of image and body merge to form objects that oscillate between spatial depth and visual flatness, showing that "aesthetic encounters are actually 'mediated' on the surface."[53]

Unmonumental Monumental

As you make your way through New York's Lower East Side on your way to the New Museum, you are brought to a stop the very moment the museum appears in front of you. It

50 Marcos Novak cited in Weigand, "Virtual Aesthetics—Contemplating Images," 2008, p. 38. The quote was taken from Novak's website www.centrifuge.org, which is unfortunately no longer available.

51 For "liquid architecture" (and design), see for example the work of the late Iraqi-British designer and architect Zaha Hadid, who was among the first to use 3D visualization for an architectural design approach termed "parametricism." The realization of these digitally generated fluid architectural designs, however, would start only in the first decade of the twenty-first century. See, for example, Patrik Schumacher, "A New Global Style (2009)," in *The Digital Turn in Architecture 1992–2012*, ed. Mario Carpo (Somerset: John Wiley and Sons, 2012), pp. 240–57. Buildings realized in this period are, for instance, the science center Phæno in Wolfsburg, Germany (2005), the installation *Lilas* for the Serpentine Gallery London, UK (2007), and the art museum MAXXI in Rome, Italy (2010).

52 Gundolf Winter, Jens Schröter, and Christian Spies, "Vorwort," in *Skulptur – zwischen Realität und Virtualität*, ed. Gundolf Winter, Jens Schröter, and Christian Spies (München: Wilhelm Fink, 2006), pp. 7–10, here p. 7: "Mit dem Aufkommen digital erzeugter Bildformen haben sich die medialen Voraussetzungen von Wahrnehmung verändert. Vertraute Wahrnehmungsformen wurden durch neue erweitert und die etablierten Beschreibungskategorien müssen überdacht werden. Ein Aspekt dieser neuartigen Bildformen fällt dabei immer wieder besonders auf: Durchweg kommt es zu einer neuartigen Betonung räumlicher Bildparameter und Wahrnehmungswerte." Translation by the author.

53 Giuliana Bruno, *Surface: Matters of Aesthetics, Materiality, and Media* (Chicago: University of Chicago Press, 2014), p. 3.

7 SANAA, *New Museum*, New York, 2007. View of the museum building at 235 Bowery.

towers over the surrounding buildings, shimmering strangely, like a projection. Composed of seven rectangular boxes that are irregularly stacked on top of each other (fig. 7), its shape—"no-frill white cubes not only inside, but outside too"—suggests the use of the building: the museum for contemporary art was built by Kazuyo Sejima and Ryue Nishizawa of the Japanese architectural studio SANAA and opened in December 2007.[54] In order to

54 Roberta Smith, "Art Review 'Unmonumental: In Galleries, a Nervy Opening Volley,'" *The New York Times*, November 30, 2007, https://www.nytimes.com/2007/11/30/arts/design/30newm.html (accessed December 10, 2021).

understand the immaterial appearance of the building, it is (again) necessary to take a closer look at the materiality of its surface: "The New Museum is clad in a seamless, anodized expanded aluminium mesh chosen by SANAA to emphasize the volume of the boxes while dressing the whole of the building like a strong body in a delicate, filmy, softly shimmering skin."[55] Anodized aluminum was widely used in the 2000s and the same material Messner chose for his installation. Anodizing is a surface treatment to prevent corrosion in which a fine-pored oxide layer is created on the metal surface that is also completely transparent and invisible, thus preserving the metallic character of the material. The micropores create a pixel-like effect on the surface, causing a diffuse scattering when light is reflected, almost as if the surface were illuminated from the inside rather than from the outside. The result is surface that appears simulated—just as the surfaces of 3D designs displayed on a computer screen that is homogeneously illuminated by the monitor's backlight.

This effect is further enhanced by a layering effect of the façade. Aluminum panels were fixed to the building first and then covered with the expanded aluminum mesh, so that the pixel-like effect created by anodization on the micro level also replicates on a macro level. The resulting screen-like texture triggers the effect of backlighting when exposed to (day) light. In the "age of virtuality," cultural critic and media theorist Giuliana Bruno notes, "[t]he language of the screen has become an actual material condition of our existence, for its geometry is not only ever-present but also manifold."[56] She observes that "[t]here appears to be a widespread 'superficial' movement engaged in uncovering the strata and thickness of surface, and in creating deep, textured, layered surfaces."[57] This also counts for the New Museum's architecture, whose textured façade becomes a contemporary screen that, according to Bruno, "far from representing any perspectival ideal, is no longer containable within optical framings, and cannot be likened to a window or a mirror, but is to be reconfigured as a different surface."[58] In case of the museum's façade, the difference lies in its ability to "animate": "With windows just visible behind this porous scrim-like surface …," as the museum's website explains, "the structure appears as a single, coherent und even heroic form that is nevertheless mutable, dynamic, and animated by the changing light of day."[59] It is not a media façade in the sense of digital displays that are familiar to us from our urban surroundings. It is rather a surface with a simulated character, animated by and sensitive to changing weather and lighting conditions, exploiting the façade's particular fabrication of reflecting light that follows the virtual object's ability to shine from within. "In surface encounters," states Bruno, "novel dynamics are generated, including an innovative form of materiality that is light, diffuse, flexible and permeable."[60] This also affects the perception of time: "[T]he experience of light as it is mediated on the surface becomes an

55 "New Museum Building," https://www.newmuseum.org/building (accessed December 10, 2021).
56 Bruno, *Surface*, 2014, pp. 2 and 7.
57 Ibid., p. 81.
58 Ibid., p. 5.
59 "New Museum Building," https://www.newmuseum.org/building (accessed December 10, 2021).
60 Bruno, *Surface*, 2014, p. 5.

environmental experience that incorporates the movement of observation and the sensing of time as an atmosphere," resulting in an experience of space and time that becomes increasingly permeable and fluid.[61] These tendencies toward dissolution can also be found at the edges of the façade. Here, the cut expanded aluminum mesh forms a blurred, pixelated line as in the gridded structure of digital images, causing the blurry fuzziness addressed earlier by Manglano-Ovalle.[62] This play with virtual aesthetics leads to a paradoxical effect: the monumental building negates its own monumentality.

Strikingly, the inaugural exhibition of the new museum building was titled *Unmonumental: The Object in the 21st Century*. Curated by Richard Flood, Laura Hoptman, and Massimiliano Gioni, the show draws attention to "fragmented forms, torn pictures and clashing sounds" reflecting the unstable and fractured condition of our fast-changing world.[63] In this context, the curators also drew on the war in Iraq, observing a shift in dealings with facticity: "As the twenty-first century moves forward, it is being forced to barrel through masses of relative 'truths,'" which results in replacing "the tentatively real with something else that is probably less real."[64] The works presented are assemblages characterized by the lack of expensive materials or industrial "fabrication processes that result in shiny (read lulling) surfaces," as well as the absence of well-made manufacturing, heavy machinery, and computer tech.[65] Although at first glance the exhibition appears to be diametrically opposed to the new museum architecture with its minimalist, withdrawn form and shimmering façade, a second glance reveals the uniting factor: "If the term 'monumental' connotes massiveness, timelessness and public significance," states Hoptman, "the neologism 'un-monumental' is meant to describe a kind of sculpture that is not against these values (as in 'anti-monumental') but intentionally lacks them."[66] The dissolution of monumentality and the resulting experience of matter as "unmonumental" and time as unstable and fluid is found in both, in analog form in the exhibits and in virtual form in the museum building. In that sense, the exhibition as well as the architecture of the building, show that sculpture, or rather the sculptural in the (post-)digital age, "complicates space and viewer perception much more than any other medium."[67]

61 Ibid., p. 87.

62 In this context, Martin Warnke speaks of "staircasing lines" ("Treppigkeit" von Linien), see Warnke, "Aesthetik des Digitalen," 2014, p. 278. Mitchell points to the "gridded microstructure" of the digital image made of pixels that "retain their crisp, square shapes." See Mitchell, *The Reconfigured Eye*, 1992, p. 6.

63 "Unmonumental: The Object in the 21st Century," https://archive.newmuseum.org/exhibitions/918 (accessed December 10, 2021). The exhibition displayed eighty works by thirty artists, among them Alexandra Bircken, John Bock, Martin Boyce, Tom Burr, Aaron Cury, Isa Genzken, Sarah Lucas, Manfred Pernice, Anselm Reyle, and Rebecca Warren to name but a few.

64 Richard Flood, "Not about Mel Gibson," in *Unmonumental: The Object in the 21st Century*, exh. cat. New Museum New York (London/New York: Phaidon Press, 2007), pp. 10–13, here p. 11 and 10.

65 Smith, "Art Review 'Unmonumental: In Galleries, a Nervy Opening Volley,'" 2007.

66 Laura Hoptman, "Unmonumental: Going to Pieces in the 21st Century," in *Unmonumental: The Object in the 21st Century*, exh. cat. New Museum New York (London/New York: Phaidon Press, 2007), pp. 128–38, here p. 138.

67 Flood, "Not about Mel Gibson," 2007, p. 12.

Tangible Virtuality

The works discussed in this essay reflect on the changed conditions caused by a medium "that privileges fragmentation, indeterminacy, and heterogeneity."[68] They reveal a new set of possibilities and perceptual offers that are "subject to the laws of rastering and quantisation"[69] and in which "representation is displaced by another practice, simulation."[70] In the field of art, these perceptual offers underline critical approaches that aim to dismantle constructed realities and post-truth conditions by means of a materiality that points to simulation and thus its virtual origin. The fictitiousness of facticity is intended to be experienced via the perceptual experience of the virtual in the physical space. The field of the sculptural is thus expanded toward a new spatial experience, that of a materialized, walk-in "virtual" space. In this regard, our attention is drawn across material surfaces that we previously only encountered on our screens. The screens function not only as "a representation of digital universes but also a manifestation of how the digital can reinvent a surface condition that is a form of materiality."[71] As a result, we are confronted with objects that tempt us to speculate about them and that we encounter not only in art but also in architecture and design. In the process of imitation of simulated objects for physical production, the qualities of the virtual manifest themselves in materials, surfaces, and forms, affecting our perception of objects, space, and materiality. The resulting feedback loops superimpose two-dimensional images and three-dimensional spaces and illusorily dissolve the solidity of objects, which manifests itself in an aesthetic flatness of bodies and spaces. The surface of the materials plays a key role, as it can now appear "simulated" or "animated" or turn itself into a screen. It "no longer has the status of decorative element but becomes an entity in itself."[72] Inherent in these new surfaces is an ephemeral quality that is determined by lighting conditions such as daylight, as in the façade of the New Museum, or by the respective position of the viewer, as with Messner's installation. Surfaces mediated in this way have the effect that "[w]e no longer face or confront a screen only frontally but are rather immersed in an environment of screens."[73] From this perspective, the sculptural at the beginning of the twenty-first century points not only to the increasing presence of virtual aesthetics in our everyday world, but also to simulation beginning to overlay reality. Therefore, in confronting the virtual in the physical world as an increasingly seamless condition, we are challenged to relocate our position in relation to object, materiality, and space.

68 Mitchell, *The Reconfigured Eye*, 1992, p. 8.
69 Warnke, "Aesthetik des Digitalen," 2014, p. 278: "Die Wahrnehmungsangebote … unterliegen den Gesetzen der Rasterung und der Quantisierung." Translation by the author.
70 Lister, Dovey, Giddings, Grant, and Kelly, *New Media*, 2009, p. 6.
71 Bruno, *Surface*, 2014, p. 99.
72 Ibid., p. 93.
73 Ibid, p. 102.

Reclaiming Monumentality

Mara-Johanna Kölmel

The Twenty-First-Century Monuments

Reflections on Nomadic and Intermedial Monumentality

Abstract

Since the nineteenth century, the concept of the monument has undergone a significant morphosis. Its meaning shifted throughout the twentieth century, from the receptacle for heroic, self-aggrandizing, national gestures celebrating ideals and triumphs, to ephemeral, conceptual interventions marking national ambivalence and uncertainty. With the possibilities of immersive digital technology and the internet, the twenty-first-century monument has expanded toward the unmonumental, the immaterial, and the virtual. This paper focuses on two Iranian artists living outside of Iran that use digital technologies to reveal power structures inscribed into sculptural and monumental forms. Morehshin Allahyari and Shirin Fahimi engage with the sculptural codes of monuments to propose novel ways to make and mark a space for painful, diasporic, suppressed, or erased memory. They counteract a monumental aesthetic linked to solidity, permanence, and stiffness with a monumentality that is participatory, generative, mutable and unfolds between actual and physical spaces. Rethinking the function of sculpture as a monument vis-à-vis its expansion via 3D technologies, augmented reality, and the internet, this paper explores an intermedial and nomadic monumentality emerging in recent sculptural discourse.

Key Words

Intermedial and nomadic monumentality, Shirin Fahimi, Morehshin Allahyari, monuments, 3D technologies, virtual reality

"The remarkable thing about monuments is that one does not notice them. There is nothing in the world so invisible as a monument," or so the Austrian novelist Robert Musil once claimed.[1] Writing his famous essay during the early stages of the so-called mass media age in 1927, he was worried that public monuments were losing relevance in the face of the

1 Robert Musil, "Denkmale," in *Nachlaß zu Lebzeiten*, ed. Robert Musil (Hamburg: Rowohlt, 1957), pp. 59–63, here p. 59. For the English translation of Musil's quote, see Peter Carrier, *Holocaust Monuments and National Memory Cultures in France and Germany since 1989: The Origins and Political Function of the Vél'd'Hiv'in Paris and the Holocaust Monument in Berlin* (New York: Berghahn Books, 2005), p. 15.

rapidly growing and pervasive media landscape. He believed that as the public became more familiar with monuments, they became less noticeable and eventually faded into the background. Of course, writing from the perspective of a well-established European intellectual, Musil likely did not consider that the "unnoticed monuments" surrounding him could have deeply disturbing effects on others – especially those concealing painful histories and memories. It is a similar ignorance that resonates in the presence of many monuments in public space today. Contrary to Musil's prognosis, it is, however, via social media and the contemporary digital media landscape that many monuments' troubling presence is being highlighted and thematized.[2] One such example is the performative removal of a monument to Edward Colston during the worldwide Black Lives Matter protests in 2020, documented and shared via social media. Around the same time, monuments of other colonial figures were symbolically decapitated or covered in red paint.

It is these recent developments, expanding from the physical into the digital sphere, that have put the aesthetics of monumentality once again up for discussion. This paper aims to contribute to discussions on twenty-first-century monumentality through focusing on the distinct relationship between sculpture and monuments.[3] With a particular focus on the work of Iranian artists Morehshin Allahyari and Shirin Fahimi, it highlights a generation of artists that use digital technologies to reveal power structures inscribed into monumental forms but also use them as a means to restore and open up alternative sites of commemoration. It thereby reflects on the expansion of the sculptural in the (post-)digital age in relation to one of sculpture's main categories.

Based on an in-depth discussion of Morehshin Allahyari's series *She Who Sees the Unknown* and Shirin Fahimi's *Umm al Raml's Sand Narratives*, the text demonstrates how contemporary artists engage with the sculptural codes of monuments. Allahyari and Fahimi propose alternative ways to make and mark space for painful memories, without necessarily claiming that their works are monuments. Their works counteract a monumental and sculptural aesthetic, which is historically linked to solidity, weight, permanence, and stiffness, with a monumentality that is participatory, generative, mutable, and unfolds between actual and digital spaces. The use of digital technologies for the construction of alternative memory sites by the artists discussed in this contribution not only prompts renewed theoretical scrutiny of the very idea of monuments but also of the sites in which they operate.

2 See, for example, "Edward Colston Statue Pulled from Bristol Harbour," BBC News, last modified June 11, 2020, https://www.bbc.com/news/av/uk-england-bristol-53004755 (accessed December 11, 2020).

3 This contribution benefitted from the thoughtful feedback of Megan Luke and Ursula Ströbele, whom I would like to thank warmly.

Wandering the Spheres of Monuments

Since the nineteenth century, the concept of the monument as debated in sculptural discourse has undergone a significant change.[4] From a receptacle for heroic, self-aggrandizing national gestures celebrating ideals and triumphs, the notion of the monument shifted throughout the twentieth century toward conceptual interventions marking national ambivalence and uncertainty.[5] Modernism sealed the fate of monuments, countering their intentional character that fixed one version of the past artificially with unintentional, unmonumental, and ephemeral forms.[6] For modern artists and critics, the heroic stiffness and unassuming pretentiousness doomed the monument forever as archaic and it was discarded as an artistic form. "The notion of a modern monument is virtually a contradiction in terms; if it is a monument it is not modern, and if it is modern, it cannot be a monument," Lewis Mumford wrote in 1938.[7] Rosalind Krauss famously designated monuments unable to refer to anything beyond their base, "functionally placeless and largely self-referential."[8] In the context of debates on German postwar monument culture, historians suggested that monuments rather than commemorating events can also bury them beyond ideological layers of national interests.[9] Others argued that rather than preserving public memory, the monument displaces it altogether, supplanting a community's memory work with its own material form.[10] And yet, in their contention with the notion of the monument, postmodernism also triggered a new interest in the subject. If historically monuments were fixed to a site, the modern monuments were characterized by "a kind of sitelessness, or homelessness, an absolute loss of place."[11] Krauss discussed these characteristics in relation to modernist sculpture and concluded that its status, meaning, and function is therefore "essentially nomadic."[12] In Germany, the intensive reflection on the Nazi era has led to unprecedented

4 See Horst W. Janson, *The Rise and Fall of the Public Monument*, Lectures in the Humanities, ed. Andrew W. Mellon (New Orleans: Graduate School, Tulane University, 1976); Rosalind Krauss, "Sculpture in the Expanded Field," *October*, no. 8 (Spring 1979): 31–44, here 33.

5 See James E. Young, "Twentieth-Century Countermonuments," in *Encyclopedia of Aesthetics*, ed. Michael Kelly (Oxford: Oxford University Press, 1998), pp. 276–78, here. p. 276.

6 See for example Michael Diers and Andreas Beyer, eds., *Mo(nu)mente: Formen und Funktionen Ephemerer Denkmäler* (Berlin: Akademie Verlag, 1993).

7 Lewis Mumford, *The Culture of Cities* (New York: Harcourt, Brace and Co., 1938), p. 438.

8 Krauss, "Sculpture in the Expanded Field," 1979, 34.

9 See Martin Broszat and Saul Friedlander, "A Controversy about the Historicization of National Socialism," in *Reworking the Past: Hitler, the Holocaust, and the Historians' Debate*, ed. Peter Baldwin (Boston: Beacon, 1990), pp. 102–34.

10 Andreas Huyssen, "Monument and Memory in a Postmodern Age," *The Yale Journal of Criticism: Interpretation in the Humanities* 6, no. 2 (1993): 249–61, here 249; Huyssen, *Twilight Memories: Marking Time in a Culture of Amnesia* (New York: Psychology Press, 1995); See Hermann Lübbe, "Zeit-Verhältnisse," in *Zeitphänomen Musealisierung: Das Verschwinden der Gegenwart und die Konstruktion der Erinnerung*, ed. Wolfgang Zacharias (Essen: Klartext, 1990), pp. 40–50.

11 Krauss, "Sculpture in the Expanded Field," 1979, 34.

12 Ibid.

levels of reflective preoccupation and public debate around the notion of the monument.[13] A generation of conceptual artists countered the problematic history of the monument with propositions for counter and anti-monuments, such as Hans Haacke's *Ihr Habt Doch Gesiegt* (1988), Sol LeWitt's *Black Form (Dedicated to the Missing Jews)* (1988), or Jochen Gerz's and Esther Shalev-Gerz's *Harburg Monument Against Fascism* (1989), Krzysztof Wodiczko's *Homeless Projection* (1981). Hermann Lübbe identified the peak of the building of monuments and memorials in the 1970s and 1980s.[14]

This development went hand in hand with a general expansion of the field of sculpture since the 1960s, one that questioned statuary, permanence, as well as the anthropomorphic, and brought forth unmonumental, time-based, or immaterial aspects of the medium.[15] The notion of sculpture broadened as the spheres of sculpture and everyday life merged.[16] As artists have developed critical approaches to traditional monumental and sculptural codes through ephemeral, living, impermanent or vivid modes, the monument has become a contested site, a site of cultural conflict, but also a place of possibility, to potentially restore the memories of those that have been left behind.

Since the late 1980s, postcolonial and feminist discourses across the globe have contributed to critical reflections on appropriate national forms of mourning of the genocides of Indigenous populations, the resuscitation of slavery, and the presence of female voices in the act of commemoration.[17] These contributions have marked the monument as a place

13 See, for example, Arkadi Zeltser, *Unwelcome Memory: Holocaust Monuments in the Soviet Union*, trans. A. S. Brown (Jerusalem: Yad Vashem, 2018); William John Niven and Chloe E. M. Paver, *Memorialization in Germany since 1945* (Basingstoke: Palgrave Macmillan, 2010); Carrier, *Holocaust Monuments and National Memory Cultures in France and Germany since 1989*, 2005; Brigitte Hausmann, *Duell mit der Verdrängung?: Denkmäler für die Opfer des Nationalsozialismus in der Bundesrepublik Deutschland 1980 bis 1990,* vol. 11: *Theorie der Gegenwartskunst* (Münster: Lit, 1997); Günter Morsch and Christine Brade, *Ich dachte, Sie wären tot: NS-Mahnmale und Erinnerungsprozesse in Ostwestfalen-Lippe* (Bielefeld: Verlag für Regionalgeschichte, 1997); Günter Morsch, ed., *Von der Erinnerung zum Monument: Die Entstehungsgeschichte der Nationalen Mahn- und Gedenkstätte Sachsenhausen*, Schriftenreihe der Stiftung Brandenburgische Gedenkstätten, vol. 8, (Berlin: Hentrich, 1996); Ekkehard Mai and Gisela Schmirber, eds., *Denkmal – Zeichen – Monument: Skulptur und Öffentlicher Raum Heute* (Munich: Prestel, 1989).

14 See Hermann Lübbe, "Zeit-Verhältnisse," 1990, pp. 40–50.

15 See, for example, Mary Ceruti, *Where Is Production?*: *Inquiries into Contemporary Sculpture*, ed. Ruba Katrib (London: Black Dog Publishing, 2017); Ceruti, *How Does It Feel?: Inquiries Into Contemporary Sculpture*, ed. Ruba Katrib (London: Black Dog Publishing, 2016); Ceruti, *What About Power?: Inquiries into Contemporary Sculpture*, ed. Ruba Katrib (London: Black Dog Publishing, 2015); Eva Grubinger and Jörg Heiser, eds., *Sculpture Unlimited 2—Materiality in Times of Immateriality* (Berlin: Sternberg Press, 2015); Ursula Ströbele, ed., *24h Skulptur: Notes on Time Sculpture* (Berlin: Distanz, 2015); Richard Flood, Laura Hoptman, Massimiliano Gioni, and Trevor Smith, eds., *Unmonumental: The Object in the 21st Century* (London: Phaidon Press, 2012); Grubinger and Heiser, eds., *Sculpture Unlimited* (Berlin: Sternberg Press, 2011).

16 See Sabine B. Vogel, "Die Grenzenlosigkeit der Skulptur," *Kunstforum International* 229 (2014), pp. 30–85, here p. 30.

17 Andrew Denson, *Monuments to Absence: Cherokee Removal and the Contest over Southern Memory* (Chapel Hill, NC: University of North Carolina Press, 2017); Shiera S. El-Malik and Isaac A. Kamola, eds., *Politics of African Anticolonial Archive* (Lanham: Rowman & Littlefield, 2017); Anthony Downey, ed.,

of cultural debate rather than of shared national values and ideals. Reviving the academic study of monuments within discourses on sculpture, it becomes clear that there is an increasing interest in the monumental and its various forms for both cultural analysis and recoding.[18] At a time when protestors all over the world take down monuments that celebrate colonial histories, questions around monumentality are once again surfacing with force.

Alongside the possibilities of immersive digital technology and the internet, the twenty-first-century monumental codes have further expanded toward the unmonumental, the immaterial, and the virtual. This development goes hand in hand with a general expansion of the very idea of the public realm into virtual and digital spaces. Surprisingly, there are very few publications that focus on and deeply examine the impact of digital technology on sculptural production and in particular the discourse relating to monuments.[19] This is astounding when we remind ourselves that the fundamental delimitation of monumentality has been the subject of theoretical debate since at least the beginning of the last century. With distinctions between the virtual and the real, the digital and the analog, and the material and the immaterial becoming ever more elusive, offline public space and online public spaces are considered equally relevant sites to enact monumental structures.[20] By rethinking the function of sculpture as a monument vis-à-vis its expansion and boundary crossings through 3D technologies, augmented reality, and the internet, this text aims to conceptualize an *intermedial* and *nomadic* monumentality. It sets out with a careful iconographic reading of Allahyari's work *She Who Sees the Unknown: Aisha Qandisha* and then places the artist's practice in conversation with the work by artist Shirin Fahimi and her *Umm al Raml's Sand Narratives*. How does twenty-first-century monumentality need to be rethought?

Dissonant Archives: Contemporary Visual Culture and Contested Narratives in the Middle East, Visual Culture in the Middle East Series, vol. 2 (London: I.B. Tauris, 2015); Ana Lucia Araujo, *Politics of Memory: Making Slavery Visible in the Public Space,* Routledge Studies in Cultural History, vol. 17 (New York: Routledge, 2012); Daniel J. Walkowitz and Lisa Maya Knauer, eds., *Contested Histories in Public Space: Memory, Race, and Nation* (Durham, NC: Duke University Press, 2009); K. S. Inglis, *Sacred Places: War Memorials in the Australian Landscape*, 3rd ed. (Carlton: Melbourne University Publishing, 2008); Joanne M. Braxton and Maria Diedrich, eds., *Monuments of the Black Atlantic: Slavery and Memory,* FORECAAST, vol. 13 (Münster: Lit, 2004); W. J. T. Mitchell, *Art and the Public Sphere*, 2nd ed. (Chicago: University of Chicago Press, 1993).

18 See, in this context, one of the most recent publications, Nausikaä El-Mecky, "Illegal Monuments: Memorials between Crime and State Endorsement," in *Monument Culture: International Perspectives on the Future of Monuments in a Changing World*, ed. Laura A. Macaluso, American Association for State and Local History Book Series (Lanham, MD: Rowman & Littlefield, 2019), 177–89. In 2020, *e-flux architecture* and Het Nieuwe Instituut hosted a discursive series on monuments, see "Monument," Het Nieuwe Instituut, Research & Development, last modified September 17, 2020, https://research-development.hetnieuweinstituut.nl/en/research-projects/monument (accessed October 12, 2020).

19 Important contributions to this rethinking of sculpture in the digital age have been made by the DFG-funded research project at the University of Siegen, *Virtualisierung von Skulptur. Rekonstruktion, Präsentation, Installation* (2002–09) under the direction of Manfred Bogen, Jens Schröter, and Gundolf Winter, however not in relation to the monument. See Christian Spies, Jens Schröter, and Gundolf Winter, *Skulptur – Zwischen Realität und Virtualität* (Munich: Wilhelm Fink, 2006).

20 For deeper reflections on the dissolution between digital and physical worlds in the context of the post-digital, see the introduction to this volume.

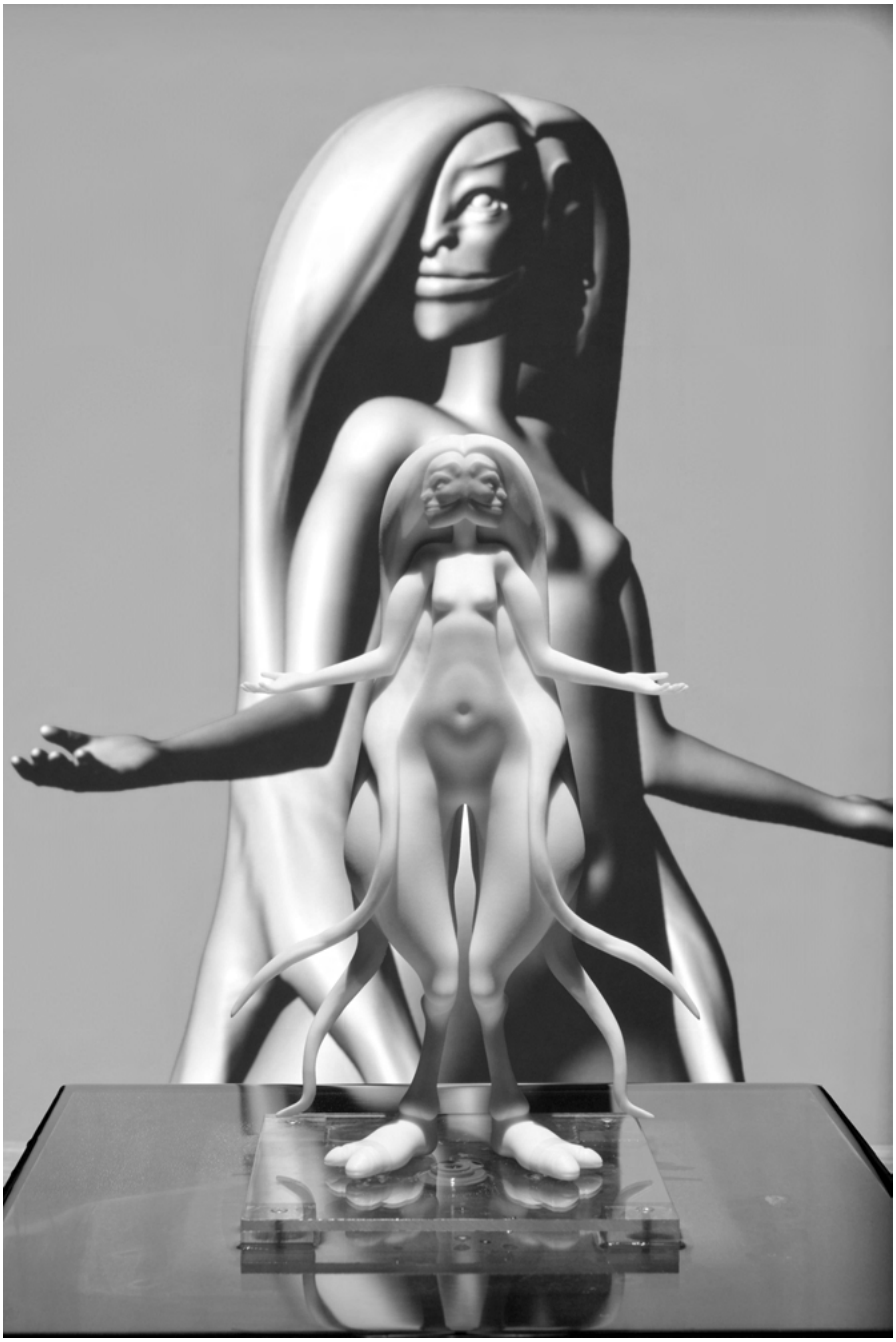
Sculpting Memories

The center of the sculptural installation *She Who Sees the Unknown*: *Aisha Qandisha* by Iranian and US-based artist Morehshin Allahyari at the MacKenzie Art Gallery in Regina, Canada, is a small white figure (fig. 1). The creature is two-headed, with each head facing opposite directions like a Janus head. Its thighs are split open. All the way to the abdomen, the figure appears to be composed of two parts. It has a front and a back with a distinct void in the middle. Its inviting and confident pose seems welcoming and intimidating at the same time.

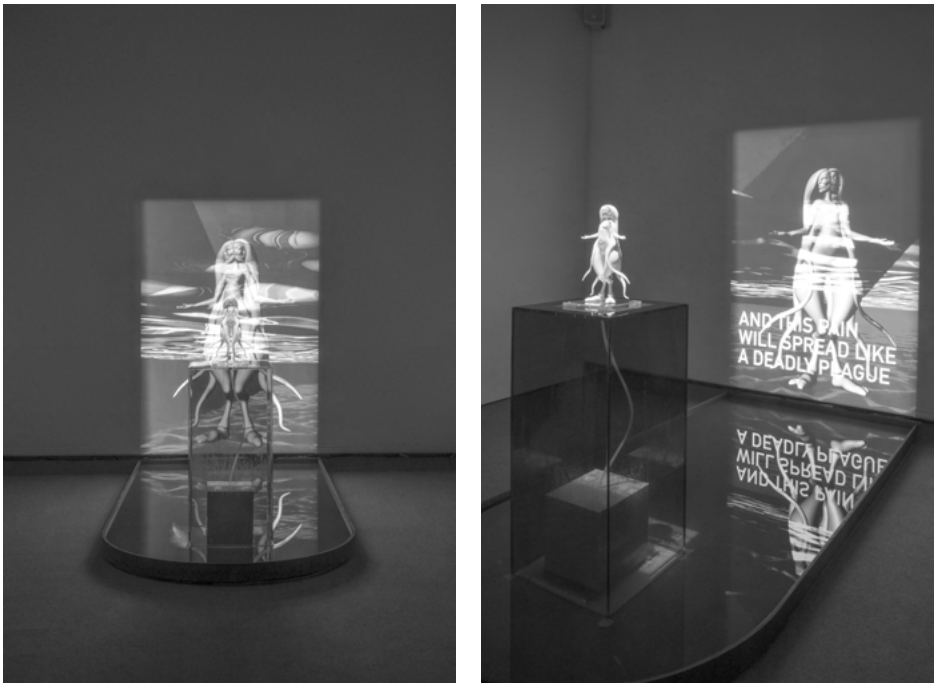
The chimera, half human and half animal, is made from white resin and sits on a red translucent plastic plinth that is placed inside a water basin. The highly reflective surface of the water functions like a mirror that factors into the video projection on the wall behind the display. In Allahyari's video essay, the monstrous figure appears against a red background. It stands thigh-high in water. While the actual figure on the plinth is around 35.5 centimeters high, 23.8 centimeters wide, and 8.6 centimeters deep, and therefore relatively small, the video projection shows the mythological figure of Aisha Qandisha (or Aicha Kandicha) in human-size. When positioned in front of the installation at the MacKenzie Art Gallery, the actual 3D-printed figure and its projection are overlaid and the object and image merge into each another. The figure's physical features are augmented by its digital counterpart which magnifies its sculptural presence and relates it to the visitors' body. Upon entering Allahyari's installations, the physicality of her 3D-printed object and its virtual equivalent in the video essay begin to converge. As a connector and transgressor between the realm of the physical and the digital, the 3D-sculpted object is positioned at their boundary (fig. 2). Water, sculpture, and screen engage spectators and implicate them into an intimidating and commemorative spatial experience. Allahyari's *Aisha/Quandisha* is part of the series *She Who Sees the Unknown*, which revives the memory of the partly forgotten but once powerful jinns and goddesses of Middle Eastern origin by representing them in sculptural forms. In pre-Islamic mythology and Islamic theology, jinns play a central role. They are fearsome and honored creatures that reveal themselves to humans either to solve or create catastrophic situations.[21] At the heart of her series, Allahyari places the reconstruction of these monstrous, often female or gender neutral figures and their stories using 3D-sculpting and -printing.

Combined across the works in her series—including *Ya'jooj Ma'jooj*, *Huma*, *Kabous: The Right Witness,* and *The Left Witness* as well as *The Laughing Snake*—Allahyari reveals herself to be engaged in complex cross-media dialogues, incorporating 3D-printed sculptures,

21 For comprehensive research on the importance of jinns, see G. Hussein Rassool, *Evil Eye, Jinn Possession, and Mental Health Issues: An Islamic Perspective* (London: Routledge, 2018); Robert W. Lebling, *Legends of the Fire Spirits: Jinn and Genies from Arabia to Zanzibar* (London: I. B. Tauris, 2010); Amira El-Zein, *Islam, Arabs, and the Intelligent World of the Jinn*, Contemporary Issues in the Middle East (Syracuse, NY: Syracuse University Press, 2009); Waḥīd ʿAbd al-Salām Bālī, *Man's Protection against Jinn and Satan*, trans. Haytham Kreidly (Beirut: Dar al-Kotob al-Ilmiyah, 2006).



1 Morehshin Allahyari, *She Who Sees the Unknown: Aisha Qandisha*, 2019, installation with 3D-printed resin sculpture, reflecting pool, and HD video.



2 Morehshin Allahyari, *She Who Sees the Unknown: Aisha Qandisha*, 2019, installation with 3D-printed resin sculpture, reflecting pool, and HD video.

videos, VR experiences, the internet, and, at times, performance.[22] The connective tissue in the series, however, is the materialization of her composite figures in sculptural form. Their space-encompassing presentations are not only intended to preserve, protect, celebrate, and archive their historical influence, they also allow the artist to recode, or in her words "refigure," their historical trajectory for critical and creative reflections on the contemporary experiences of Southwest Asian and North African (SWANA) women.[23]

Allahyari's work *She Who Sees the Unknown*: *Aisha Qandisha* revolves around a she-demon, also called *jinnia*, who is deeply rooted in North Moroccan popular beliefs and which Allahyari has revived using 3D technology and storytelling. Still relevant today, the belief in Aisha Qandisha, and Allahyari's interpretation of it, embodies the fear of female influence and power. Allahyari describes the symptoms of a spell by Aisha Qandisha in a passage

22 For a comprehensive documentation of the project, including images of the works, see Morehshin Allahyari, "She Who Sees the Unknown by Morehshin Allahyari," http://shewhoseestheunknown.com/ (accessed February 8, 2020).

23 SWANA is a decolonial acronym for the South West Asian/North African region. It is used instead of terms such as Middle Eastern, Near Eastern, Arab World or Islamic World that have colonial, Eurocentric, and Orientalist origins, see SWANA Alliance, "About," website, https://swanaalliance.com/about (accessed October 24, 2022).

of her video essay. A possessed man is said to suffer from blindness, paralysis, muteness, impotence or a disinterest in other women.[24] This fear can be traced back to the ancient goddess of love, Astarte or Astart who reached Morocco via the ancient city Carthage.[25] Fallen to the ranks of a Moorish *jinnia*, Aisha Qandisha is considered to be an updated version of the powerful goddess, who is thought to have her origin and counterpart in the early Semitic matriarchies.[26] With the change from a matriarchal to a patriarchal social structure, women were robbed of their powerful status. Once influential goddesses were turned into jinns thought to pose real danger to their male counterparts.[27] Allahyari's work not only reinscribes Aisha Qandisha back into contemporary memory culture, but also into a whole lineage of women reaching from the Semitic matriarch, to the goddess Astarte, to contemporary SWANA woman represented by the artist herself.

Her installations thereby not only evolve around memory assemblages surrounding her jinns, but more precisely an artistic embodiment of these memories and their aesthetic formation. In his pioneering book *Les Cadres Sociaux de la Mémoire* (1925), Maurice Halbwachs conceptualized the social dimension of individual memory, reminding us that an individual's memories are always situated within their sociocultural context.[28] Pierre Nora call this a "lieux de mémoire," a memory site "where memory is crystallized, in which it finds refuge."[29] Astrid Erll has further specified that the emergence and life of memory sites depend "on repeated media representations, on a host of remediated versions of the past which converge and coalesce"—a dynamic that strongly underpins Allahyari's work with memory.[30] The German couple Aleida and Jan Assmann coined the term "cultural memory" to speak about a form of memory that is tied to material objectivizations, such as images, texts or works of art. Cultural memory refers to objectified and institutionalized memories that can be stored, transferred, and reincorporated throughout generations.[31] "The concept of cultural memory comprises that body of reusable texts, images and rituals specific to each society, in each epoch, whose 'cultivation' serves to stabilise and convey that society's self-image. Upon such collective knowledge, for the most part (but not exclusively) of the

24 Jordi Aguadé, "Â'isha Qandîsha," in *The Encyclopaedia of Islam*, eds. Hamilton A. R. Gibb (Leiden: Brill, 1954), p. 85.

25 See Manfred Lurker, *The Routledge Dictionary of Gods, Goddesses, Devils and Demons*, 2nd ed. (London: Routledge, 2004), p. 157; Edward Westermarck, *Ritual and Belief in Morocco* (London: Macmillan & Co., 1926), p. 395.

26 Ibid., p. 396.

27 See James Hastings, *Encyclopaedia of Religion and Ethics*, vol. 2 (Edinburgh: T. & T. Clark, 1908), p. 115.

28 See Maurice Halbwachs, *Les Cadres Sociaux de la Mémoire* (Paris: Librairie Félix Alcan, 1925), p. ix.

29 Pierre Nora and Lawrence D. Kritzman, *Realms of Memory: Rethinking the French Past.* vol. 1: *Conflicts and Divisions*, trans. Arthur Goldhammer (New York: Columbia University Press, 1996), p. 1.

30 Astrid Erll and Ann Rigney, "Introduction: Cultural Memory and its Dynamics," in *Mediation, Remediation, and the Dynamics of Cultural Memory,* ed. Astrid Erll and Ann Rigney (Berlin: De Gruyter, 2009), pp. 1–14, here p. 4.

31 Jan Assmann, "Communicative and Cultural Memory," in *Cultural Memory Studies: An International and Interdisciplinary Handbook*, ed. Astrid Erll, Ansgar Nünning, and Sara Young (Berlin: De Gruyter, 2008), pp. 109–18, here pp. 110–11.

past, each group bases its awareness of unity and particularly," Jan Assmann writes.[32] They thereby distinguished and refined Halbwachs's notion of "collective memory" by subdividing it into "cultural" and "communicative memory," in order to examine the distinct forms of transmission of memory.[33] While "cultural memory" is linked to objectified memory, "communicative" memory designates acts of transmission of memory in everyday oral practices.

Throughout the series *She Who Sees the Unknown*, the sculptural matrix maintains an important reference point to transmit both cultural as well as communicative memory. This "objectification" of memory is key in illuminating the multi-layered trajectories and memory assemblages surrounding Allahyari's protagonists. This also becomes evident with the presentation of her hypertext narrative *The Laughing Snake,* an online narrative that weaves together Allahyari's personal experiences of molestation, coercion, and cultural castigation growing up in post-revolutionary Iran with the myth of *The Laughing Snake. The Laughing Snak*e is a tale that appears both in the illustrated manuscripts from the *Book of Felicity* and the *Kitab al-Bulhan* (often translated as the *Book of Wonders* or the *Book of Surprises*). The *Book of Felicity* was commissioned by the Ottoman Sultan Murad III in 1582.[34] Its story involves a female jinn with a face of a human and the body of a snake who conducts a murderous rampage. She conquered cities, murdering human and animals alike. Numerous attempts to kill the jinn were unsuccessful. The way she was finally defeated was by holding a mirror in front of her; confronted by her own reflection she laughed until she died. Although the exact literary source of the tale remains unknown, its association with a number of legends is evident. These include Narcissus, Medusa, and the Gorgons, as well as the Iranian motif of the horse-phoenix that killed people by making them laugh.[35] One may also think of the basilisk in Roman mythology, a reptile with a terrifying stare, which translates in Persian as "laughing snake," or the epic Iranian figure of Zahhak, "the man who laughs," who grew two hungry snakes on his shoulders.[36]

The sculptural quality of Allahyari's work is not only discernable in the presentation of *Aisha/Qandisha*, where the figure is presented on a plinth and it is monumentally extended via the screen and amplified even further through its reflection in the surrounding water (fig. 2). It is also present in the exhibition setting of the *Laughing Snake*. In a room completely decked out with mirrors, a 3D-printed and painted figure (41.9 by 63.5 by 10.1 centimeters) of the *Laughing Snake* is dangled from the ceiling and completes the

32 Jan Assmann and John Czaplicka, "Collective Memory and Cultural Identity," *New German Critique*, no. 65 (1995): 125–33, here 132.

33 Assmann, "Communicative and Cultural Memory," 2008, p. 110.

34 See Miguel Ángel de Bunes Ibarra and Evrim Turkcelik, *The Book of Felicity | Matali' al-Saadet | Islamic Art, Astronomy and Astrology* (Barcelona: M. Moleiro Editor S.A., 2008); Stefano Carboni, "The 'Book of Surprises' (Kitab al-Bulhan) of the Bodleian Library," in *The La Trobe Journal* (Love and Devotion: Persian Cultural Crossroads, State Library of Victoria Foundation, 2013), p. 22, https://research-repository.uwa.edu.au/en/publications/the-book-of-surprises-kitab-al-bulhan-of-the-bodleian-library (accessed September 23, 2020).

35 See Carboni, "The 'Book of Surprises'," 2013, p. 29.

36 See Ibid.

3 Morehshin Allahyari, *She Who Sees the Unknown: The Laughing Snake*, 2019, installation with 3D-printed plastic sculpture, mirrored room, and interactive hypertextual narrative, at *Refiguring the Future*, Hunter College, New York.

futurist, shrine-like installation (fig. 3). Once again, the presentation alludes to a sanctified, devotional space. The spatial experience magnifies the viewers body and extends it along with the sculptural object beyond its actual boundaries.

Allahyari constructs structures that address and implicate the viewers' bodies in an experiential and sculptural setting. At the same time, her works are places that house gendered and diasporic memories and histories that the artist enacts through digital technologies. It is this intentional fixation of memories in *sculptural* modes, their embodiment in a designated form and site, that not only suggests a discussion of Allahyari's work in the context of digital, diasporic, and generative archives. It also positions her work in proximity to monumental codes, in the sense of memorial structures that aim to transmit a message for the future through visual modes. Rethinking the function of monuments under digital terms, what forms of monumentality does such work educe?

Recoding Monuments

بنای یادبود

Distinct from an archive, a monument indicates something that is emphasized in a double sense in regard to the cause for its representation as well as its form.[37] A monument highlights something worthy of glorification or remembrance. [38] Compared to an archive, a monument is thus not only an embodiment of a memory in a textual or physical format, but also a particularly motivated form of art object often in sculptural form. From its earliest usages until today, the word "monument" refers to a human artifact erected to preserve the memory of a notable person, action or an event.[39] Monuments memorialize and are therefore also called memorials. While archives record the past and its memories in wider, more diffuse forms, monuments are *intentional* memory structures often in a sculptural form that record the past but are equally enacted to convey a message to the future. Following Foucault, the archive is always already a representation of a taxonomy, classification, and annotation of knowledge.[40] Monuments in comparison, transcend the mere act of archiving and move toward structures that commemorate and monumentalize.[41]

The English (and German) word, "monument," derives from the Latin word *monumentum*, something that reminds.[42] The German word *Denkmal* is an exception to the pattern. It has its roots in "to think" but is often used synonymously with monument. "Memorial" derives directly from the Latin word *memoria*, "memory," and notably monuments convey memory. The word "monument" also links to the Latin word *manere*, something that remains.[43] From the same origin derives *monere*, to remind, and *monimenta*, memorials or burial places who remind those who are passing by that they themselves existed and are mortal.[44] Following these origins, other things that are written or produced for the sake of memory are called *monimenta*, "reminders."[45] According to *The Chambers Dictionary*, the word "monument" can either refer to "a statute, trophy, building or sim, erected to commemorate a

37 See Albrecht Graf von Egloffstein, "Das Denkmal – Versuch einer Begriffsbestimmung," in Mai and Schmirber, eds., *Denkmal – Zeichen – Monument, 1989,* pp. 38–41, here p. 38.

38 Ibid.

39 See Marita Sturken, "Monuments," in *Encyclopedia of Aesthetics*, ed. Michael Kelly (New York: Oxford University Press, 1998), pp. 272–76, here p. 274.

40 See Michel Foucault, *The Archaeology of Knowledge* (New York: Pantheon Books, 1972), p. 22.

41 For a nuanced discussion of Allahyari's work in the context of archives and monuments, see the chapter "Monumentality: Sculpting Memories between Monuments and Archives," in Mara-Johanna Kölmel, *Sculpture in the Augmented Sphere: Reflections at the Intersection of Corporeality, Plasticity and Monumentality*, PhD diss. (Lüneburg: Leuphana University, 2022).

42 See Robert K. Barnhart, ed., *Chambers Dictionary of Etymology* (Edinburgh: Chambers, 1999), p. 675.

43 See Andrew Hui, "Texts, Monuments and the Desire for Immortality," in *Moment to Monument: The Making & Unmaking of Cultural Significance*, eds. Ladina Bezzola Lambert and Andrea Ochsner (Bielefeld: transcript, 2008), pp. 19–33, here p.20.

44 Ibid.

45 Ibid.

person or event," a "tomb," "anything which serves as a commemoration, a memorial," but also a "written memorial, document, record" or "a literary work, book, writings, literature."[46] A monument is thus an embodiment of a memory in a textual, physical, or sculptural form. Using visual codes, monuments aim to convey and transmit a message. The German art historian Alois Riegel defined the monument as an object that itself preserves an element of the past. He distinguishes between two types of monuments – intentional ones, whose lasting significance is determined by its makers, and unintentional ones who achieve their monumental status through later events.[47]

یادبود (Yādbūd) is the Persian word for "monument, memorial or landmark." In a literal sense, it can be translated as an "aid to memory," something used as a reminder of something or someone. The word is tied to the Persian word بنای یادبود (Banāye Yādbūd), which means "memorial or monument" and commonly refers to a construct, a figure, or a building. Other words that are used for memorials are لوح یادبود (Loḥe Yādbūd), which is more commonly used for a "memorial plaque, board," or even a valuable sheet of paper, as well as یادگار (Yādegār), which is translated as "relic, souvenir, memorial, memory, evocation, or token."[48] While memorials mainly focus on paying tribute to the dead by emphasizing loss or sacrifice, monuments in both the West and the SWANA region can honor and be a reminder of the past in wider forms.[49] They not only reconstruct the past to communicate it to future generations, they also actively take part in these realities and are able to shape them. In interviews and public presentations, Allahyari has suggested that *She Who Sees the Unknown* not only aims to challenge "the limitations and possibilities of remembering and forgetting," but is also intended "to remind women, *femmes*, the people of the Middle East that our figures and our stories, fictional and actual, matter—not just for the present but for claiming of an alternative future that is not exclusively white or Western."[50]

Allahyari's works can thus be described as being in the proximity of monuments in the sense of *memorial structures* that aim to transmit a message for the future. Allahyari's work goes toward the development of future-oriented structures, which are intended to commemorate, bring people together, or, in other words, to memorialize, to remind, to instruct the public, as in the derivation of the word "monument."

46 Editors of Chambers, *The Chambers Dictionary,* 12th ed. (Edinburgh: Chambers, 2011), p. 995.

47 See Alois Riegl, "The Modern Cult of Monuments: Its Character and Its Origins," trans. Kurt W. Forster and Diane Ghirardo, *Oppositions: A Journal for Ideas and Criticism in Architecture* 25 (Fall 1982): 21–56.

48 My sincere thanks to Dr. Zahra Samareh, translation researcher, authorized translator, and sworn interpreter for Persian, for providing generous support with the spelling, translation, and transliteration of the Farsi words.

49 See Sturken, "Monuments," 1998, p. 274.

50 "Morehshin Allahyari: She Who Sees the Unknown: The Laughing Snake," *Art-Agenda*, Announcements, https://www.art-agenda.com/announcements/216308/morehshin-allahyarishe-who-sees-the-unknown-the-laughing-snake (accessed February 6, 2020).

Another example of such an approach is the work of Iranian and Toronto-based artist Shirin Fahimi.[51] Fahimi shares with her colleague and collaborator Allahyari an interest in SWANA mythology, in magic, esoteric, and spiritual practices and their revival through the lens of technology. At the heart of her projects is the act of reworking and reclaiming forgotten memories and beliefs of the SWANA region and making them fruitful for our present and future. *Umm al-Raml*, the mother of sand, is a fictional persona that Fahimi has been developing throughout different iterations and in performative collaborations, also with Allahyari. Known as the opener of time and space, Fahimi's *Umm al-Raml* masters *ilm al raml*, or science of sand, known as geomancy in English, a centuries-old method of divination practiced in Iran until today.[52]

Raml means sand and points to the conceptual core of *ilm al raml* that entails predicting the future from tracing figures in sand or the earth. Since the Golden Age of Islam (ca. 8th–14th century), sand was used as a medium for predicting such things as the weather, victories, or personal events. Ibn Khaldun, a well-known Muslim scholar, implies that geomancy was developed to avoid difficult calculations, such as that of the planetary positions required by astrology.[53] Put differently, *ilm al raml* uses algorithmic procedures, some of the oldest material practices, to try and understand the beyond. Shirin sees this cultural technique as an important precursor of the algorithmic procedures underpinning today's digital space, and as an attempt to counter the lack of reference to female spiritualism and prophecy in the literature on *ilm al raml*. But it is also important to note the ancient mathematical structures that are based on binary codes, one and zero configurations, that underpin ritualistic practices of divination. Such practices have been dismissed as irrational or superstitious in the contemporary era, but in fact may help us to understand the algorithm as an "emergent form" throughout history rather than a "technological a priori."[54] Fahimi however, reimagines the history of *ilm al raml* from the perspective of a female *rammal* (geomancer). Her work broaches the gender bias embedded in the contemporary practice of "occult" sciences or divination techniques in which women practicing these methods are perceived as naive, uneducated or prone to superstition. She thereby questions how the exclusion of women from spiritual leadership in Islam influences their exclusion from political power in society. Her *Umm al-Raml* thus represents a female prophet, one of the many

51 See, in this context, Shirin Fahimi's website shirinfahimi.com/home.

52 See "Pattern Recognition: From Tracing Figures in Sand to Devising Other Futures: A Conversation between Shirin Fahimi and Mara-Johanna Kölmel," Akademie-Solitude.de*,* blog, February 24, 2021, https://www.akademie-solitude.de/de/web-residencies/pattern-recognition-from-tracing-figures-in-sand-to-devising-other-futures/ (accessed January 29, 2023).

53 See Marion B. Smith, "The Nature of Islamic Geomancy with a Critique of a Structuralist's Approach," *Studia Islamica* 49 (1979): 5–38, here 31.

54 Matteo Pasquinelli, "Three Thousand Years of Algorithmic Rituals: The Emergence of AI from the Computation of Space," *e-flux,* no. 101 (June 2019), https://www.e-flux.com/journal/101/273221/three-thousand-years-of-algorithmic-rituals-the-emergence-of-ai-from-the-computation-of-space/ (accessed January 29, 2023).

4 Shirin Fahimi, *Umm al Raml Sand Narratives: First Story*, 2021, screenshots, augmented reality. Open this link on a mobile device to see the effect preview: https://www.instagram.com/umm.al.raml/?hl=de.

female forces that have been erased throughout history. Using digital means, Fahimi aims to bring this empowering female presence back into the public sphere.

For a web residency at the Akademie Schloss Solitude in 2021, Fahimi created a 3D model of her *Umm al-Raml* avatar in form of an Instagram filter (fig. 4). Using this augmented reality filter that you can access through Fahimi's Instagram account, the avatar alongside her tools for divination appear virtually in the user's chosen public and private spaces. Pairing the chosen space and the filter, one thereby experiences the mother of sand inhabiting a hybrid space between the actual and virtual spheres. By making the viewer complicit in enacting *Umm al Raml's* presence with a phone device, Fahimi inscribes her figure into public life. At the moment of using the filter, the space onto which Fahimi's avatar is projected becomes a commemorative site, a structure that reminds and monumentalizes *Umm al Raml* alongside the centuries-old divination technique *ilm al raml*. Her work thus offers a temporary monument to this fictional figure that emerges from the overlap of a virtual avatar and a physical place.

In a further iteration of her project, *Umm al Raml's Sand Narratives*, Fahimi uses virtual reality to tell the individual stories of four Iranian women that practice mysticism in Toronto. Fahimi highlights their approach to female prophecy and interweaves their stories with her own approach to *ilm al raml*. Her VR experience transports the viewer into a sandy, desert-like landscape that hosts sixteen houses (fig. 5). Corresponding in their spatial structure to a geomantic divination, these houses open different doors toward the past, future, and present. The houses speak to the female encounter with mysticism and divination

5 Shirin Fahimi, *Avaz-e-Eshgh in the House of Fire & Rose in the House of Water*, from *Umm al Raml's Sand Narratives*, 2022, digital rendering of 3D models.

techniques and allow the users to create paths to different epochs. By moving between the houses via steps or by using the VR teleport function, time takes on a spatial quality. Within each house there are series of 3D objects and videos alongside sculptural busts of each woman. Their faces, however, are covered by a face mask to protect their identity and create a mystical presence. These installations talk about the women's spiritual journey in the context of their diasporic experiences, their interpretation of "foreseeing" the future, and their reflection on the power of female prophecy.

Fahimi's work not only evolves from the women's individual memories, but from their artistic embodiment and their aesthetic formation in a dedicated site and form. Fahimi reformats their memories using VR technology to create a memorial structure, and a particularly contemporary one at that. The immersive, participatory potential of her work and the VR technology she uses are key in illuminating the multilayered narratives and memory assemblages that lie behind the protagonists of her installations.

Within this VR experience, the objects, videos, and busts take on sculptural qualities. As 3D objects, they appear larger than life and evoke a monumental feel. One can move around or through them and see them from multiple perspectives, like objects in actual space. Of course, they are not haptic objects in space but visual ones that address the viewer's body primarily through their gaze. While the movements of the users in Fahimi's VR landscape do not translate to movements of their bodies in actual space, the work however

does evoke a whole-body experience. Through the soundscape, the tactility of the controller, and the life-size object and figures in her VR world, the viewer becomes immersed through what Ursula Ströbele calls in this volume "a dynamic coupling of body and virtual space/image and the indiscernibility of perception and affection."[55] Mediating between collective and individual, as well as present and past memory, the VR experience animates and sculpts Fahimi's narrative.

The VR work itself thereby begins to function like an accessible and immersive monumental structure to remind, commemorate, and preserve the spiritual and mystical voyages of Iranian women in diaspora for future generations. Inscribed into Fahimi's approach to 3D-spatial-capture technology and augmented reality, is thus a proposal of recoding both digital and physical space as a site for commemorating alternative histories and erased memories.

Intermedial Monumentality

Rather than reverting to a monumental vocabulary linked to solidity, grandeur, or material vehemence, Allahyari and Fahimi recode monumental structures using digital technology to speak about acts of cultural forgetting that reveal themselves to have complex gendered characteristics. Their work thereby transgresses the boundaries of how memories have typically been solidified in aesthetic and monumental forms. To this end, Allahyari and Fahimi fuse participatory, interactive, and time-based qualities with a three-dimensional experience of their work in the form of space-encompassing or immersive presentations. In *She Who Sees the Unknown*, Allahyari constructs memory sites that unfold across the medium of sculpture, digital files, projections, as well as storytelling. Through the figure's elevation on a plinth, its expansion through its reflection in the water, its augmentation through the digital projection on the wall and its soundscape, Allahyari incorporates the spectator in a memory site and at the same time a sculptural setting that imitates a sacred space for commemoration and remembrance (figs. 1–2). This sculptural quality of her work is also magnified in the exhibition setting of *The Laughing Snake* and by the many reflections of the object in the space. Allahyari's orchestration is thereby also evocative of spaces that are sacred and monuments to jinns. In Aisha Qandisha's case, these are usually pits, grottos, springs, and fountains as well as places where someone has seen her.[56] In the exhibition setting of Fahimi's *Umm al Raml's Sand Narratives* one enters the gallery through a hall covered in sand that echoes the terrain of her VR experience. At the heart of the exhibition, one finds a sculptural structure illuminated by green LED lights that bear the same contours of the houses in her VR experience (fig. 6). It houses the reality headset and controller to enter the

55 Ursula Ströbele, "Notes on Truth to Materials, the Aesthetic Limit, Site-Specificity and 3D-Printing" in this volume.

56 Vincent Crapanzano, *The Hamadsha: A Study in Moroccan Ethnopsychiatry* (Berkeley: University of California Press, 1973), p. 145.

6 Shirin Fahimi, *Umm al Raml's Sand Narratives*, 2022, exhibition view at articule, Montreal. Photo: Guy L'Heureux.

VR world and is surrounded by human-sized digital screens broadcasting interviews with Fahimi's masked protagonists.

More precisely, it is then Allahyari's and Fahimi's intermediality, their mixing of analog and digital techniques of storytelling, moving image, and sculptural vocabularies that allow them to expand codes of monuments.[57] In their works, the monumental is no longer merely bound to the typical aesthetic form of monument but rather functions as an expanded site for commemoration. Allahyari and Fahimi foster an intermedial monumentality that, through its heterogeneous media, questions a monument's ability to bury memory under a monolithic material form. Following Klaus Bruhn Jensen's reflection on twentieth-century avant-gardes and their embrace of heterogeneous media, the term intermedia can once again be employed to speak of a transgression and innovation of a sculptural form, namely the monument, which is now articulated in the interstices between different media forms.[58]

57 The term "intermedia" was coined in the context of 1960s discourses on the structural interactions and overlaps of different art forms. See, in this context, Dick Higgins, "Intermedia," *Something Else Newsletter* (1965), reprinted in *Horizons: The Poetics and Theory of the Intermedia* (Carbondale and Edwardsville, IL: Southern Illinois University Press, 1983). The term "intermedium" is adapted from Samuel Taylor Coleridge, "Lecture No. 3, On Edmund Spencer," reprinted in *Coleridge's Miscellaneous Criticism*, ed. Thomas Middleton Raysor, lecture III (London: Constable & Co, 1936), pp. 21 and 31ff.

58 See Klaus Bruhn Jensen, "Intermediality," in *The International Encyclopedia of Communication Theory and Philosophy,* eds. Eric W. Rothenbuhler, Klaus Jensen, Jefferson Pooley, Robert T. Craig (Hoboken: Wiley Online Library, 2016), pp. 1–12, here p. 1.

Such intermedial monumentality uses numerous media to diversify its message and thus reinscribe and transmit memories. Crafted from myth, historical data, and very personal experience, Allahyari and Fahimi's works' intermedial monumentality uses hybrid modes including sculptural objects, video projections, hyper-narratives, and sound to reframe relationships between past, present, and future and inscribes the marginalized into the developing script. On one hand, their work thereby becomes evidence to the monument's durability and its continued social function. On the other hand, it is witness to the dramatic change in aesthetic codes of monuments or counter-monuments, and their expansion into the digital sphere.

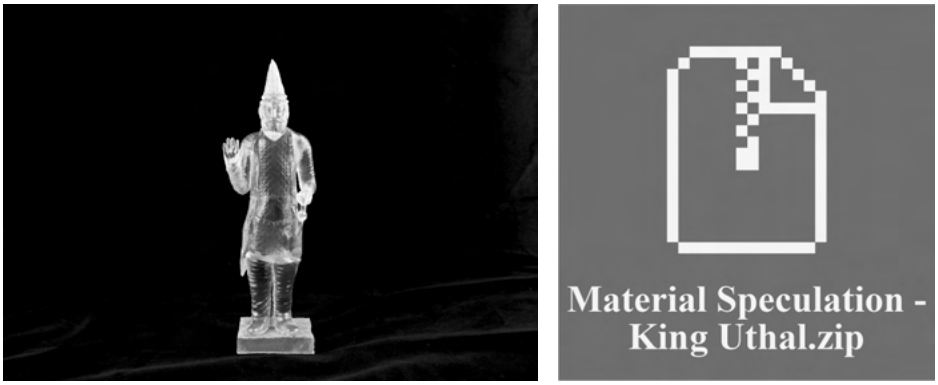
Nomadic Monumentality

Fahimi and Allahyari's works thereby become amalgamating of different individual and collective memories, experiences, influences, and sources from here, there, and elsewhere. Their works could thus be described in a way Avtar Brah describes diasporic experiences, namely as "contested cultural and political terrains where individual and collective memories collide, reassemble and reconfigure."[59] Similar to Allahyari, Fahimi enacts in her work alternative structures of remembrance, a proposal of what one could call an augmented, intermedial, and yet nomadic monumentality that may also speak to the artist's own diasporic position.

This form of monumentality can also be demonstrated with Allahyari's *King Uthal* for her *Material Speculations: ISIS* series.[60] It is here that the artist uses her typical triad of research, archiving, 3D-modeling, and -printing, to digitally recreate twelve selected monuments from the Roman city of Hatra and Assyrian artifacts from Nineveh, which were purposefully destroyed by Isis in 2015. The files of one of the reconstructed monuments, to King Uthal of Hatra, is made available online on rhizome.org for download and printing (fig. 7). In this way, Allahyari subtly subverts and criticizes the institutional implications (from erecting to distribution) of monuments, yet equally critiques the iconoclastic acts of destruction against monuments that have been a part of their history since their beginnings. Her use of digital technology not only allows her to critically comment on ordinary public monuments, but to actively reshape their aesthetic and functions. As a downloadable .STL and .OBJ file, the former and now-destroyed monument of King Uthal has exchanged its solidity with a nomadic mutability that is further contextualized by research documents and data related to the original statues, all available in the downloadable folder. The work thereby assumes a nomadic monumentality that reaffirms and multiplies its presence as memory sites every time the folder is downloaded to someone's hard drive. The memory sites that her nomadic monuments mark can then be described as having several locations

59 Avtar Brah, *Cartographies of Diaspora: Contesting Identities* (London: Routledge, 1996), p. 193.

60 For an in-depth reading of Allahyari's work *Material Speculations: ISIS*, see also the contributions by Verena Kuni and Ursula Ströbele in this volume.



7 Morehshin Allahyari, *Material Speculations: ISIS, King Uthal*, 2015–16.

and materialities at the same time. They have a digital materiality existing in form of a file on Rhizome's servers or after a download on an individual's computer, but they can also assume an actual materiality and location in form of a 3D-printed object in actual space. Allahyari's project does not claim to be comprehensive copies of destroyed artifacts and monuments. The objects themselves do not conceal their role as plastic containers. Her works act as monuments in response to an absence of monumentality. They are stand-ins, reminders of destroyed memory sites that at the same time reveal and display the information and causes of their absence. The cultural information and critique that these works convey becomes more important than the object itself.

Allahyari's and Fahimi's works invite a collective form of remembrance in the public arena of the internet, virtual reality, as well as physical sites that can take root in a community and strongly resembles the functions and structures of monuments. They thereby activate the digital realm as a monumental space. This gesture may also link to a Persian understanding of monumentality that is not based around singular objects but expanded toward whole cities and entire spaces, such as Persepolis or Hatra. The "monumentalization of the public sphere is therefore among the most striking phenomena of the Middle East," according to Jean-Baptiste Yon.[61] One might then even argue, as I have done elsewhere, that Allahyari and Fahimi apply the expanded notion of Persian monumentality within the digital realm.[62]

61 Jean-Baptiste Yon, "Hatra and Palmyra: The Monumentalization of Public Space," in *Hatra: Politics, Culture and Religion between Parthia and Rome, Oriens et Occidens*, 21., ed. Lucinda Dirven (Stuttgart: Franz Steiner, 2013), pp. 161–70, here p. 161.

62 See Kölmel, *Sculpture in the Augmented Sphere*, 2022.

8 John Craig Freeman, *Border Memorial: Frontera de los Muertos*, 2012, augmented reality public art, Lukeville border crossing, Arizona.

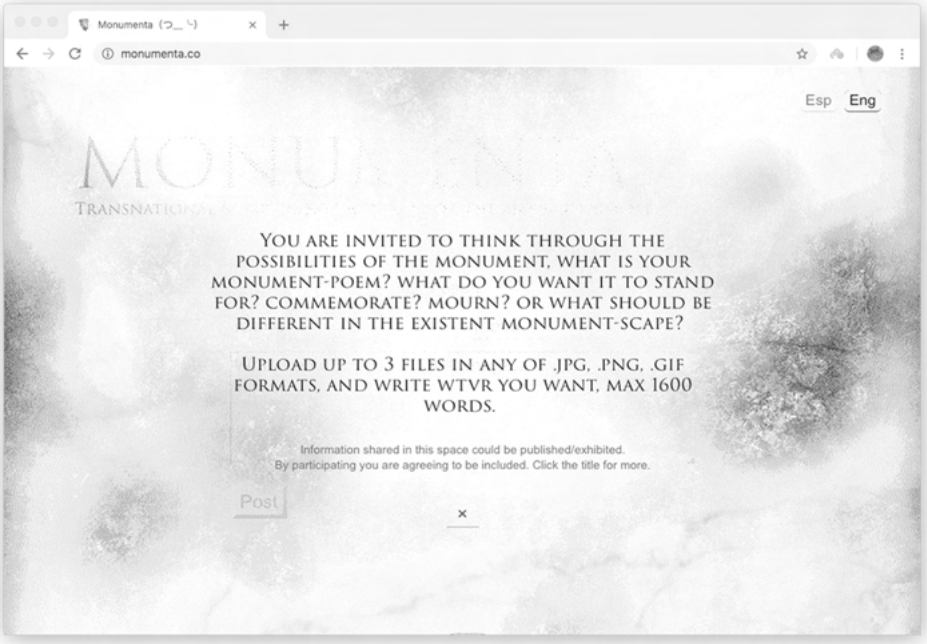
Conclusion

> Every period has the impulse to create symbols in the form of monuments which according to the Latin meaning are "things that remind," things to be transmitted to later generations. This demand for monumentality cannot, in the long run, be suppressed. It will find an outlet at all cost.[63]

Morehshin Allahyari and Shirin Fahimi update and advance reflections on monumentality under digital terms. As this contribution has argued, it is both through an intermedial and nomadic approach to monumentality that these artists have questioned a monument's capacity to extinguish memory and bury it under homogenous material forms. Their cross-media approach uses hybrid modes from physical sculpture to video, virtual and augmented reality experiences, the internet and at times performance, to redefine and refigure relationships between the past, present, and future. Their work can also be seen as part of a wider development of the increasing infiltration of monumental structures in the digital and augmented sphere. John Craig Freeman, for example, has developed a number of VR monuments and memorials, such as *The Border Memorial: Frontera de los Muertos* (fig. 8), which uses AR to commemorate Mexicans who have died along the US/Mexico border.[64] In their crowd-sourced project *Monumenta* (2018–present, fig. 9), Puerto Rican artist Gabriella Torres-Ferrer invites the public to use an interface that allows the user to both archive existing monuments and also to submit proposals for future commemorative sites. The project rethinks who and what monuments are for through contributions such as Nolad Chaliha's submission *Destroy All the Confederate Statues Left in the US*. The artist exposes the forces

63 Sigfried Giedion, *Architecture, You and Me: The Diary of a Development* (Cambridge, MA: Harvard University Press, 1958), p. 28.

64 See John Craig Freeman, "Border Memorial: Frontera de Los Muertos," JohnCraigFreeman.com, blog, last modified December 30, 2013, https://johncraigfreeman.wordpress.com/border-memorial-frontera-de-los-muertos/ (accessed January 29, 2022).



9 Gabriella Torres-Ferrer, *Monumenta*, 2018–present, participative unique website, http://monumenta.co.

constructing collective memory and history in public space by proposing an app that allows users to disassemble confederate monuments in the US by simply using one's hand.

Similar to Allahyari's or Fahimi's works, the proposed monuments on Gabriella Torres-Ferrer's webpage or the augmented memory sites of Freeman (which require further elaboration elsewhere), counteract problematic monuments by imagining themselves as transmedial, nomadic, distributed, and migratory. More precisely, these works acquire site, weight, and presence in a participative act, or in a distributed manner. They consciously resist and reject fixity, permanence, and site-specificity as seen in more traditional monuments. These works activate monumental functions to expand the sculptural form and offer novel impulses to commemorate complex historical trajectories and gendered experiences. The spectators thereby become complicit in enacting the works and their bodies are immersed in a multisensory experience that unfolds across VR, AR, 3D-printed objects, video, and sound. Using digital technologies, these artists thus remodel, remediate, and expand the notion of a sculpture and its deep links to the monument, namely as an intermedial, a nomadic, and a migratory form of commemoration. No longer a precious object empowered by sacred efficacy, solidity, grandeur, and material vehemence or weight, the monumental rather functions as an expendable, nomadic memory site that can be enacted at any time online. Given that the number of people online on social media and blogs, such

as Tumblr or Instagram, can on some days eclipse the population of a small country, the reality is that large parts of the public participate in these sites frequently. Catalyzed by the COVID-19 pandemic, they often spend much more time in online public spaces than they would in any form of actual public space.[65] These interventions, then, also speak of an active reclaiming of public space—one that goes hand in hand with a general expansion of the very idea of the public realm and toward the virtual and digital spheres. By symbolically critiquing and engaging in the very malleability of cultural monuments, they address the evocative power of monumental structures, and at the same time adhere to the socially acceptable function of the recreated artifact, as a memory site and a hinge between an individual and collective form of remembrance. Every response to what Sigfried Giedion calls a period's "demand for monumentality" comes with a responsibility: an ability to respond to such time with appropriate, meaningful, sensitive, and at times radical structures for memory. It is this responsibility, inherent in making monumental structures, that Allahyari, Fahimi, and their peers address through their critical engagement with monumental codes. As such, the discussed works not only critically examine the tendency of monuments to be deployed in ways that reproduce power relations. They also remind us that history and its memory are always subject to forms of representation and that it is through both a conceptual and aesthetic confrontation that such heritage can be addressed critically.

65 According to recent statistics, 5.16 billion people (65 percent of the world population) currently have an internet connection and 4.76 billion have internet-enabled smart phones. See Statista, "Internet Users in the World 2023," last modified January 2023, https://www.statista.com/statistics/617136/digital-population-worldwide/ (accessed March 11, 2023).

Elizabeth Anne Johnson

Confederate Monument 2.0

Mary Ellen Carroll at *Prospect.3*

Abstract

Since 2015, the discourse of public monuments has been dominated by questions of monument removals in the wake of the rise of the Rhodes Must Fall activist movement. However, prior to this emphasis on removals, there was also a strong tradition of contemporary artists proposing creative interventions that responded to the existing landscape of public monuments as markers of systemic inequalities. This essay focuses on an unrealised intervention proposed by New York-based artist Mary Ellen Carroll in the run up to the *Prospect.3* contemporary art triennial in New Orleans in 2014, which aimed to transform a monument to Robert E. Lee into a transmitter for free-to-use, long-range, high-speed wireless internet. Drawing from scholar of media Florian Cramer, it suggests Carroll's proposal to repurpose the Confederate monument was a post-digital choice that envisaged a radical solution to internet inequity while mobilizing the monument's symbolism to attend to the history of structural discrimination shaping unequal internet access in contemporary New Orleans.

Key Words

Monument, Confederate, internet, wi-fi, post-digital, Mary Ellen Carroll

The photograph shows a bronze statue on a marble plinth with its back to the camera (fig. 1). The statue is outside and must be raised some height, given only mottled clouds are visible around it. Despite appearing from behind, it is possible to make out its historical military attire: hat, belted coat, knee-high boots, and a sword suspended by its left side. Two fine lines extend upward from the hat like an insect's antennae that appear to have been added in photographic postproduction. Are they intended to be ridiculous? Are they receiving messages like the antenna of a TV? Or sending signals like a radio transmitter? And why is the statue facing away from the camera?

Titled *PUBLIC UTILITY 2.0, Proposed Rabbit Ears Antenna Placement on General Lee in New Orleans at Lee Circle for Prospect.3 New Orleans*, the image was made in 2013 by New York-based artist Mary Ellen Carroll (b. 1961). It was published in the journal *October*

1 Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Proposed Rabbit Ears Antenna Placement on General Lee in New Orleans at Lee Circle for Prospect.3 New Orleans*, 2013, silver gelatin print, 8 × 10 in.

in 2018 as part of a special edition on monuments: an urgent and inflammatory issue in the wake of the Rhodes Must Fall movement and the Charlottesville car attack.[1] Over fifty artists and writers responded to the editors' prompt to consider the significance of monuments as markers of histories of racial conflict, but Carroll's was the only entry to explicitly engage the topic in relation to the internet. As her accompanying text explained, the photograph depicted her proposal to transform a nineteenth-century figurative monument to Confederate General Robert E. Lee in New Orleans into a transmission tower for a wireless internet network. However, what is represented in the image was never realized as sculpture. When Carroll made the proposal, the City of New Orleans's Department of Parks and Parkways (hereafter the Parks Department) oversaw the monument's care. It flatly refused her request for permission to add what it described as "rabbit ears" to the statue. This was not, they admonished, "an appropriate installation for this iconic historic landmark."[2]

1 When the image was published in *October* in 2018, it was under the title *General Robert E. Lee Statue with "Rabbit Ears"* and dated 2014. The title and date detailed in this essay were supplied by Mary Ellen Carroll in 2022. The Rhodes Must Fall movement began in 2015 when activist Chumani Maxwele threw human excrement on a monument to British imperialist Cecil Rhodes located on the campus of the University of Cape Town. Maxwele's act sparked renewed calls for the monument's removal and symbolized wider demands to decolonize educational practices across South Africa and beyond. In 2017, the debate over the continuing presence of Confederate monuments in the United States appeared to reach a fever pitch when the suggested removal of a monument to Confederate General Robert E. Lee from a city park in Charlottesville, Virginia, prompted a white supremacist rally and a peaceful counter-demonstration during which counter protestor Heather Heyer was murdered.

2 Mary Ellen Carroll, "Mary Ellen Carroll: Response to a Questionnaire on Monuments," *October*, no. 165 (Summer 2018): 22–27, here 23.

The proposal's unrealized status reflects the historically contingent conditions from which Carroll's sculptural statement (represented by the image) could not emerge. The historical contingency is important. Just a few years later, the same proposal would not have been possible; not only because the statue of Lee was stripped from the streets of New Orleans in 2017, but also because public debate on Confederate monuments changed significantly. After the wave of monument removals following the global Black Lives Matter protests of 2020, it would have been clear that Carroll's self-described "lampooning" of the Lee monument did not answer calls for its outright removal.[3] What this essay will show is how the proposal helped articulate the historical contours of the social, economic, political, and cultural systems that around 2013 both upheld the monument and contributed to the levels of internet connectivity in the city. I will suggest Carroll's proposal to transform the Lee monument into a wireless internet transmitter represents a post-digital repurposing of the monument that mobilizes its symbolism to attend to the longer histories of structural discrimination foundational to internet inequity in New Orleans.

Carroll first conceived of her proposal for the Lee monument in 2012, when curator Franklin Sirmans invited her to participate in *Prospect.3*, a citywide contemporary art triennial staged in New Orleans in 2014–15. Sirmans assigned Carroll the site of the American Institute of Architects' Center for Architecture and Design (hereafter AIA Center), which was located in the shadow of the city's monument to Lee. Carroll exhibited *PUBLIC UTILITY 2.0*, an ongoing artwork begun in 2008, which models how underused bands of the electromagnetic spectrum can be repurposed to create high-speed, long-range wireless internet networks. The exhibition featured photographs, diagrams, and maquettes outlining Carroll's proposition. A printed timeline ran throughout, chronicling over a century of regional and national policies and events that ultimately had given rise to the landscape of infrastructure in New Orleans at the time of the exhibition. This timeline was repeated and also expanded by tweets issued hourly throughout the triennial by the Twitter handle @publicutility2.[4] For the duration of *Prospect.3*, Carroll's model of internet access was temporarily put into practice, and an experimental license was secured to permit a free-to-use wireless network at the AIA Center. Carroll also planned to extend the network in future along a portion of the Interstate 10 (I-10) freeway running through the center of New Orleans.

In the exhibition catalogue accompanying *Prospect.3*, artist and researcher Imani Jacqueline Brown describes how after the triennial Carroll intended to produce "transmission towers" that would "stand as functional monuments, marking and facilitating the redistribution of power."[5]

3 Carroll, "Mary Ellen Carroll: Response to a Questionnaire on Monuments," 2018, 24.

4 For example, "2014 PUBLIC UTILITY 2.0 LAUNCHES IN #NOLA @ #AIA FOR #PROSPECT3, INTRODUCES #SUPERWIFI: RETROFITTING #TV FOR 21ST CENTURY #PUBLICUTILITY2." At the time of writing, the Twitter handle @publicutility2 was ongoing and its last public post was in 2018. Additional content for transmission via the network was also created during public program community sessions.

5 Imani Jacqueline Brown, "Mary Ellen Carroll," in *Prospect.3: Notes for Now: A Project of Prospect New Orleans*, ed. Franklin Sirmans, exh. cat. Prospect New Orleans (New York: DelMonico Books, 2014), pp. 62–63, here p. 62.

Not only would the towers extend the reach of the *PUBLIC UTILITY 2.0* wireless network, but also provide highly visible markers of it. Due to time and funding constraints, no towers were realized during the triennial. In fact, the only reference to transmission towers in the AIA Center were two bright orange scale models of pylon-like towers placed carefully on a restrained wooden architect's model of a central slice of the city. The proposal for the Lee monument did not feature in the exhibition. Although unrealized, the envisaged repurposing of an existing monument reflects Carroll's resistance to an amnesiac discourse of the internet that overemphasizes the present and future. Instead, it sees Carroll exploring how the vectors of racism and structural discrimination shaped internet inequities in twenty-first century New Orleans.

Made by New York-based sculptor Alexander Doyle, the statue of Lee had looked down on New Orleans since 1884. It was commissioned and paid for by the Robert E. Lee Monumental Association in New Orleans, which was founded in 1870, the year of Lee's death, with the intention of building a local monument in his honor.[6] The sixteen-and-a-half-foot statue was elevated more than sixty-feet skyward by a towering marble Doric column, rooted in a vast flight of granite steps. The steps, in turn, rose from a mound at the center of a traffic intersection which came to be known as Lee Circle.[7] The colossal figure depicted Lee, arms folded confidently, casting a paternalistic gaze across the city. Its portrayal of a man racialized as white, with a tall, athletic build conformed to what scholar of monuments Kirk Savage calls the "canonical whiteness" of a classical sculptural tradition that falsely upheld the bodies of men racialized as white as images of physical perfection and intellectual superiority.[8]

New Orleans's monument to Lee did not represent a particular affiliation between Lee and the city, but rather was one of hundreds of Confederate monuments thrust into the civic landscape of the South, after the hopes of the Reconstruction era faltered, as public symbols of the propaganda campaign that came to be known as the Lost Cause. The perfidious narrative of the Lost Cause asserted the Confederacy had not fought the American Civil War in an effort to uphold chattel slavery based on racialization, but to defend the rights of individual States to determine their own governance without Federal intervention. Despite

6 For a history of the monument, see Karen L. Cox, *No Common Ground: Confederate Monuments and the Ongoing Fight for Racial Justice* (Chapel Hill, NC: The University of North Carolina Press, 2021), pp. 39–43, "History and Description of the Robert E. Lee Statue at Lee's Circle in New Orleans, Louisiana from the 1930s," Louisiana Works Progress Administration, Louisiana Digital Library, last modified 2007, https://louisianadigitallibrary.org/islandora/object/state-lwp%3A7942/ (accessed February 10, 2023), and Alex von Tunzelmann, *Fallen Idols: Twelve Statues That Made History* (London: Headline, 2021), pp. 153–72.

7 Prior to the erection of the Lee monument, the area was known as Tivoli Circle. In 2022, the local council approved a decision to rename the area Harmony Circle.

8 Kirk Savage, *Standing Soldiers, Kneeling Slaves: Race, War, and Monument in Nineteenth-Century America* (Princeton, NJ: Princeton University Press, 1997), p. 132. For more on color in American sculpture and its correlation to a moral index see Charmaine Nelson, *The Color of Stone: Sculpting the Black Female Subject in Nineteenth-Century America* (Minneapolis, MN: University of Minnesota Press, 2007).

leading his troops to defeat, many Southerners had come to regard Lee as "the embodiment of the Confederacy" and an emblem of nostalgia for an antebellum South expunged of its memory of slavery's horrors.[9] Since its grand unveiling, New Orleans's monument to Lee had operated as a communications transmitter of a different sort to the type imagined by Carroll's proposal. Its presence acted as a node in a network of monuments, statues, and names of streets, parks, and schools that sent the message of white supremacy across the city and the southern States.

By proposing the Lee monument as a wireless internet transmission tower, Carroll was not simply identifying the highest point close to her designated site (although its height would have offered certain practical advantages for extending the network's reach). She was putting the issue of internet equity in dialogue with the history symbolized by the monument. On the one hand, the proposal used ridicule to critique the public presence and symbolism of the monument; on the other, it represented a practicable solution to a genuine need for improving access to all but essential infrastructure.

Attempting to realize her vision, in 2014 during the run up to *Prospect.3*, on two separate occasions Carroll wrote to the Parks Department to request permission to repurpose the monument to Lee. Both times her appeals were denied; once on the grounds her proposal was an "unacceptable" way to treat "the treasured monument," and once because the Parks Department "must protect" this "significant piece of history … from potential damage."[10] The responses overlook the proposal's practical goals and focus on its incendiary symbolism. They also help enunciate the mechanisms that at the time of *Prospect.3* worked to hold the statue in place, including the active and ongoing support for its maintenance by a local governing body and the fallacy that history itself can reside in a sculptural object.

I suggest Carroll's proposal to use a Confederate monument as a wireless transmission tower represents what scholar of media Florian Cramer describes as a "post-digital choice."[11] In a 2019 interview with art historian David Joselit, Carroll signposted the post-digital as a constructive framing through which to address her work. She claimed, "My works are considerations and expansions of time in the age of the post-digital."[12] Whereas the word 'post-digital' might initially imply the end of the digital, in Cramer's 2014 article, "What is 'Post-Digital'?," he highlights how the influence and effects of "computersiation and global digital networking of communication, technical infrastructures, markets and geopolitics" have not been surpassed, but rather become ubiquitous.[13] The prefix in 'post-digital', then, signals not a termination as it does in 'postmodernism,' for instance, but a continuation

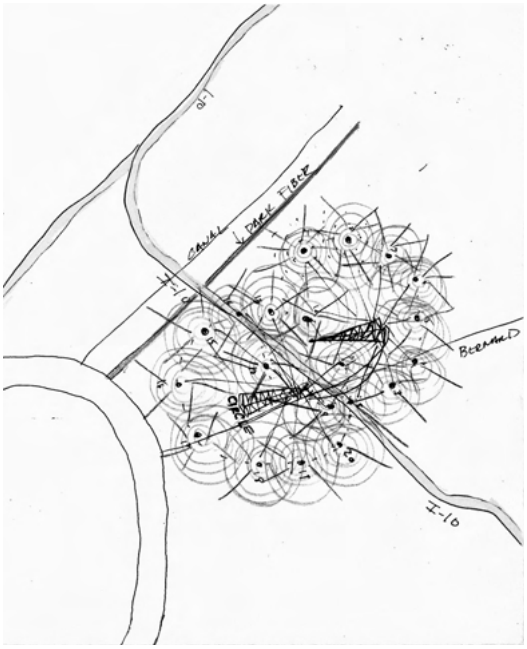
9 Savage, *Standing Soldiers, Kneeling Slaves*, 1997, p. 130.

10 Carroll, "Mary Ellen Carroll: Response to a Questionnaire on Monuments," 2018, 23, 25.

11 Florian Cramer, "What Is 'Post-Digital'?," *APRJA* 3, no. 1 (2014): 11–23, here 21, https://doi.org/10.7146/aprja.v3i1.116068.

12 Carroll quoted in David Joselit, "A Conversation with Mary Ellen Carroll," *October*, no. 170 (Fall 2019): 120–45, here 135.

13 Cramer, "What Is 'Post-Digital'?," 2014, 13.



2 Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Proposed Tower Location for Prospect.3 New Orleans*, 2013, ink and colored pencil and marker on vellum, 8 ×10 in.

operating along the lines of "more subtle cultural shifts and ongoing mutations."[14] One of the features of Cramer's account of the post-digital is an emphasis on the "hybridity of 'old' and 'new' media." For Cramer, a "post-digital choice" often entails "giving the 'old' technology a new function usually associated with 'new media', by exploiting specific qualities of the 'old' which make up for the limitations of the 'new'."[15] Carroll's proposal imagines giving the old monument a new function as a wireless transmission tower. It exploits both the physical features of a structure that stood in total at eighty-four foot high to create an effective transmitter, while also putting the problem of inequitable internet access in dialogue with the history of racism in the United States symbolized by the monument.

The post-digital repurposing of the monument would have corresponded with Carroll's intention to situate the *PUBLIC UTILITY 2.0* wireless network along a city-center section of the I-10 freeway. The drawing, *PUBLIC UTILITY 2.0, Proposed Tower Location for Prospect.3 New Orleans* (2013) (fig. 2) maps the freeway with a serpentine yellow line and shows the position of two potential sites for towers (at the Circle Food Store and on the opposite side of the I-10), presumably identified as alternatives to the Lee monument.[16] Drawn over

14 Ibid.

15 Ibid., 21.

16 This drawing is also referred to with the alternative title, *Public Utility 2.0 (Drawing of Nodes for a Mesh Network in Conjunction with Super Wi-Fi Towers and Connectivity in New Orleans)*, and dated 2014 in the *Prospect.3* exhibition catalogue. The title and date detailed in this essay were supplied by Mary Ellen Carroll in 2022.

these features in green pencil, concentric circles diagram the network's intended field of coverage across the famous neighborhoods of the 7th ward and the Tremé. One of the historical factors that had given shape to the distribution of internet access in New Orleans had been the building of the I-10 during the 1960s. In a brutal act of urban planning, the freeway's passage through the city was designed as a mammoth concrete overpass running along Claiborne Avenue. Prior to the freeway's construction, Claiborne Avenue's oak-lined thoroughfare had housed prospering businesses owned by people of the African diaspora, and doubled as a playground and social gathering place for New Orleanians who were excluded from the city's main retail and business area in Canal Street by Jim Crow laws.[17] When the overpass was built it laid waste to the thriving commercial hub and, as one period commentator put it, transformed the "broad landscaped boulevard into a dingy concrete cavern."[18] The I-10's route through New Orleans corresponded with a well-worn postwar national pattern that saw urban planners racialized as white build freeways in areas predominantly inhabited by populations racialized as black, where land was cheap and opposition to construction weakened by political power structures that worked to exclude people of the African diaspora from public decision-making processes. Not only did the construction of the freeway through the center of New Orleans cause lasting economic damage to the adjacent neighborhoods, but the colossal concrete slab created a physical barrier that would, in future, hinder traditional Wi-Fi coverage for those living in the vicinity of the overpass. The I-10, Carroll suggests, was an "unintended monument."[19]

The city's 7th ward was one of the districts cut into two by the I-10. When *Prospect.3* was staged the ward's broadband usage rates were reported as standing at just 10 percent, in comparison with averages of 56 percent citywide, and 68 percent nationally.[20] In addition

17 For a discussion of the building of the I-10 in New Orleans in relation to the politics of race, see chapter 4, "Killing Claiborne's Avenue," in Michael E. Crutcher, *Tremé: Race and Place in a New Orleans Neighborhood* (Athens, GA: University of Georgia Press, 2010), pp. 50–65. Carroll has noted how the initial plans for the passage of the I-10 through New Orleans were drawn up by urban planner Robert Moses, in Mary Ellen Carroll, "Mary Ellen Carroll: Response to a Questionnaire on Monuments," 25. Moses's work on the Long Island parkway system in New York has long stood accused of being designed to enable affluent car owners, who at the time would have been predominantly racialized as white, to move freely, while restricting the movement of working-class people reliant on buses, who at the time would predominantly have been racialized as black. For a summary of the racial segregation implemented architecturally by the Long Island parkway system, see Ruha Benjamin, *Race after Technology: Abolitionist Tools for the New Jim Code* (Cambridge, MA: Polity, 2019), pp. 91–93. However, while the involvement of Moses in the planning of the I-10 helps situate its construction in a broader picture of structural discrimination based on racialization, the specific plan put forward by Moses for the route of the I-10 in New Orleans situated it along the Mississippi riverfront rather than Claiborne Avenue.

18 Peirce F. Lewis, *New Orleans: The Making of an Urban Landscape* (Cambridge, MA: Ballinger, 1976), p. 99.

19 Carroll, "Mary Ellen Carroll: Response to a Questionnaire on Monuments," 2018, 25.

20 Nathan C. Martin, "Why Art, Not Google, Could Revolutionize Wifi in New Orleans, an Artist Experiments with a New Model for Connectivity," *Nextcity*, December 22, 2014, https://nextcity.org/features/cities-best-wifi-digital-divide-solution-new-orleans-mary-ellen-carroll-art/ (accessed February 10, 2023). The

to poor wireless coverage, the problem of inadequate access to high-speed internet was compounded by expensive recurring broadband fees that proved prohibitive for many low-income local residents. Brown suggests Carroll's plan to situate the *PUBLIC UTILITY 2.0* network along the I-10 was intended to link "sectors of the city neglected by private Internet providers because of a perceived lack of economic incentive."[21] Simultaneously, it framed the issue of inequitable internet access in New Orleans in relation to the decades of structural discrimination underpinning it.

If the metaphor of a road as an internet network seems familiar, that is because it is. Video art pioneer Nam June Paik coined the phrase "electronic superhighways" back in 1974 in anticipation of a vast two-way communications system, now recognizable as the internet and Carroll has cited this as an important reference for the work.[22] But Carroll has been clear, she does not deal in metaphor, and in New Orleans she intended a real freeway to route a real network. The framing of the internet as a road, like the title *PUBLIC UTILITY 2.0*, positions high-speed internet as foundational infrastructure, akin to utilities such as clean water, sewerage, electricity, and gas. Few today might remember Paik's phrase had it not resurfaced in the 1990s, revived and revised by the Clinton-Gore administration as "information superhighway." (Paik would lament, "Bill Clinton stole my idea.")[23] In her path-breaking 2008 book, *Digitizing Race: Visual Cultures of the Internet*, scholar of media Lisa Nakamura outlines how the emergence of the internet as a mass media in the 1990s was shaped by the political strategy of the Clinton-Gore administration which refused to engage the divisive political issue of race.[24] Nakamura suggests mainstream US politics at that time encouraged a "color-blind" framing of the internet, which often presented cyberspace as an immaterial realm in which the social coding of the body was transcended.[25] Carroll's staging of *PUBLIC UTILITY 2.0* in New Orleans used the specific political history of the I-10 to center questions of structural racism in its intervention into the issue of local connectivity. The

article also reported that at the time of the triennial, computer devices could be purchased locally for under $50.

21 Brown, "Mary Ellen Carroll," 2014, p. 62.

22 Nam June Paik, "Media Planning for the Post Industrial Age (1974): Only 26 Years Left until the 21st Century," reproduced in *We Are in Open Circuits: Writings by Nam June Paik*, ed. John G. Hanhardt, Gregory Zinman, and Edith Decker-Phillips (Cambridge, MA: MIT Press, 2019), p. 163. Carroll has described Paik's pioneering use of televisions as art as catalytic for her interest in sculpting the intangible material of television transmission bands in Joselit, "A Conversation with Mary Ellen Carroll," 2019, 138.

23 Nam June Paik, *Nam June Paik: Becoming Robot*, ed. Melissa Chiu and Michelle Yun (New York: Asia Society, 2014), p. 29.

24 Lisa Nakamura, *Digitizing Race: Visual Cultures of the Internet* (Minneapolis: University of Minnesota Press, 2008), pp. 3–5.

25 This stance can by typified by John Perry Barlow's influential 1996 manifesto for cyberspace in which he exalts, "We are creating a world that all may enter without privilege or prejudice accorded by race, economic power, military force, or station of birth." John Perry Barlow, "A Declaration of the Independence of Cyberspace," Electronic Frontier Foundation, https://www.eff.org/cyberspace-independence/ (accessed May 10, 2022).

post-digital repurposing of the Lee monument would have advanced Carroll's engagement with the historical power relations that had given rise to internet inequity in the city.

Scholar of monuments Paul Farber defines monuments as highly visible "statements of power and presence in public space."[26] By proposing a monument as a wireless transmission tower, Carroll not only envisaged using its visibility to draw attention to the electromagnetic spectrum, but also to suggest this invisible realm is subject to the exertions of political power. *PUBLIC UTILITY 2.0* concerns efforts to sculpt the electromagnetic spectrum. In the migration from analog to digital television transmission, bands of the electromagnetic spectrum historically used for broadcasting terrestrial television have increasingly fallen into disuse. In response, researchers at Rice University, Houston, developed a software-defined radio technology known as Super WiFi that utilizes these underused bands to create long-range wireless internet networks.[27] The ultrahigh and very high frequencies (UHF and VHF) used for broadcasting analog television have the capacity to transmit over long distances and penetrate dense masses. Super WiFi harnesses these qualities, enabling it to outstrip the limited coverage of traditional Wi-Fi, which travels over only relatively short distances and can be blocked by dense physical structures. *PUBLIC UTILITY 2.0* utilized Super WiFi in a further layer of post-digital repurposing of old media, in which the "specific qualities of the 'old'… make up for the limitations of the 'new'."[28] As Carroll explained to me, in *PUBLIC UTILITY 2.0*, "seemingly obsolete technologies are being essentially retrofitted for contemporary use."[29]

What is radical about *PUBLIC UTILITY 2.0* is how it models a practicable intervention in the politics of internet access which operates via reconceptualizing the electromagnetic spectrum as a public resource. In the US the spectrum is controlled by the communications regulator, the Federal Communications Commission (FCC) who, from 1994 until 2015, auctioned off to the highest private bidder the right to transmit on certain bands.[30] Using a temporary, experimental license issued by the FCC, for the duration of *Prospect.3, PUBLIC UTILITY 2.0* was able to model the potential of leaving the bands open as a public resource

26 Paul M. Farber, "How to Build a Monument," in *Monument Lab Creative Speculations for Philadelphia*, ed. Paul M. Farber and Ken Lum (Philadelphia: Temple University Press, 2020), p. 6.

27 In 2011, Super WiFi was successfully trialled by Rice's researchers in partnership with the charity Technology for All, in a project that supplied free, high-speed wireless connectivity to underserved residents in east Houston. "Houston Grandmother Is Nation's First 'Super Wi-Fi' User," *Science X*, last updated April 19, 2011, https://phys.org/news/2011-04-houston-grandmother-nation-super-wi-fi.html (accessed February 10, 2023).

28 Cramer, "What Is 'Post-Digital'?," 2014, 21.

29 Mary Ellen Carroll, video-conferencing interview with author, June 29, 2022.

30 In 2016, a new policy was introduced known as 'reverse auctioning' in which broadcasters could auction underutilized bands back to the FCC. My understanding of the history of the regulation of the electromagnetic spectrum and spectrum auctions comes from Paul Milgrom, Jonathan Levin, and Assaf Eilat, *The Case for Unlicensed Spectrum*, last modified October 12, 2011, https://web.stanford.edu/~jdlevin/Papers/UnlicensedSpectrum.pdf (accessed February 10, 2023), and Ben Christopher, "The Spectrum Auction: How Economists Saved the Day," *Priceonomics*, last modified August 19, 2016, https://priceonomics.com/the-spectrum-auction-how-economists-saved-the-day/.

like "national parkland."[31] The staging of *PUBLIC UTILITY 2.0* demonstrated how Super WiFi could supply free connectivity to residents underserved by private providers and priced out by recurring private broadband fees. Carroll's project showed how Super WiFi technology could be leveraged alongside a shift in public communications policy to achieve equitable internet access on a national scale.

Although radical, the type of deregulation proposed by *PUBLIC UTILITY 2.0* is not unprecedented. At the AIA Center, Carroll also exhibited a range of electronic goods that use Wi-Fi and Bluetooth connectivity, such as printers, cordless phones, laptops, wireless headphones, and wireless speakers. Either readymades or 3D-printed replicas, the selection of electronic goods invoked the 1985 FCC decision to leave three bands of the electromagnetic spectrum, once referred to as "garbage bands," open for unlicensed use. It was a decision that led to technological innovations including Wi-Fi and Bluetooth. One of the goals of *PUBLIC UTILITY 2.0* is to try to reshape how FCC policy governs the electromagnetic spectrum. The work sees the practice of sculpture migrate from object to ether.

PUBLIC UTILITY 2.0 takes both the electromagnetic spectrum and public communications policy as its materials. The problem Carroll notes, "with these non-visible materials, how do you make them visible; how do you make them understandable?"[32] The public prominence of New Orleans's monument appeared to offer one solution. Situated at the center of the traffic intersection that bisects the grand boulevard of St. Charles Avenue, it was among the city's most conspicuous public landmarks. Its post-digital repurposing would have mobilized its sculptural presence to bring the politics of the electromagnetic spectrum into public view.

Carroll's proposal was certainly not the first time an artist had planned a monument that doubled as a wireless transmitter. In 1919, Vladimir Tatlin designed a *Monument to the Third International* in honor of Russia's October Revolution. The vast glass and steel tower comprised rotating geometric structures housing a conference hall, an executive committee meeting room, and an information center. At its summit were two radio masts, stretching above a dome housing radio equipment, ready to beam out the Socialist message honed in the information center below. Tatlin's Tower, as it became known, advanced the aims of the "Plan for Monumental Propaganda," authorized by Lenin in 1919, which set out to replace the Tsarist statues of the past with rapidly produced new monuments celebrating Socialist ideals.[33] By uniting the monument with the defining media of the age, both Tatlin's Tower

31 Brown, "Mary Ellen Carroll," 2014, p. 62.

32 Mary Ellen Carroll, video-conferencing interview with author, June 29, 2022. Carroll addressed this question inside the AIA Center by exhibiting largescale multi-colored diagrams that mapped how the different frequencies of the electromagnetic spectrum were portioned up, including showing where the wireless networks supplied by *PUBLIC UTILITY 2.0* would sit within this schema.

33 My understanding of the history of Tatlin's Tower comes from John Milner, *Vladimir Tatlin and the Russian Avant-Garde* (New Haven: Yale University Press, 1983), pp. 151–80, and Iliana Cepero, "Reading Tatlin's Tower in Socialist Cuba," *Art Journal* 77, no. 2 (2018): 62–64. On monuments as radio transmitters see Mark Wigley, *Buckminster Fuller Inc.: Architecture in the Age of Radio* (Zurich: Lars Müller Publishers, 2015), pp. 30–37.

and Carroll's proposal for the Lee monument imagine the monument's political intervention as not only symbolic, but instrumental. But, whereas Tatlin's Tower sought to overturn the monumental landscape of the past by creating a vision of a new monumentality orientated towards the future, Carroll appropriates the monument's history to attend to the concealed power dynamics shaping internet access.

Like several of Carroll's other works, *PUBLIC UTILITY 2.0* has unfolded over a number of years. Initiated in 2008 and still ongoing, inevitably the discourses of both monuments and the internet have changed during the lifespan of the work. It is undeniable that adequate internet access increasingly affects full participation in many areas of daily life in the industrialized world (including access to work, healthcare, education, and personal financial management), and this was only accelerated by the COVID-19 pandemic. The ongoing challenge of achieving internet equity in the US is reflected by the introduction of the Broadband Justice Act 2021, by Democratic Representatives Emanuel Cleaver and Jamaal Bowman, which sought to update existing utility legislation to expand affordable broadband access to residents of federally subsidized housing.[34] Nonetheless, leading scholars of digital technology, such as Safiya Umoja Noble and Ruha Benjamin, have challenged simplistic narratives of the "digital divide" advanced during earlier phases of the mass uptake of the internet that imply achieving social equality is merely a matter of securing better technological access.[35] Technological innovations made by people of color are minimized. Degrees and gradations of access are flattened. The reproduction of structural discrimination in wider digital ecologies, such as the labor conditions of workers in the Global South involved in both the manufacture of digital hardware and extraction of the raw minerals involved in these processes, are overlooked. The prevalence of narratives that focus on the binary of having or not having internet access have largely been overtaken by more nuanced considerations of the effects of the extent and types of access available to differently racialized, classed, and gendered groups.

The move towards discussions concerned with types of access can be seen reflected by another sculpture made by New York and Los Angeles-based artist Aria Dean (b. 1993). Like Carroll's proposal, Dean's 2017 sculpture, *Dead Zone (1)*, also addresses the internet through symbolism overtly bound to the history of discrimination based on racialization in the US. Dean takes cotton—a material freighted with the symbolism of the Transatlantic slave trade—and preserves and presents a fragile sprig of the plant like a botanical specimen

34 "Reps. Cleaver, Bowman Introduce Bill to Expand Affordable Broadband to 8 Million Households," Press Release, Congressman Emanuel Cleaver, last modified March 16, 2021, https://cleaver.house.gov/media-center/press-releases/reps-cleaver-bowman-introduce-bill-expand-affordable-broadband-8 (accessed February 10, 2023).

35 The term the "digital divide" was initially promoted by the Clinton-Gore administration to describe the gap between those who did and did not have adequate access to digital hardware, software, connectivity, and education and training in computer technologies, but subsequently came increasingly to signify disparities in access to high-speed internet. See Safiya Umoja Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism* (New York: New York University Press, 2018), pp. 160–65. Benjamin, *Race after Technology*, 2019, pp. 41–42.

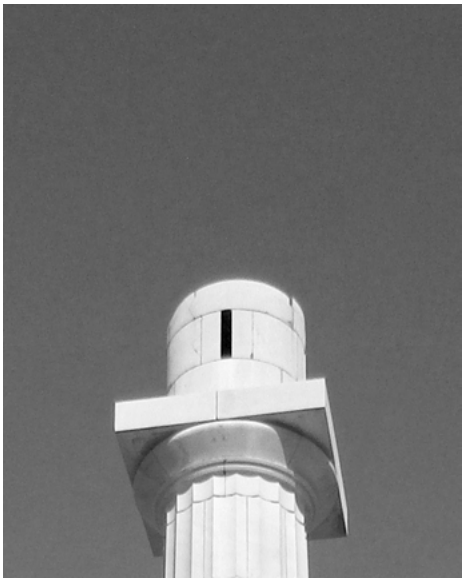
beneath the glass dome of a bell jar. Dipped by Dean in polyurethane, the plant's typically downy cottontails are clagged thick with plastic, and slump into hardened lumps. Invisible to viewers, concealed in the bell jar's thick wooden base is a signal jammer; a device that disrupts the wireless signal between mobile internet devices and local base stations that enable their connection to the internet. Dean imagines producing a connective dead zone, barring internet access for those in the sculpture's immediate vicinity. I say "imagines" because Dean's act is largely rhetorical: in the US signal jammers are illegal to operate (and illegal to own in many other countries). *Dead Zone (1)* imagines disrupting connectivity as a critique of the conditions of online culture itself. Dean's title evokes both the local absence of connectivity supposedly instrumentalized by the sculpture and the millions of African men, women, and children whose enslavement, symbolized by the cotton, was foundational to the emergence of a global capitalist economic system. *Dead Zone (1)* weaves together the themes of connectivity and race to imagine resisting connectivity as a rejection of the online appropriation and commodification of the creative labor of people of the African diaspora. In her 2016 essay, "Poor Meme, Rich Meme," Dean claims: "When we say that the internet extends and exacerbates the same old offline relations, we mean it."[36]

The problem of inequitable internet access certainly did not disappear in the time between the initiation of *PUBLIC UTILITY 2.0* in 2008 and the creation of *Dead Zone (1)* in 2017, but this period saw a deepening cynicism concerning commercial applications of the internet and its myriad sociopolitical and environmental effects. The rich imaginary of Dean's sculpture offers a productive pairing with Carroll's proposal that reflects the shift in debate over the last decade from questions of access to the unequal power dynamics of wider internet ecologies.

Carroll's submission to the *October* special issue on monuments was bracketed by two images. The image discussed at the start of this essay was accompanied by a counterpart: a close-cropped photograph of the plinth on which Lee had stood, now empty against a clear sky (fig. 3). The statue facing away. The empty plinth. The sequence of images reflects the direction of travel. In 2015, New Orleans City Council voted in favor of removing four high-profile Confederate monuments, including the city's monument to Lee. By then, the maintenance of public symbols of white supremacy had become a matter of intense public debate following the Charleston church mass shooting in 2015.[37] Although Charleston

36 Aria Dean, "Poor Meme, Rich Meme," *Real Life*, last modified July 25, 2016, https://reallifemag.com/poor-meme-rich-meme/ (accessed February 10, 2023). Dean's position corresponds with recent scholarship on race and technology that articulates how digital technologies, often wrongly perceived as neutral tools, frequently not only reinforce but extend existing forms of racial discrimination, such as Noble, *Algorithms of Oppression*, Benjamin, *Race after Technology*, and Simone Browne, *Dark Matters: On the Surveillance of Blackness* (Durham, NC: Duke University Press, 2015). I am grateful to Levi Prombaum for directing me toward Dean's *Dead Zone* series as an instructive comparison with Carroll's proposal.

37 In 2015, a white supremacist entered a Bible study group at the historic Emanuel African Methodist Episcopal Church, Charleston, South Carolina, and murdered Rev. Clementa C. Pinckney, Cynthia Hurd, Susie Jackson, Ethel Lance, Rev. DePayne Middleton-Doctor, Tywanza Sanders, Rev. Daniel Simmons



3 Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Empty Plinth with General Lee Removed at Lee Circle for Prospect.3 New Orleans*, 2017, silver gelatin print, 8 × 10 in.

represented a tipping point, the groundwork for the removals in New Orleans had been laid by longstanding pressure from local activists, including Rev. Avery Alexander, Angela Kinlaw, Michael "Quess?" Moore, and the activist group Take Em Down NOLA.[38] The racist murders prompted little change to the physical landscape of Confederate monuments in many other Southern cities, but in New Orleans decades of campaigning had set the stage for the Council's decision. Following a series of legal wranglings, in 2017 the bronze figure of Lee was bound with ropes, hostage to a new era, and lifted by a crane from the security of its neoclassical plinth, where it appeared momentarily to tremble in the air before the brooding clouds.

The question remains, what to make of the antennae? The two lines on the photograph signified not only the genuine solution *PUBLIC UTILITY 2.0* posed to the problem of inequitable internet access, but Carroll suggests they were provocations intended to prompt the Parks Department to consider the monument's future. She claims, "It was intended that the lampooning of the monument and its transformation into something of utility would

Sr., Rev. Sharonda Singleton, and Myra Thompson, all of whom were people of the African diaspora. Following the attack, media reports emerged showing the perpetrator posing with a Confederate flag, prompting widespread national calls for the removal of public symbols of the Confederacy.

38 For details of the history of monument removal in New Orleans, see Mary Niall Mitchell, "We Always Knew It Was Possible: The Long Fight against Symbols of White Supremacy in New Orleans," *City* 24, nos. 3–4 (2020): 580–93; Taylor & Francis online; Ana Croegaert, "Architectures of Pain: Racism and Monuments Removal Activism in the 'New' New Orleans," *City & Society* 32, no. 3 (2020): 579–602; and Bailey J. Duhé, "Decentering Whiteness and Refocusing on the Local: Reframing Debates on Confederate Monument Removal in New Orleans," *Museum Anthropology* 41, no. 2 (2018): 120–25.

provoke a public discourse that would end up questioning the statue's usefulness *as a monument*."[39] Yet, the achievements of recent "fallist" movements might make it difficult for some to accept a critique of the monument that stops short of an outright call for its removal, particularly when made by an out-of-town artist racialized as white. Symbols are linked to systems, Rhodes Must Fall and Black Lives Matter activists told the world, and the maintenance of monuments corresponds with the maintenance of wider ongoing systems of oppression.[40] At *Prospect.3* Carroll sought to link a symbol to the systems perpetuating internet inequities, focusing on a proposal for the reform of certain systems rather than the outright removal of the symbol. Yet, the fact that Carroll chose to depict the statue of Lee facing away from the camera in the image at the start of this essay intimates that despite her efforts to repurpose the monument she was conscious of its symbolic violence—a violence that could be controlled and mitigated in a two-dimensional representation, but could not be contained when it stood on the streets of New Orleans.

As discussed here, at *Prospect.3* Carroll's proposal for transmission towers went unrealized, and she remains in talks with the triennial's organizers about the future development of *PUBLIC UTILITY 2.0*. Yet, I suggest Carroll's proposal evokes a new definition of a "monument," which strays beyond the term's more frequent uses as a descriptor of figurative statuary, ancient ruins, funerary architecture, memorials, Land Art, and colossal sculptures. In *The Archaeology of Knowledge* (1992), philosopher Michel Foucault describes "discourse in its own volume, as a *monument*."[41] Of course, Foucault was not talking about any of the variety of sculptural monuments listed above, but rather the historically contingent organizing principles of thought that enable the production of knowledge. Carroll's proposal conjures something like an inversion of this, in which the monument is the enunciation of a historically contingent matrix of conditions from which a particular sculptural statement can, or, also crucially, *cannot* emerge. Carroll's proposal helped articulate the landscape of social, economic, political, and cultural systems that had evolved over centuries in New Orleans and the US and, at the time of *Prospect.3*, worked to uphold both the statue of Lee and the unequal levels of internet connectivity in the city. Her proposal exposes the set of conditions unable to countenance its own realization. Carroll did not create a monument in the form of a sculptural intervention. She created a monument as a discourse.

39 Carroll, "Mary Ellen Carroll: Response to a Questionnaire on Monuments," 2018, 24; original italics.

40 Rhodes Must Fall Oxford et al., *Rhodes Must Fall: The Struggle to Decolonise the Racist Heart of Empire* (London: Zed, 2018).

41 Michel Foucault, *The Archaeology of Knowledge*, trans. A. M. Sheridan Smith (London: Routledge, 1992), pp. 138–39, original italics. First published as *L'Archéologie du savoir* in 1969.

The Expanded Field of Digital Sculpture and the Cybernetic Condition

Claudia Giannetti

Media Sculpture

The Cybernetic Condition

Abstract
In the twentieth century, sculpture underwent radical changes both aesthetically and technically as a result of several factors, including the influences of new scientific theories. In this text I explore synthetically some of these changes in the field of sculpture and in particular the influence of cybernetic theory on sculpture using electronic and digital technologies. I briefly analyze the impact of these transformations on aesthetic theories.

Key Words
Media sculpture, cybernetics, media art, art, science, technology, contemporary aesthetics, cybernetic aesthetics, Moholy-Nagy, Schöffer, Paik, Bense, Cordeiro, Palatnik

Matter, form, and space have been central concerns for sculptors, along with the techniques, content, and aesthetics pertaining to each historic moment. The way that artists have interpreted and worked through them has varied enormously. After thousands of years dominated by techniques involving sculpting, engraving, modeling, or carving, sculpture underwent radical, paradigmatic changes in the twentieth century. Among them, emerging twentieth-century scientific theories had a considerable influence on the arts in general and on sculpture in particular. Along with quantum physics and Einstein's spatial-temporal relativity emerged another theory, which was one of the most significant from the late 1940s onward: cybernetics. In this text, I synthetically explore some of these influences in the field of sculpture, and more specifically on sculpture that makes use of electronic and digital technology. Due to the limited length of the text, I have to refrain from in-depth analyses and interpretations of the artworks mentioned as examples. The selection of artists cited is also rather restricted, chosen according to the criterion of exemplarity. I would nonetheless like to apologize for the many and rather evident omissions in this brief essay.

The thought of Michelangelo Buonarroti was paradigmatic for various generations of sculptors. According to the Renaissance artist, sculptural form was virtually contained within the block of stone, making it necessary to liberate it from material excess, allowing it to emerge. The sculptor's work was carried out with and as a function of the material, whose final form, whose solid, three-dimensional volume, was in dialogue with space and the artist's iconological conception.

This gesture is the translation of the idea to matter mediated by manual labor. The sculptor's gesture seeks to reveal information hidden in the matter. This is the gesture that traditionally accompanies the act of sculpting.

In the twentieth century, certain sculptors introduced a fourth fundamental factor: spatial-temporal dynamism. Notions derived from physics, namely simultaneity, energy, and mobility, were explored in the visual arts. Meanwhile, conventional sculptural concepts, such as line, volume, and mass, lost some of their prominence, as is made explicit in Naum Gabo and Antoine Pevsner's 1920 manifesto of Constructivist practices.[1] They sought, rather, rhythm and depth with their new spatial-temporal forms.

Starting in the 1920s, apart from Gabo, László Moholy-Nagy had the pioneering vision to consider the play of movements and effects of light and shadow, projected into space by kinetic-luminous objects, as key motifs of the sculptural piece, quite beyond the object in itself, its materiality, and mechanics. The dynamism and fluidity of the forms derived from the projection of sculptural features in motion onto the walls over time and space became essential to the work. Rather than proposing a model, Moholy-Nagy put forth a kinetic-constructive system to allow for the "recognition of a space condition which is not the result of the position of static volumes, but consists of visible and invisible activities of forces, e.g., of phenomena of movement and the formations that movements take; and may thus under certain conditions consist of fields of force."[2]

His positions were constituted as an essential starting point for the process of the dematerialization of the sculptural object. Like the scientific theory that establishes the equivalence between mass and energy, Moholy-Nagy defended the substitution of arts of the mass—the inert physical object—for relational fields or spatial relationships. The rigid separation between exterior and interior, which was part and parcel of finished, permanent pieces, had to be subjugated by simultaneous interpenetration, enabled by latent relational forces in the materials. This new occupation of space was not only intangible, but also

1 Naum Gabo with Antoine Pevsner, *Realistic Manifesto* (Moscow: Second State Printing House, 1920).

2 "Der Anerkennung eines Raumzustandes, der nicht das Ergebnis der Lagebeziehungen von starren Volumen ist, sondern von sichtbaren und unsichtbaren Wirksamkeiten der Bewegungstatsachen und Bewegungsformationen, unter Umständen also aus Beziehungen von Kraftfeldern besteht." László Moholy-Nagy, "Von Material zu Architektur – Der Weg zum Erlebnis von Plastik und Architektur," *Bauhausbücher*, no. 14 (Munich: Albert Langen Verlag 1929), p. 202. Facsimile available at: https://digi.ub.uni-heidelberg.de/diglit/moholy_nagy1929/0208. English translation from: László Moholy-Nagy, *The New Vision: Fundamentals of Bauhaus Design, Painting, Sculpture and Architecture* (New York: Dover Publications, 2012).

processual, interrelational, transitory, and ephemeral in time. Equally revolutionary was the introduction of the parameter of performativity in the context of sculpture.

Three decades later, Jorge Oteiza revived the principles of physics and the relation between mass and energy to propose a further step toward "trans-sculpture." For the Basque sculptor, in artistic terms, time was terrified by space. Therefore, the arts always sought to spatialize time by trapping, immobilizing, and appropriating it. The result was a work that would be increasingly concerned with physical space. In contrast, for Oteiza, the sculptor's work meant the creation of a void through the liberation or de-occupation of space, experimenting with the negative, leading to the very renouncement of the classic spatial conception of sculpture.[3] His posture made it possible to open up another path altogether.

The gesture of liberation is the gesture of exploration. Hands renounce being transformed into a medium, into an instrument of the prolongation of the idea in the material (volume and mass). It is a gesture whereby, rather than extracting form from matter, one wields the concepts of noninformation and information.

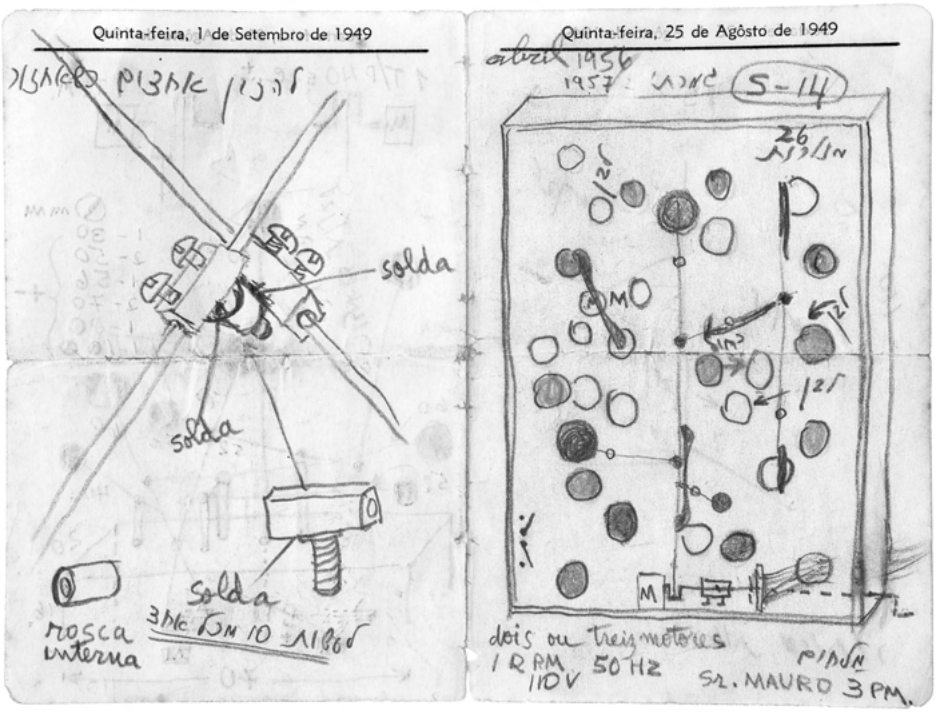
These are just three different examples of possible ways to approach the phenomenon of sculpture.

Another fundamental shift was driven by the incorporation into the arts of period-specific electronic and digital resources, as well as their corresponding materials, artifacts, techniques, and methods. The changes in artistic productions were diverse and profound. Here I will focus solely on the influence of cybernetic theory, and especially on its notion of open systems, on new sculptural conceptions including technological resources, starting in the 1950s.

Cybernetics, as a cross-science that considered the interrelation of various forms of knowledge that, until the 1950s, had been isolated in different scientific specializations, was a factor driving processual and transdisciplinary practices. What most attracted the attention of various artists from the period were factors such as indetermination, feedback, experimentation, and pluri-mediality.

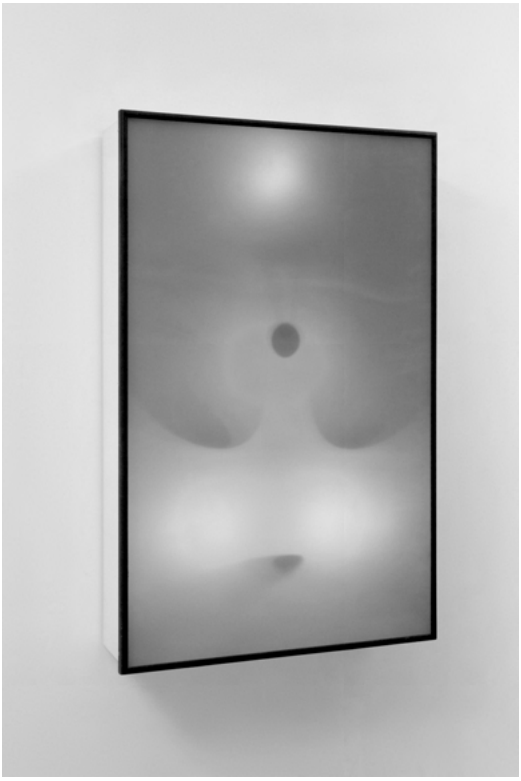
Information became a key parameter for the understanding of aesthetic processes and for the structuring of those new artistic positions, influenced mainly by the cybernetic theories of Norbert Wiener. From the mid-1950s on, artists inspired by cybernetic approaches, such as Abraham Palatnik, Nicolas Schöffer, Nam June Paik, Gustav Metzger, and Les Levine, appropriated its methods and revolutionized the field of sculpture.

3 Txomin Badiola, *Oteiza: catálogo razonado de escultura* (San Sebastián: Nerea, 2016). See also the interview with Jorge Oteiza, "El espacio y el tiempo en la escultura" (ca. 1988), Museo Oteiza, https://www.museooteiza.org/jorge-oteiza/ also "Jorge Oteiza: El espacio y el tiempo en la escultura," YouTube video, April 3, 2013, uploaded by Museo Oteiza, https://www.youtube.com/watch?v=dXFUYyo3KRc&t=128s (accessed February 10, 2023).



1 Abraham Palatnik, Desenho para o projeto de peça *Cinecromática 02*, Item 29 (Drawing for the piece project Cinecromatic 02, Item 29), April 1956. 110 × 70 × 20 cm.

The Brazilian artist Palatnik carried out pioneering research into the relation between art, science, and technology, as well as in the development of participative art. His research first took on a sensorial form, in his kinetic-objectual series of *Aparelhos Cinecromáticos* (Cinechromatic Devices) from 1949 (figs. 1, 2). Later on, he disarticulated the traditional references of two- and three-dimensional works, implementing the variability and transformation of forms, colors, and visual fields by means of movements created through mechanical, electric, and luminous complexes. In these works, created starting from 1959, he explored viewer participation, such as with magnetic fields in various works from the series *Mobilidade* (Mobility). In 1962, he constructed the object-game *Quadrado perfeito* (Perfect Square), based on the movement of pieces on a chess-like board, with its own rules motivating the intuitive participation of the public. *Objeto Rotativo* (Rotative Object) from 1969 depended on the viewer's intervention for it to work and move, and questioned Newtonian physics. Palatnik applied the principles of cybernetic communication to art, and especially to his kinetic sculptures, following the notion that information exchange between diverse systems encourages feedback. In a world saturated with information, Palatnik understood the positioning of art as follows:

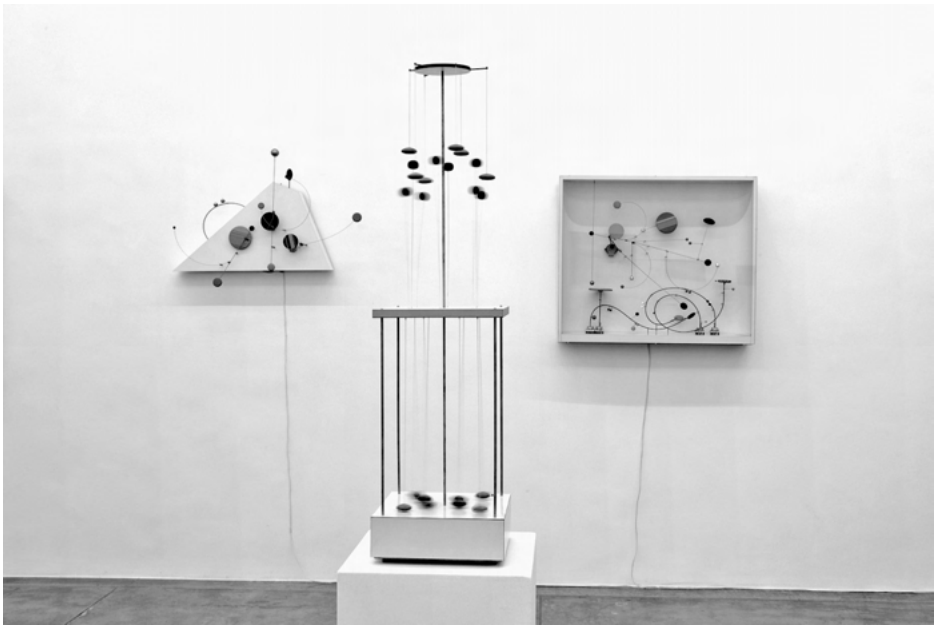


2 Abraham Palatnik, *Aparelho Cinecromático* (Cinecromatic Apparatus), 1969/1986, wood, metal, synthetic linen, light bulbs, and motor. 112.5 × 70.5 × 20.5 cm.

> Its legitimacy lies in our constant adjusting to the exterior world, which we make manifest through our actions in it, either directly or through our extensions and technologies. A kind of "barter." … Likewise, I believe that the form of something is not only its contour, but above all its essence. Reaching this essence is really intriguing. It is the origin of all aesthetic manifestations managed by the artist. It is where sensitivity is brought into play, the improvisation mechanism is liberated and ludic characteristics are presented, once again drawing the human being closer to his condition of participation and integration.[4]

His "sculptures"—which he called at the time *aparelho* (apparatus) or *relevo* (relief), some of which also take on the format of *tableaux-objets*, while others are assemblages—and kinetic-participative objects (fig. 3) are exceptional examples of the way in which the parameter of information plays a decisive role in the conception of the work. They thereby open up a path toward surpassing conventional uses of forms, materials, colors, spaces, and times.

4 Abraham Palatnik, "A evolução do ser humano está ligada diretamente a adoção da tecnologia e da informação" (1977), exh. cat. Instituto de Arquitetos do Brasil (Rio de Janeiro: IAB – Instituto de Arquitetos do Brasil, 1981).

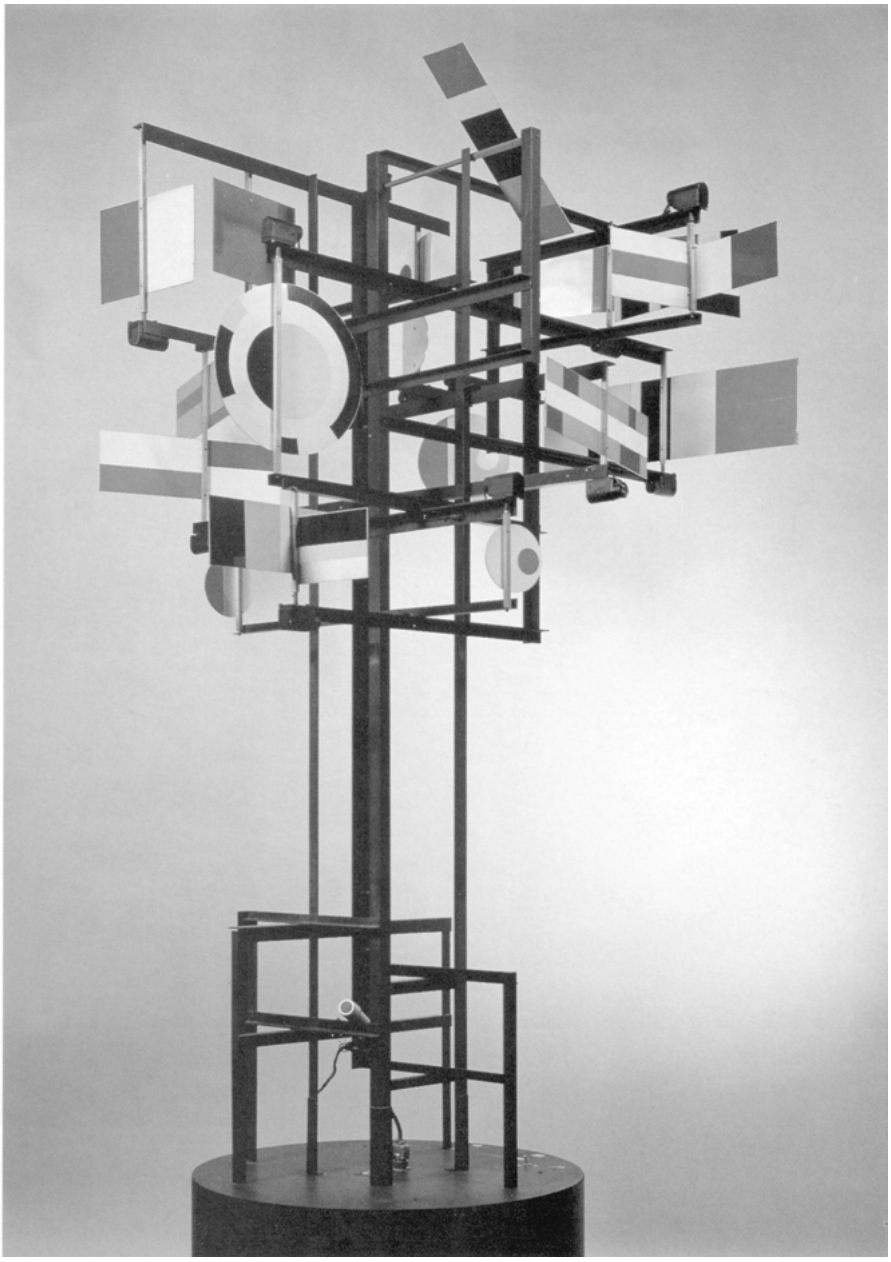


3 Abraham Palatnik, *Objetos Cinéticos* (Kinetic Objects), exhibition view, 2012, curated by Frederico Morais.

For Nicolas Schöffer, works of art should change just as human beings and nature do. Therefore, they should avoid the inert state of matter. With his sculptural shapes, this French-Hungarian artist researched the fourth dimension of time, through real movement, and applied the cybernetic notion of feedback as a dialogical strategy in the work. In striving to achieve this aim, Schöffer programmed indeterminist features, susceptible to influence by natural phenomena (for example, the works responded through electronic sensors to changes in the weather or the presence of humans), or by the action of *performers* (as works which could be manipulated by the viewer). His cybernetic sculptures, such as *CYSP 1* (1956) (fig. 4) were prepared with electronic systems and sensors that converted certain environmental variations around them into kinetic transformations within the piece itself, whether they involved movements, sound, or lighting.

In this position we find the basis—which was highly important in the context of media art—for the objection to the cult of the finished object, as well as the emphasis on open processes and on each work's potential for variability.

Also highly stimulated by cybernetics, Nam June Paik related the concept of freedom to communication problems in art. His first works of cybernetic art, and later his video sculptures, considered communication as a form of free interrelation and interaction between the medium, the public, and the work, and not as a mode whereby purely informational and explanatory messages were transmitted. According to Paik, it is necessary to tran-



4 Nicolas Schöffer, *CYSP 1*, 1956, aluminum and mixed media (computer, traction motor, direction motor, two microphones, two photoelectric cells, nineteen micromotors), height: 2.6 m. This was the first spatial-dynamic sculpture, having total autonomy of movement (traveling in all directions at two speeds) as well as having axial and eccentric rotation (setting in motion its sixteen pivoting polychromed plates).

scend monodirectional experiments with art's randomness.[5] Reflections on indeterminism, variability, transdisciplinarity, communication, and public participation come to the fore in the pieces seen in Paik's first exhibition, held in 1963 at Galerie Parnass in Wuppertal, Germany. In the show, Paik exhibited his first cybernetic sculptures using electronic devices. Just as Palatnik and Schöffer drew from Constructivist sources and the mechanical-luminous kinetics of Moholy-Nagy, Paik had as his starting point certain Dadaist positions regarding the ready-made, Fluxus notions of improvisation, and John Cage's indeterminism to explore the new field of electronic art. Paik structured the exhibition into two parts, made explicit in the very title: *Exposition of Music—Electronic Television*. In the part dedicated to sound objects, Paik showed (among other works) four "prepared pianos," following on Cage, conceived for visitors to be able to touch and manipulate. The five sound sculptures consisted of manipulated audio devices—tape recorders and record players—which encouraged visitors to interact and create sounds. For example, the piece *Schallplatten-Schaschlik* consisted of a record player with the possibility of increasing up to ten vinyl records in movement, and a large pickup allowing visitors to freely place the needle on any of the records and listen, which due to the obvious instability of the arrangement gave out random sounds. The other works, entitled *Participation TV*, were some of the first examples of electronic and interactive audiovisual "sculptural" objects. Paik equipped a television set with an attached switch at its base which, when activated by the viewer, caused a small burst of light on the screen. Another object had an attached microphone that transmuted the vibrations of human voices into visual vibrations on its canvas. Following on the same principle, Paik attached another television set to a working radio whose broadcast intensity enabled a sole point of light in the center of a dark screen to expand or contract in tandem with the radio's acoustic loudness.

Paik's idea coincided with those of Schöffer and Palatnik on the need to research into strategies to incorporate indeterminist and random information processes into electronic-visual creation to break with the one-directional principles of broadcaster-receiver, opening up the work to public intervention or its interrelation with its surroundings or other media. *Participation Music* and *Participation TV* are noteworthy examples of the articulation of participative art as a system based on "interdependent processes," following on a definition coined by Hans Haacke in 1968, who was likely more influenced by systems theory.[6]

It is important to recall that starting in the early part of the 1960s, a series of artists began to use the television set or frame as an "objectual" feature, to be transcended or intervened upon. This was seen with César, who in 1962 showed *Télévision*, a sculptural television which corresponded to the characteristic proposals of Nouveau Réalisme. Günther Uecker, for his part, in *TV 1963*, covered the casing of a television set with nails. This

5 See Nam June Paik and Edith Decker, eds., *Niederschriften eines Kulturnomaden: Aphorismen, Briefe, Texte* (Cologne: DuMont, 1992).

6 See Hans Haacke and Alexander Alberro, eds., *Working Conditions: The Writings of Hans Haacke* (Cambridge, MA: MIT Press, 2016).

transgressive gesture transformed a status symbol of modern life into a fetish object, like certain African shamanist sculptures done by the Nkisi, from the Congo. In 1963, moreover, Wolf Vostell exhibited *TV Décoll/age*, a clear reference to the deconstruction of mass media's most stellar device.

Starting in 1965, with the first artistic experiments with video, and especially in the 1970s and 1980s, the format of video-sculpture underwent considerable development. The video-sculptures of Paik combined the materiality of found objects with the temporality of audiovisual found footage. They constitute an assemblage of forms and recycled audiovisual information.

In 1969, Les Levine, in *Contact: A Cybernetic Sculpture,* proposed the active inclusion of the public by means of a system of closed-circuit cameras that captured images of the people in the gallery, rebroadcasting them in real time through the televisions found there. The eighteen CRT televisions were combined into a sculptural structure and their screens were covered with acrylic gel in different tones. Sharing in the cybernetic spirit, Levine held that works of art should be established as open systems.[7]

Besides Paik and Les Levine, Shigeko Kubota, who had studied sculpture in Tokyo, was another precursor of video-sculpture. Her emblematic *Nude Descending a Staircase*, from 1976, established a dialogue between audiovisual container and content, moving fully beyond the two-dimensional Duchampian simulation of simultaneous displacement.

Now that we have come to this point, it would seem pertinent for both practical and methodological considerations to reaffirm the need to distinguish between the various formats taken up by media sculpture[8]—such as TV-based sculpture, video-sculpture or monitor-based sculpture (single-channel or multimonitor multi-channel)—and expanded formats closer to environments and installations, such as audiovisual installation, video installation, closed-circuit installation, interactive installation, and many more. Video-sculpture can use one or more monitors and channels, related or not with other features. Its main characteristic is the conception of a work with a delimited three-dimensional format that incorporates video production, which may or may not be closely related to the support. In this way, it is unlike video installation and audiovisual installation, which break with the clearly delimited physical form of the object and put the emphasis on integrating the whole into the space, on ideas of site-specificity, the transitory or ephemeral nature of adapting each intervention to each site, the relationship between context (space, architecture, ambience, surrounding, and so on), time (duration), and the work's component parts, as well as the recourse to a certain degree of "staging."

Some authors do not defend this distinction, although I have not been able to find strong arguments in their writings that might justify the objections to such groupings. In

7 See Gene Youngblood, *Expanded Cinema* (New York: E. P. Dutton & Co., Inc., 1970).

8 The acceptance of the term here is more clearly defined and is differentiated from the meaning Les Levine gave it, where "media sculpture" encompasses a much broader set of possibilities, expanded and independent of its use of technologies, and at other times more related to the question of the mass media.

fact, there is difficulty in certain cases of setting out clear demarcations between formats and ways of presentation, especially in the period when the goal was precisely to break with said limitations and promote hybridism and transdisciplinarity, i.e., "expanded sculpture." The term "expanded" in relation to the arts comes from one of the pioneers of electronic art, Mary Ellen Bute. In the 1930s, she researched the field of expanding cinema and her ideas influenced a posteriori other artists and theorists. However, the use of the term "sculpture" here is associated (without running the risk of recurring to synthopic forms[9]) with various essential and constant characteristics of each artistic expression.

Although they were being broadened and diversified, especially with the use of electronic and digital technologies (as I have observed above), they are implicitly different from the unfolding in space-time that characterized the installation. It is also interesting to mention the approximation of sculpture to what is known as time-based art, which decades earlier would have been considered a contradiction.

Quite independently of formats, the ideas of art as process and as system as well as the dual position of the observer as receiver and emitter came to be constituted as new aesthetic parameters in the realm of media art, and more specifically in media sculpture. Perhaps the main shifts taking place in that first stage of media sculpture, influenced as it was by cybernetic principles, involved overcoming the dichotomy between materiality and immateriality, between the tangible and the intangible, as well as introducing notions of variability and indetermination into the field of sculpture.

One of the effects of these new approaches was the proposal to move beyond aesthetic experience oriented toward subjective, distant fruition, a posture propagated by Romanticism and which would last, to a certain degree, into our century. It is worth recalling what the gnoseological dispossession of the works, which supported aesthetic reflection based on taste with neither concepts nor context, precisely was.[10] We must recognize that the renouncement of this kind of aesthetic discourse in favor of a communicative, even informational, consideration of art, was acutely influenced by phenomenology, hermeneutics, and semiotics. Examples of this current, developed as it was over the entire period encompassing the postwar up to the 1970s, include informational aesthetics, cybernetic aesthetics, and generative aesthetics,[11] all of whose main starting point, as the terms already suggest, was precisely cybernetic theory, with certain notions received as well from systems theory. They deepened the chasm between ontological or metaphysical aesthetics and aesthetics of a rationalist tendency.

9 I used the concept of "synthopia" in 2000, and after, in Claudia Giannetti, *Estética Digital – Sintopía del arte, la ciencia y la tecnología* (Barcelona: L'Angelot, 2002), p. 15, and *Ästhetik des Digitalen: Ein intermediärer Beitrag zu Wissenschaft, Medien- und Kunstsystemen* (Vienna/New York: Springer Verlag, 2004).

10 For more information, see Giannetti, *Ästhetik des Digitalen*, 2004, ibid., pp. 167–70.

11 For more regarding these theories, see Giannetti, *Ästhetik des Digitalen*, 2004, pp. 29–52; see also a more succinct text in: Giannetti, "Aesthetics of the Digital" (2003), *Media Art Net*, http://www.medienkunstnetz.de/themes/aesthetics_of_the_digital/ (accessed February 10, 2023).

What clearly set apart their different theoretical lines was above all the emphasis given to the information parameter. In his *Informationsästhetik* (informational aesthetics), developed from 1957 on, Max Bense defended the idea, for example, that art should *liberate itself* methodically from objects and forms as the vehicles of aesthetic processes, while reducing aesthetic imitation proportionally to the degree of aesthetic abstraction. This would allow the introduction of an *aesthetic kinetics* characterized by the emancipation of aesthetic medium. "Kinetics" refers to another way of conceiving the work of art as a structure that keeps the possibility of transforming itself, converting itself and diversifying itself as latent, just as what happens with information. His proposal for the objective analysis of the work of art signified, in other words, an explicit split with aesthetic theories for the most part derived from a subjective, metaphysical understanding of art centered on styles and on stable, permanent forms and objects. For Bense, aesthetic objects were not solely physical and inert; their aesthetics had to be addressed as an informational process. Observation and communication technique would, therefore, take the place of previous interpretational aesthetic processes. In other words, works of art would be understood as information mediators (aesthetic information): "It might also be stated that works of art are a special class (that is, created, not given) that are 'carriers' of 'aesthetic information.'"[12]

Something that was indicative of the rapid expansion of cybernetic thought also in the artistic/cultural world is found in the various exhibitions of art and technology organized in various continents throughout the 1960s. These brought together works of art with a clear processual, behavioral, and communicational foundation. To cite a brief selection of these exhibitions: in 1968, *Computer and Visual Research*, held in Zagreb as part of the biennial of new tendencies created in 1961; *Cybernetic Serendipity*, held in London in 1968, which among others featured artists who had taken risks with the sculptural and robotic format, including Paik with *Robot K-456* and his *Participation TV*, and artists who presented interactive kinetic sculptures, such as Schöffer with *CYSP 1*, Edward Ihnatowicz with *Sound Activated Mobile (S.A.M.)*, and Gordon Pask with *The Colloquy of Mobiles*.[13]

In South America, in turn, two exhibitions carried out a vital role in spreading information on the new relationship between art, science, and technology. In 1969, the Buenos Aires-based Centro de Arte y Comunicación – CAyC (Centre for Art and Communication) of the Fundación de Investigación Interdisciplinaria (Foundation for Interdisciplinary Research) organized the first exhibition of *Arte y Cibernética* (Art and Cybernetics), presented at the

12 "Kunstwerke, so lässt sich auch formulieren, sind eine besondere (nämlich hergestellte, nicht gegebene) Klasse von 'Trägern' der 'ästhetischen Information'." Max Bense, "Ästhetische Kommunikation," in "Semiotik: Allgemeine Theorie der Zeichen," *Internationale Reihe Kybernetik und Information*, vol. 4. (Baden-Baden: Agis Verlag, 1967), pp. 18–25. See also Max Bense, *Ästhetische Information* (*Aesthetica II*) (Krefeld/Baden-Baden: Agis Verlag, 1957); *Ästhetik und Zivilisation* (*Aesthetica III*) (Krefeld/Baden-Baden: Agis Verlag, 1958); *Einführung in die informationstheoretische Ästhetik* (Reinbek bei Hamburg: Rowohlt, 1969); *Programmierung des Schönen* (Krefeld/Baden-Baden: Agis Verlag, 1960).

13 Jasia Reichardt, ed., *Cybernetic Serendipity: The Computer and the Arts* (London/New York: Studio International, 1968).

city's Galería Bonino. The exhibition curator and director of the CAyC, Jorge Glusberg, who was also a member of the Argentina Inter-medios program,[14] was one of the early promoters of the potential of cybernetics in implementing the relationships between art and science from a transdisciplinary perspective, focused on the inclusion of technologies into the artistic context. In 1971, Glusberg was likewise a member of the Grupo de los Trece (Group of Thirteen) along with Edgardo Vigo, an Argentine artist who gave an ironic twist to sculpture with his *Máquinas Inútiles* (Useless Machines, developed from 1957 onward), which used rudimentary kinetic mechanisms taken from scrap material. In São Paulo, the exhibition *Arteônica* (1971) brought together, for the first time in Latin America, the leading international artists and researchers in the field at that time, such as Manfred Mohr, Georg Nees, Michael Noll, Herbert Franke, François Morellet, the group from the Centro de Cálculo de Madrid (Madrid Calculus Centre; Barbadillo, Sevilla, Sempere, Delgado, Alexanco, Yturralde), and many more. The initiator and the author of the manifesto that accompanied the exhibition was Waldemar Cordeiro, renowned as one of the most experimental and international artists and theoreticians on the Brazilian scene. Recognized today the world over as a leading figure of Concrete Art, Cordeiro took his place as one of the precursors in the Latin American context of programming and computer art, having done his first pieces in this field in 1968, in collaboration with the Italian physicist Giorgio Moscati. Notions of processual and random art were made patent in his electronic artistic praxis from this early period onward.

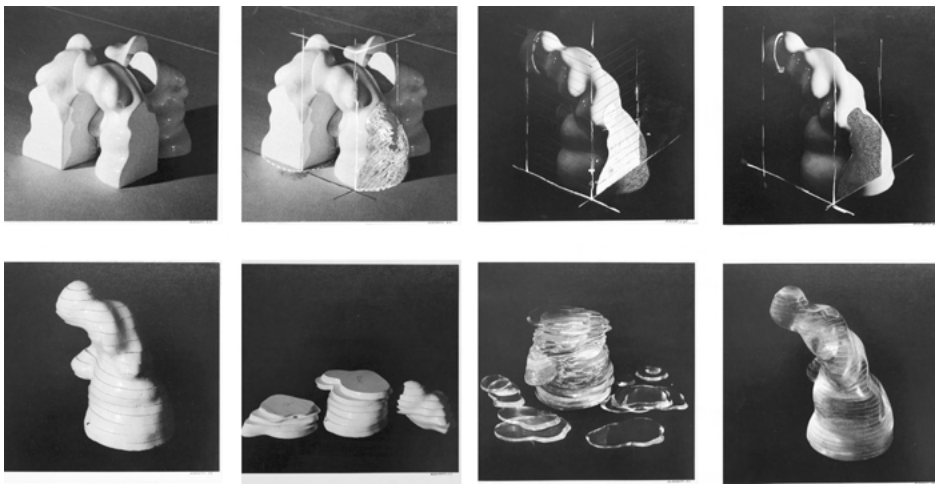
Artistic use of computer systems, as applied to creative processes, was another radical transformation. The production of computer art in its first phase is relatively well known, especially starting in the 1960s, when it was dedicated to generative works, computer graphics, and software art whose output results were in two-dimensional printed pieces. Less would be known, however, of the earliest research by artists into computer-generated sculpture.

One of the innovative proposals in the translation of two-dimensional visuality of computer-generated graphics to three-dimensional materials was conceived by a student of Bense, Georg Nees. This German artist, who studied mathematics and physics, exhibited his first works with computer graphics in Stuttgart in 1965. The most surprising aspect of his *Plastik 1* (Sculpture 1) a relief created from 1965–68 on an aluminum plate, was that he used an automatic milling machine to cut the material. His process of carving the material followed the shapes of images created by a computer by means of an algorithm with random parameters.

In Spain, from 1968 to 1973, the Centro de Cálculo (Calculus Centre) of the University of Madrid developed a series of courses and a research residence program that enabled artists and architects to learn more about the possibilities of computer technologies. The "Seminar in the Automatic Generation of Visual Forms"[15] was of vital importance for the first

14 See Jorge Glusberg, *Argentina Inter-medios* (Buenos Aires: Centro de Arte y Comunicación, 1969).

15 See Manuel Barbadillo, "Hommage to Norbert Wiener" (1975), in Claudia Giannetti, ed., *El discreto encanto de la tecnología: Artes en España/The Discreet Charm of Technology—Arts in Spain* (Badajoz/Madrid: MEIAC/Seacex, 2008), pp. 322–27.



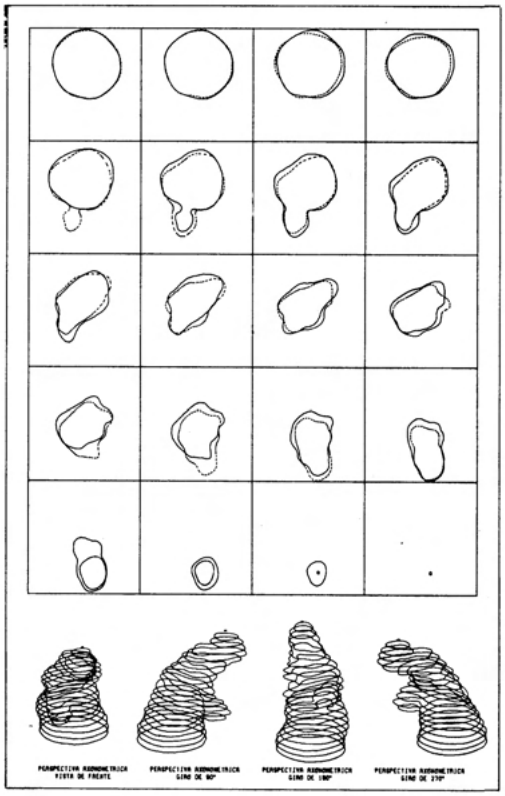
5 José Luis Alexanco, genesis of *Mouvnt*, 1969, eight elements, intervened on photographs on baryta paper, 50 × 100 cm.

generation of Spanish artists to explore the use of computers as tools for art. Participants in the seminar included Manuel Barbadillo, José Luis Alexanco, José María Yturralde, Eusebio Sempere, and Elena Asins.

One of the pioneers in the application of the principles of digital combinatorics to the field of sculpture was José Luis Alexanco. In the period from 1969 to 1973, when he worked in the aforementioned Centro de Cálculo in Madrid, this Spanish artist programmed the algorithm *Mouvnt*, written in Fortran IV. This program made it possible to execute topological transformations on the basis of a three-dimensional form-origin, calculated in functions of data defining forty level curves in an X, Y, Z coordinate system. The algorithm used five different types of methods to transform level curves and a series of parameters for each type. When combined, it was practically impossible for a result to be repeated. The interlinking of the different parameters allowed him to create new forms indefinitely. These forms were applied to methacrylic slices, which were grouped together and juxtaposed to create a sculptural object, as was the case with *Mouvnt XX* (1972) (fig. 5, 6). They also served as molds to create sculptures in resin or cast metal, such as *Plata* (Silver, 1968).[16] The combinatory possibilities were virtually infinite, rendering incalculable the variability of the sculptural results.

Unlike early cybernetic art, which worked above all with feedback and indetermination using factors external to the sculpture, this kind of "permutational art"—a term used

16 See Giannetti, ed., *El discreto encanto de la tecnología: Artes en España*, 2008, pp. 438–39.



6 José Luiz Alexanco, *Mouvnt*, 1969, plotter output print on paper, 100 × 70 cm.

by Abraham Moles,[17] another important supporter of including cybernetic models in art—sought to research the internal resources of the information processor. Through the creation of combinatory algorithms that encompassed diverse possibilities, the machine could systematically analyze the totality of the field, something quite beyond the mental capacities of a person in a reasonable time frame. Using a repertoire as a foundation, the artist created an algorithm in the function of the definition of certain parameters for the manipulation of symbols. Though the artwork was so algorithmically defined, the responsibility for the final work may or may not be assumed by the artist.

In this kind of system, the machine can generate proposals of possible works of art. The artist analyzes and selects them, establishing human-machine co-authorship.[18] The process of actively integrating the machine into the creation of the work gives rise to new que-

17 See Abraham Moles, *Informationstheorie und ästhetische Wahrnehmung* (Cologne: Du Mont, 1971), see also *Théorie de l'information et perception esthétique* (Paris: Flammarion, 1958).

18 For the question of the co-author and the meta-author, see Giannetti, *Ästhetik des Digitalen,* 2004, pp. 102–18.

ries on aesthetic paradigms and the meaning of authorship. Various theoreticians, Douglas Hofstadter[19] among them, propose the figure of the meta-author, i.e., the author of the author of the result. However, it is vital to underline that the relationship between the meta-author and the author—person and machine—cannot be hierarchical in the creation process where the machine is playing an active role. Indeed, their respective contributions are always complementary and grounded in complicity. This point of view contradicts the traditional idea of the machine as a simple, passive, non-mediating tool.

Another highly interesting experimentation was the use of computer processes in the definition of corporeal movements, abandoning the objectification of the body—such as Piero Manzoni's *Sculture viventi* (Living Sculptures, 1961)—and opting for the programming of body dynamics. In 1973, the visual artist and dancer Analívia Cordeiro carried out her first experiments with an algorithm to interrelate dance and audiovisual language, which found its practical application in the audiovisual piece entitled *M3x3* (1973), considered the first work of video art in Latin America. Cordeiro continued her research in the development of a computer program for dance notation in 1982. The resultant software, called Nota-Anna, was programmed in Fortran IV in collaboration with Nilton Lobo. This made it possible to analyze specific body movements, decompose them, and formalize them using spatial lines that schematically symbolize the succession of the dancers' gestures. The objective was to graphically express corporeal action and define its spatial-temporal positioning. This process of codification, of translating an ephemeral movement or sequence of movements into information, allows for the conservation of the gesture's expressive potential.

In the period 2015 to 2017, Cordeiro used Nota-Anna to make a series of smaller computer-aided sculptures with very concrete gestures as their visual leitmotifs. Examples included two Pelé football kicks or a Yoko Geri Kekomi blow by Bruce Lee, both from 1960s audiovisual sources. This program transforms body movement into symbolic coordinates—geometric diagrams in space—which are then formally condensed with extreme exactitude into a single three-dimensional virtual model. The dematerialization of the body takes place through the transformation of mass into energy. The linking of pure dynamic lines present in the trajectory of a specific gesture is thereby conserved. In this way, the memory of the dynamics of the action over time is maintained. The final pieces, as spatial volumes with potentially condensed complex mobility, are modeled and printed in 3D using various materials (figs. 7, 8).

This kind of creative process demonstrates the dual function taken up by the creator regarding computer-assisted sculpture: that of aesthete, and that of manipulator of symbols.[20] The aesthete sets out the artistic criteria (repertoires) that he or she believes must be present in the work, which will be processed and generated by the computer. On the other hand, there is the defining of the algorithm's programming, which must balance the creative necessities of art practice with the formal language of the machine. The algorithm is

19 Douglas R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books, 1979).
20 See Giannetti, *Ästhetik des Digitalen*, 2004, pp. 34–42.

7 Analívia Cordeiro, *Materialization of Sight II*, 2015, computer-assisted sculpture, blue polyamide, 28.43 × 22.42 × 21.38 cm.

8 Analívia Cordeiro, *Tribute to Oskar Schlemmer I*, 2016, computer-assisted sculpture, red polyamide, 23.36 x 16.74 x 10.31 cm.

understood as an extension that increases limited human perceptive capacities. Humans, for instance, cannot precisely register a sequence of movements presented at a higher speed than the time required for an impression on the human retina (almost a quarter of a second). In this sense, the exactitude of the forms and the dynamics, regarding the reality of the movement, can only be artistically expressed with the support of technological resources.

Continuing research and technological advancement has opened up new possibilities for art, such as computer-generated sculpture (such as through systems of Artificial Intelligence) or virtual sculpture (from holography to stereoscopic vision techniques), which would be the subject of a different essay. Nevertheless, in essence these formats do not involve changes in the central parameters mentioned previously, while varying the degrees of autonomy of the technological systems wielded. With this in mind, the human-machine relationship (as the co-author or meta-author) as well as the final results regarding the artwork's degree of materiality or immateriality also become far more variable.

Translated from the Spanish by Jeffrey Swartz

Jens Schröter

Sculpture in the Digitally Expanded Field

Abstract

The title of this text is an allusion to Rosalind Krauss's essay "Sculpture in the Expanded Field." She locates sculpture on a structural map between (not-)architecture and (not-)landscape and is able to classify the very different "sculptural" phenomena of the 1970s. I want to propose a kind of systematics to relate the sculptural to the virtual, as defined in the field of digital technologies. The central argument will be that digital technologies allow, among other things, the construction of virtual models of entities, meaning mathematical descriptions without materiality. Computers can, in this sense, construct virtual models of sculpture, which are mathematical descriptions of spatial objects. In that sense, there is a fundamental sculptural dimension to (certain types of) computer graphics. I will further discuss the notion of digital modernism. My thesis is that the worn-out paradigm of describing art as a reflection of medium specificity can have a comeback with digital technologies, since these are able to construct virtual models of media. With this malleable virtual media, questions regarding medium specificity can be posed anew. Finally, I will come back to Krauss's systematics of sculpture in the expanded field and try to develop a sketch of a similar systematic—of sculpture in the digitally expanded field.

Key Words

Computer graphics, object space, virtual camera, 3D-printing, Rosalind Krauss

I. Introduction

The title of this text is an allusion to Rosalind Krauss's paradigmatic essay "Sculpture in the Expanded Field."[1] In this essay, she locates sculpture on a structural map between (not-) architecture and (not-)landscape and classifies the very different "sculptural" phenomena of the 1970s. The idea in my paper is somewhat similar. I want to propose a kind of systematics

1 Rosalind Krauss, "Sculpture in the Expanded Field," *October*, no. 8 (1979): 30–44.

to relate the "sculptural" to the virtual, as defined in the field of digital technologies. A new expanded field of sculptural possibilities thereby becomes visible.[2]

In section 2 I will explain my use of the notion of virtuality. The central argument will be that digital technologies allow, among other things, the construction of virtual models of entities, meaning mathematical descriptions without materiality.[3] Computers can, in this sense, construct virtual models of sculpture, that is mathematical accounts of spatial objects. Actually, several types of computer graphics operate by constructing virtual objects in "object space," which are then "photographed" by a "virtual camera."[4] In that sense, there is a fundamental sculptural dimension to (certain types of) computer graphics.

In section 3 I will discuss the perhaps surprising notion of *digital* or *virtual modernism*. While in the second section I only discuss the formal spatiality of certain virtual objects, here the question is one of aesthetics. My thesis is that the worn-out paradigm of describing art as a reflection of medium-specificity can have a comeback with digital technologies, since these are able to construct virtual models of media. With this malleable virtual media, questions regarding medium-specificity can be posed anew—and this is also the case for sculpture.

In section 4, building on the discussion in sections 2 and 3, I will come back to Krauss' systematics of sculpture in the expanded field and try to develop a sketch of a similar systematic—of sculpture in the digitally expanded field. I want to do this by discussing some artworks and artistic practices.

II. The Virtual, Simulation, Object Space, and the Sculptural

Why do I speak of the "virtual"? First of all, because the notion of "digital" is somewhat confusing. Language is also a digital code, insofar as it is based on a discrete and disjunct repertoire of basic elements, namely the letters of the alphabet.[5] "Digital" is not a very specific criterion to describe the contemporary situation, characterized by the diffusion of

2 Martina Dobbe, "Lesarten einer generischen Bestimmung: Skulptur," in *Die Kunst und die Künste: Ein Kompendium zur Kunsttheorie der Gegenwar*t, ed. Georg W. Bertram, Stefan Deines, and Daniel Martin Feige (Berlin: Suhrkamp, 2021), pp. 297–316 for a discussion of the "sculptural" in analogy to the definition of "the photographic" also given by Krauss in other texts. See also Martina Dobbe and Ursula Ströbele, "Gegenstand: Skulptur," in *Gegenstand Skulptur*, ed. Martina Dobbe and Ursula Ströbele (Paderborn: Fink, 2020), pp. 1–16.

3 That does not mean that digital information processing is a process not bound to materiality and energy consumption (see Rudolf Landauer, "Irreversibility and Heat Generation in the Computing Process," *IBM Journal of Research and Development* 5, no. 3 [July 1961]: 83–90). Moreover, the production of computing machines and the data infrastructures needs lot of materials that have to be (often violently) extracted. But that does not mean that the mathematical descriptions of a material object are themselves material.

4 See John F. Hughes et al., *Computer Graphics: Principles and Practice*, Third Edition (Upper Saddle River, NJ: Addison Wesley, 2014), pp. 21–23.

5 Nelson Goodman, *Languages of Art: An Approach to a Theory of Symbols* (Indianapolis, IN: Bobbs-Merrill, 1968), pp. 130–41.

computing machines (of a certain type). I suggest that at least for the cases I discuss here, the notion of "virtual" is more helpful, although it has a complicated history, composed of several very different strands.[6] As far as the relation of sculpture and the sculptural to (the imagistic possibilities of) modern computing technologies is concerned, I focus on the notion of virtual as it emerged in the history of computing.

In the discourse of computer science, "virtual" is first used in the context of research on virtual memory. To cut a longer story short: around 1962, virtual memory took on the meaning it has today. At that time, the high price of memory with short access time was the main problem of electronic computers. As a result, information not needed at the moment had to be moved from main memory to auxiliary memory. Memory allocation refers to the process of deciding which data is currently required in main memory and which can be swapped out to auxiliary memory. There were a number of proposed solutions, of which the concept of virtual memory ultimately prevailed. It is an automatic memory allocation method that was first used in the Atlas computer developed in 1961.[7]

The programmer can operate with the "address" or "name space" on computers (with "virtual memory"), as if it were a continuous memory. The computer system maps (as a black box invisible to the programmer) these addresses in the name space by means of an "address-translation function" to the real addresses in memory space (that can be composed of quite different types of memories). The computer system only loads the program parts or data that are currently required by the program into the actual main memory. Virtual memories operate on the basis of the *separation of the logical address space from the actual material memory space*.

This meaning of virtual can be supported by history: in an official letter to Christian Gottlob Voigt from November 24/25, 1795, Goethe wrote: "Libraries now also attract our attention. We have four of them: the local one, the Jenaisch Akademische; the Buderische and Büttnerische, which will probably always remain separate in terms of institution and place, but whose virtual unification is desired and thought possible." In a letter to Schiller from December 9, 1797, he wrote: "Perhaps I will have some influence in library matters in the future, tell me what you think of an idea with which I held for long, namely to unite the local, the Büttnische and Academic Library, virtually [virtualiter], into one corpus."[8] Goethe is not proposing a physical union of libraries, but a common catalogue that functions as a uniform "address space," although the physical location of the books (the "memory space") remains heterogeneous.

6 Jens Schröter, "What is a Virtual Image?," in *Virtual Images: Trilogy of Synthetic Realities I*, ed. Lars C. Grabbe, Patrick Rupert-Kruse, and Norbert M. Schmitz (Marburg: Büchner, 2021), pp. 91–104.

7 Peter J. Denning, "Virtual Memory," *ACM Computing Surveys* 2 (1970): 153–89, here 156.

8 Johann Wolfgang von Goethe, *Sämtliche Werke nach Epochen seines Schaffens: Münchner Ausgabe*, ed. Karl Richter et. al., vol. 4.2: 880 and vol. 8.1: 462 (Munich: Hanser, 1985 and following). All quotes from German are translated by the author.

This difference of structure and materiality is crucial.[9] To give a more recent and highly important example: the *computer simulation* of a real object or process used in science or the military consists of "detaching" mathematically describable structures from the materiality of the object. We can adopt Helmut Neunzert's definition: in simulations, an operationally defined "real process … is represented as mathematics … so as to be simulated in the computer using algorithms."[10] This means that, based on different kinds of gathered or sampled data, the rules governing the behavior of an object or process, that is, a theory, can be derived. This basic model is translated into a formalized model able to be carried out by a computer. To the extent that—to use Deleuze's formulation—the structure is the reality of the virtual, simulation models of objects are virtual objects.[11] Take the example of a rubber ball: the bouncing behavior of a ball is abstracted from the material ball made of rubber by observing and measuring it and then putting its data into mathematical equations, in order to then serve as the basis for a model. In other words, a "virtual ball" is created. This model can then be represented on a display showing a point that bounces "like a ball."[12] These virtual objects can now be used for virtual experiments in different ways: we could allow the model to develop more or less independently (guided by theoretical extrapolations), which permits time to be compressed considerably, so as to see what the modelled phenomenon presumably will be like; or we could modify certain parameters, so as to see how the object would behave under different conditions (for example, our virtual ball under different gravity, etc.). We could also change the parameters just to achieve surprising or aesthetically interesting effects.

After 1945, simulations were used to develop the hydrogen bomb, and today are omnipresent in urban planning, architecture, medicine, most natural and even social and economic sciences, as well as in the so-called interactive simulations used to train pilots, high-speed train drivers, and the staff of nuclear power stations.[13] They are also present in many forms of computer games, e. g., in the form of "physics engines" that control the behavior of certain objects in the game.

But for the discussion here, it is much more relevant that computer simulation techniques can also simulate other technological media.[14] There are many examples of this—one

9 See also Kathrin Koslicki, *The Structure of Objects* (Oxford: Oxford University Press, 2008). She delivers a convincing argument for structure as a constituent property of objects as apart from their matter.

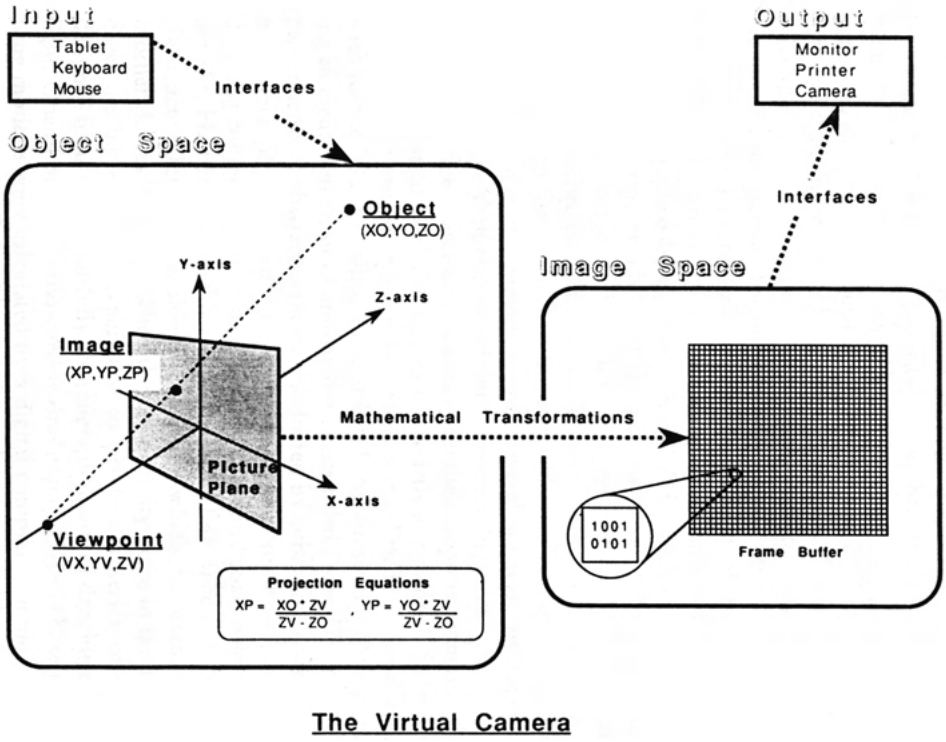
10 Helmut Neunzert, "Mathematik und Computersimulation: Modelle, Algorithmen, Bilder," in *Simulation. Computer zwischen Experiment und Theorie*, ed. Valentin Braitenberg and Inga Hosp (Reinbek bei Hamburg: Rowohlt, 1995), pp. 44–55, here p. 44.

11 Gilles Deleuze, *Difference and Repetition* (New York: Columbia University Press, 1994), p. 209: "The reality of the virtual is structure."

12 Other kinds of display are possible, for example an auditive representation. Often such simulations are not done to produce images, but deliver data that can be used for analytical purposes or to train machine learning systems, etc.

13 See Peter Galison, *Image and Logic: A Material Culture of Microphysics* (Chicago: Chicago University Press, 1997), see chapter 8 for the early development of computer simulation.

14 See Jens Schröter, "Medienästhetik, Simulation und 'Neue Medien,'" *Zeitschrift für Medienwissenschaft* 8 (2013): 88–100.



1 Schema of the virtual camera, in Timothy Binkley, "Refiguring Culture."[15]

example is "photorealism" in computer graphics, which made some of its early spectacular appearances in the early 1990s with movies such as *Terminator 2* or *Jurassic Park*. Photorealism is simulation, as the characteristics (of certain aspects) of photographic media are measured and the resulting data and their theoretical descriptions are used as the basis of computer models.[16] A simulated or virtual camera is a real (but not actual, material) camera,

15 Timothy Binkley, "Refiguring Culture," in *Future Visions: New Technologies of the Screen*, ed. Philip Hayward and Tana Wollen (London: BFI, 1993), pp. 92–122, here p. 104.

16 But it is important to add that computer graphics don't have to be photorealistic in the sense that they simulate the look of photographic images, although that might be the goal, especially if computer-generated graphics are to be integrated in an otherwise photographically recorded movie (as is often done in popular cinema). One could also construct cartoon-like objects in object space and then "photograph" them with a virtual camera that is modeled closely to photography, thereby producing images that are at the same time cartoonish and look like photography—as is done in Pixar's popular animated films, which playfully reflect their imagery's mixed status (see Jens Schröter, "Medienästhetik," 2013, Schröter, "Narration and Visuality in Monsters Inc.," in *The Cinema of Sensations*, ed. Agnes Pethö [Cambridge, UK: Cambridge Scholars Publishing, 2015], pp. 223–36). Since the computer-generated images are mathematical in nature, they can also follow completely different forms of representation: they can follow, e. g., nonoptical forms of projection like parallel perspective (see Benjamin Beil and Jens Schröter, "Die Parallelperspektive im digitalen Bild," *Zeitschrift für Medienwissenschaft* 4

which, depending on the data and theories available, can approximate its material model (actual, material cameras with their optical and material properties) as closely as desired (although a more detailed model needs more processing time and resources and that can be a hindrance).[17] The virtual camera, which ultimately is a mathematical construct, can also be changed in whichever way is desired, for example in order to be able to produce pictures which could not be produced by actual, material cameras.

On the left in fig. 1 we can see object space. The object is, for the sake of simplicity, only a point with the coordinates XO, YO, ZO (object position on the x-, y-, z-axis). The object is "photographed" from the viewpoint of the virtual camera, and the coordinates are XV (unfortunately given as VX in the image), YV, ZV. The point on the picture plane is computed through the projection equations (similar to perspectival projection). This image space is then rendered, for example, on a screen. The model presented in fig. 1 is highly simplified and does not include, for instance, a simulation of effects of the lenses or graininess, etc.

While in an earlier paper I put the emphasis on the construction and operations of the virtual camera, *simulating photography*,[18] I want to shift the emphasis here onto what the virtual camera "photographs." This is basically a mathematical process in which a mathematically defined "object space" is projected, using the mathematical rules of perspectival projection, onto an "image space" or the picture plane. This recalls Alberti and the notion of perspectival projection onto the *fenestra aperta*, but the scene in front of the "window" is mathematically constructed, as is the "window," meaning the camera and the process of projection. Instead of letting the light (and the system of lenses) do the projection automatically through physics (and chemistry in analog photography), it is done along the mathematics of perspective already developed in the Renaissance and performed by computers (but again: that is only one way to use computer graphics). Two points, relevant to this paper, follow from this:

On the one hand, there is a fundamental sculptural dimension to computer graphics (at least if they are based on a virtual camera model). The mathematical construction of objects

[2011]: 127–37). Computer graphics can be abstract or highly stylized (see Bruce Gooch and Amy Gooch, *Non-Photorealistic Rendering* [Natick, MA: A. K. Peters, 2001]). If the goal is to model objects without clear-cut boundaries (like fire, fog, or clouds) other procedures like particle systems are used (see William T. Reeves, "Particle Systems-A Technique for Modeling a Class of Fuzzy Objects," *Computer Graphics* 17, no. 3 [1983]: 359–75). And having said all this, we're still not talking about the many different methods for lighting the scene in object space, of texture mapping, and so on (see the comprehensive overview in Hughes, *Computer Graphics*, 2014. Computer graphics have many different roots and forms that cannot be reduced to one medial or pictorial "specificity." See Jens Schröter, "… especially the 'ambient term,' was a terrible thing. Ambient und Atmosphäre in der Computergraphik," in *Ambient: Ästhetik des Hintergrunds*, ed. Jens Schröter et al. (Berlin u.a.: Springer, 2018), pp. 167–84.

17 See Hughes, *Computer Graphics*, 2014, see chapter 13 on specifications for the virtual camera. The camera-model could include effects of the lens-system (like virtual lens flares) or effects of a simulated photo emulsion (graininess), etc.

18 See Jens Schröter, "Virtuelle Kamera: Zum Fortbestand fotografischer Medien in computergenerierten Bildern," *Fotogeschichte* 88 (2003): 3–16.

in object space is, insofar as their three-dimensional coordinates (and also their lighting and textures)[19] are concerned, similar in a way to the construction of sculptural objects in real space. Of course, one does not work with clay or marble or other real materials. But one does define a spatial structure, as does a sculptor with clay or marble or other real materials. It is, in that sense, possible to construct virtual sculptures in object space (and this does, actually, occur).[20] Perhaps this also means that an artistic approach, working with computer graphics and constructing virtual sculptures, should reflect on this basic medial dispositive of (certain types of) computer graphics (see section 3).

On the other hand: although I began above with the historical example of constructing virtual objects (in simulations) based on real data, it is—since it's all mathematical—possible to construct virtual objects that are completely fictitious.[21] One could construct structures in object space that are based on sampled or scanned but radically modified real data. One could also construct structures, so to speak, from scratch, that do not in any way resemble real objects, that could not even exist in the real world: sculptures of more than three dimensions with textures made of moving images.[22] Wouldn't this lead directly to the media-reflexive question of what "sculpture," the "sculptural" and their "expanded field" are? We always thought sculpture is necessary three-dimensional—but not necessarily so in object space.[23]

III. A Remark on Digital Modernism

This last remark brings up the question of what the a given medium's specificity is, so I want to address again the seemingly worn-out question of the specificity of media in art—simply because it may acquire new urgency with the onset of simulation and therefore the

19 See Hughes, *Computer Graphics*, 2014, chapter 20 on textures and chapter 26 on light.

20 See "The Rise of the Virtual Sculptor," *noupe.com*, July 5, 2011, https://www.noupe.com/inspiration/showcases/the-rise-of-the-virtual-sculptor.html (accessed December 22, 2021).

21 On the relation of fiction and simulation, which are categorically different, see Jens Schröter, "Überlegungen zu Medientheorie und Fiktionalität," in *Fiktion im Vergleich der Medien und Künste*, ed. Anne Enderwitz and Irina Rajewsky (Berlin and Boston: De Gruyter, 2016), pp. 97–124.

22 Mathematically it's no problem to handle higher-dimensional geometries, although it would be necessary to project them somehow in three dimensions (for a 3D-printed model) or two dimensions (to have it on screen) to apprehend them visually. This often results in weird warped and distorted forms, unintelligible for the lay(wo)man's eye. See e. g., the visualizations of the six-dimensional spatial structure of the so-called "Calabi-Yau-Manifold," which is a mathematical structure important in superstring theory, https://analyticphysics.com/Higher%20Dimensions/Visualizing%20Calabi-Yau%20Manifolds.htm (accessed December 22, 2021). This particular visualization allows for n = 2 to 8, that is even more than six dimensions.

23 Virtual structures are of course not per se "sculptures"—to become so they should be designed and presented in an aesthetically convincing way to reflexively point to their mediality and their contexts of production and presentation (see 3). A more cynical version of this argument would be that any virtually spatial structure can be transformed into "sculpture" by the art market and its discourse industry at any time, as the hypes around so called "AI Art" or "NFT Art" have recently shown, namely that any new technology (and the forms produced with it) can be turned into "art" in principle.

construction of virtual media. The following short detour on the discussion of media specificity in abstract painting will help to illuminate this problem.

After World War II, various forms of abstraction established themselves as the dominant art movement in the United States and, from there, in other Western countries as well. Clement Greenberg developed a historical justification for these new forms of abstraction in painting. He emphasized that, in modernism, "the unique and proper area of competence of each art coincided with all that was unique in the nature of its medium."[24] Following on this, artists would have to analyze and explore their medium step by step to find out which conventions (e.g., narrative) are borrowed from other media and are therefore dispensable. One of his central examples was the work of Jackson Pollock, whose all-over drip paintings are said to focus on the role of the line, the flow of color, and a concentrated engagement with the plane surface of the canvas. In the late 1950s and early 1960s, the first artistic positions emerged that were difficult or impossible to reconcile with Greenberg's approach (e.g., Pop Art), but initially his position remained formative. This period also saw the first artistic experiments with computers.

I will briefly introduce one of the programmatic texts of this time period: A. Michael Noll's *The Digital Computer as a Creative Medium* from 1967.[25] The fact that the computer is already dubbed a medium here—some twenty-five years before the relevant media-theoretical discussion[26]—points to an important moment in two respects: *firstly*, the artistic practice that provided the model for the concept of media at that time was abstract painting—it is no coincidence that the title page of Noll's text (fig. 2) is already adorned by a graphic that is at least vaguely reminiscent of Bridget Riley's Op-Art.[27] For experiments with computers, especially in the 1960s, when the possibilities of computer graphics were limited, recourse to geometric-constructive variants of abstract painting are obvious, since they are relatively easy to formalize and display.[28]

In any case, *secondly*, given the dominant position of Greenbergian concepts, in order to identify a practice with computers as artistic, it was necessary to reflect on a medium.

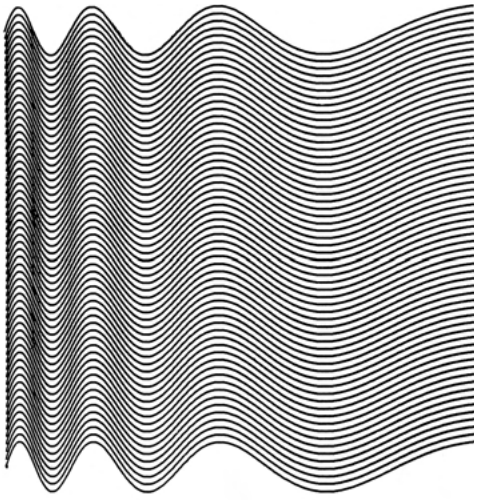
24 Clement Greenberg, "Modernist Painting," in *Clement Greenberg: The Collected Essays and Criticism*, vol. 4: *Modernism with a Vengeance, 1957–1969*, ed. John O'Brien (Chicago: University of Chicago Press, 1993), pp. 85–93, here p. 86.

25 See A. Michael Noll, "The Digital Computer as a Creative Medium," *IEEE Spectrum* 4, no. 10 (October 1967): 89–95. See also A. Michael Noll, "Computers and the Visual Arts," *Design Quarterly* 66f. (1967): 65–71.

26 See Norbert Bolz et al., *Computer als Medium* (Munich: Wilhelm Fink, 1994). However, McLuhan had already spoken of the "media of communication from speech to computer" in *Understanding Media* in 1964 (Marshall McLuhan, *Understanding Media: The Extensions of Man* [London and New York: McGraw Hill, 1964], p. 43), and moreover, according to Boris Groys, *Unter Verdacht: Eine Phänomenologie der Medien* (Munich and Vienna: Hanser, 2000), pp. 93–101. McLuhan was in turn inspired by Greenberg's modernism for his media theory.

27 Noll, "The Digital Computer as a Creative Medium," 1967, p. 91.

28 But see Clement Greenberg, "Recentness of Sculpture," in Greenberg, *Collected Essays*, 1993, pp. 250–56 who rejected Op-Art (252).



2 A. Michael Noll, *The Digital Computer as a Creative Medium*, 1967.

It was therefore necessary to understand the computer as just that.[29] Noll argues similarly to Greenberg: "The resistance of the canvas or its elastic give to the paint-loaded brush, the visual shock of real color and line, the smell of the paint, will all work on the artist's sensibilities… . So it is that an artist explores, discovers, and masters the possibilities of the medium."[30] The question of what possibilities and resistances the medium of the computer unfolds in artistic work is raised, because "computers are a *new* medium. They do not have the characteristics of paint, brushes, and canvas."[31] Noll notes that what is new about the computer is the *ability to mathematically model the specific processes that characterize other media in general*, and the processes of abstract painting, understood as a *paradigm* of artistic media, in particular. To the extent that the computer is used to simulate traditional media, it appears as a medium in itself.

For Noll, the question of whether it is possible to mathematically generate works of art based on the formalization of existing works remains open. Noll exemplified this conundrum by juxtaposing a real and a mathematically simulated Mondrian and determining via a kind of aesthetic Turing-test that the majority of viewers thought the computer image was the real Mondrian—ergo, the simulation of the painterliness of painting seemed successful

29 See Rosalind Krauss, *"A Voyage on the North Sea": Art in the Age of the Post-Medium Condition* (New York: Thames & Hudson, 1999), p. 6: "[F]rom the 60s on, to utter the word 'medium' meant invoking 'Greenberg.' …." Whether Noll, as a computer scientist, was familiar with this discourse, however, must remain open.

30 Noll, "The Digital Computer as a Creative Medium," 1967, p. 90. Clement Greenberg, "Towards a Newer Laokoon," in *Clement Greenberg: The Collected Essays and Criticism,* vol. 1: *Perceptions and Judgments, 1939–1944*, ed. John O'Brien (Chicago: University of Chicago Press, 1986), pp. 23–37, here p. 34. Here he speaks in relation to "avant-garde painting" of "resistance of its medium." On the same page, he speaks in relation to sculpture of the "resistance of its material."

31 Noll, "The Digital Computer as a Creative Medium," 1967, p. 90, emphasis in original.

(although one can seriously doubt the validity these examples' "artiness").[32] Noll's ideas and similar ones (by Frieder Nake and many more) as a whole refer to a fundamental property of the medium computer, namely to be able to *approximate* all other media—either by measuring and simulating the properties of the technical *dispositive* or by sampling the resulting signals (sounds, images, etc.) and using them as material.[33]

However, Greenberg's paradigm of media reflection gradually died out from around the mid-1960s onwards, making way for a "postmodernism" oriented toward intermediality and quotation, or for entirely different art forms such as conceptual art (a), only to reappear, perhaps not coincidentally, in the more recent discussions about the artistic potential of digital media (b).

(a) Greenberg's program of a self-analytical reduction of painting and other art forms gradually became problematic in the early 1960s, for soon this program threatened to cross the boundary beyond which "a picture stops being a picture and turns into an arbitrary object," a boundary Greenberg had insisted was not to be crossed but rather "observed and indicated."[34] Ultimately, newly emergent developments such as Minimal Art shifted the emphasis away from media specificity.[35] Finally, new technologies appeared on the art scene—especially video—which, according to Rosalind Krauss, caused the concept of reflection on the medium as the basis of art to disappear, because media, like video, were involved in practices that were too disparate.[36] De Duve has described this shift in the 1960s as a shift from *specific* (i.e., directed at media-specificity) to *generic* (i.e., directed in Duchamp's wake at the status of art in general) questions.[37] Thus, in the 1970s and 1980s, forms of art flourished that broke with any media-reflexive purism and instead worked with multi- and intermedial strategies—often in the form of "installations."[38] "As is typical of what has come to be called postmodernism, this … work is not confined to any particular medium."[39] As a result, Greenberg's role as a critic declined; even his "disciple," Rosalind Krauss, proclaimed

32 The nature of the audience and its composition is explained in more detail in A. Michael Noll, "Human or Machine: A Subjective Comparison of Piet Mondrian's 'Composition with Lines' (1917) and a Computer-Generated Image," *The Psychological Record* 16 (January 1966): 1–10.

33 See Jens Schröter, "Das Ende der Welt: Analoge und digitale Bilder – mehr oder weniger Realität?," in *Analog/Digital – Opposition oder Kontinuum? Beiträge zur Theorie und Geschichte einer Unterscheidung*, ed. Jens Schröter and Alexander Böhnke (Bielefeld: transcript, 2004), pp. 335–54.

34 Greenberg, "Modernist Painting," 1993, p. 90.

35 See Donald Judd, "Specific Objects," *Arts Yearbook* 8 (1965), 74–82. The famous first sentence is: "Half or more of the best new work in the last few years has been neither painting nor sculpture."

36 Krauss, "*A Voyage on the North Sea*," 1999, pp. 30ff.

37 Thierry De Duve, *Kant after Duchamp* (Cambridge, MA: MIT Press, 1996), pp. 193–279.

38 For what Greenberg criticized, of course, see Clement Greenberg, "Intermedia," *Arts Magazine* 56, no. 2 (October 1981): 92–93.

39 Douglas Crimp, "Pictures," *October*, no. 8 (Spring 1979): 75–88, here 75.

a "post-medium condition."[40] Greenberg's insistence on the medium seems nowadays to be "hopelessly outdated."[41]

(b) After the seemingly complete collapse of the Greenberg paradigm, it is somewhat surprising that media reflection is once again playing an important role among newer artists. Juliane Rebentisch already notes "that in intermedial contemporary art … the knowledgeable reference to the various traditions of the arts and the possibilities of their media … plays an important role."[42] Interestingly, only one page earlier she points out that the "role of technologies and new media in this context should not be underestimated," especially with regard to the "thematization of older means of representation in newer ones (painting in film), for example." It seems that especially artists operating in the "medium of digitality"[43] are paying attention to these questions again. For example, as Thomas Ruff remarked already in 1999 with regard to his digitally processed porn photos from the net, the *Nudes*: "If I work with a certain medium, then I also want to reflect this medium in the picture."[44] In the preface to his book *net.art 2.0* from 2001, Tilman Baumgärtel explicitly refers to Greenberg to legitimize the artistic status of net art via its self-reflexive procedures.[45]

There is maybe a radicalization of the possibilities for reflection on "media-specificity": virtualized, simulated media are, so to speak, (selective and approximate) structures of media without their materiality.[46] There are possibilities to transform the virtualized, simulated media—as was said above: a virtual camera can be transformed beyond the limits that would be possible for an actual, physical, material camera. The same can be done with virtual sculpture. This option may be one reason why an almost neo-Greenbergian imperative for self-reflection again plays such a major role in works with digital media. Greenberg's

40 Krauss, "*A Voyage on the North Sea*," 1999.

41 Juliane Rebentisch, "Singularität, Gattung, Form," in Bertram, Deines, and Feige, *Die Kunst und die Künste: Ein Kompendium zur Kunsttheorie der Gegenwart*, 2021, pp. 123–37, here p. 124. Original: "hoffnungslos veraltet."

42 Juliane Rebentisch, *Theorien der Gegenwartskunst zu Einführung* (Hamburg: Junius, 2013), p. 105. Original: "intermediale[n] Gegenwartskunst … der kenntnisreiche Bezug auf die verschiedenen Traditionen der Künste und die Möglichkeiten ihrer Medien … eine wichtige Rolle".

43 Ibid., p. 104. Original: "Rolle der Technologien und neuen Medien in diesem Zusammenhang nicht zu unterschätzen"; "Thematisierung älterer Darstellungsmittel in neueren (der Malerei im Film) beispielsweise"; "Medium der Digitalität."

44 Thomas Ruff, "Suchmaschinen: Ein Interview von Susanne Leeb," *Texte zur Kunst* 36 (December 1999), pp. 71–75, here p. 75. Original: "Wenn ich mit einem bestimmten Medium arbeite, dann will ich dieses Medium auch im Bild reflektieren."

45 See Tilman Baumgärtel, *[net.art 2.0] Neue Materialien zur Netzkunst* (Nuremberg: VFMK, 2001), pp. 16–17.

46 To avoid misunderstandings, see note 3. Digital technologies are of course very material and have very material infrastructures that are the topic of the work of several artists (Katja Novitzkova, Marguerite Humeau, Oliver Laric, etc.). But the virtual objects created with these very material technologies have themselves no materiality and can be changed at will (if necessary). That's why they are used, for instance, in scientific modeling.

idea of the medium also reappears in theoretical discourse.[47] In her recent work, Rosalind Krauss appraises it critically insofar as she emphasizes the necessity "to reclaim the specific from the deadening embrace of the general."[48] She sees in the work of James Coleman, William Kentridge, and others the effort to "reinvent" a specific medium by recourse to media-historically "antiquated" techniques (slide show in Coleman's case; drawn animation, 16-mm film in Kentridge's), but in a way that emphasizes the "differential" character of the medium.[49]

This is not to say that all art must now be related to the paradigm of media reflection as a figure of justification—after all, does "art" have to be related to a unified figure at all? Wouldn't it also be conceivable that, alongside—"contemporary"—artistic strategies that have detached themselves from this, there can also be, *indeed must be—today in the all-pervasive digitally expanded field*—artistic approaches that address the reconfigurations of the medial under the conditions of the computer and its differentiations into various constellations?[50] There have to be digital artistic strategies that follow the concept of a digital modernism—and some of these might reinvent sculpture.[51]

IV. Sculpture in the Digitally Expanded Field

If we take the results of sections 2 and 3 together, how can we theoretically assess sculpture in the digitally expanded field? Section 2 has shown us how (certain forms of) computer graphics are related to the sculptural in principle, and section 3 argues that the virtual forms of media can lead to new 'modernist' forms of media reflexivity. So, which new forms of sculpture in the digitally expanded field might be conceivable? Although I didn't succeed in developing an elegant structural scheme like Krauss in "Sculpture in the Expanded Field," I would argue that at least three options can be conceived.

47 There are currently further discussions on notions like "post-media" or "post-digitality." Although I cannot discuss these in detail here, they also point to a certain resurgence of questions of the medium (even if *ex negativo*).

48 Rosalind Krauss, "Reinventing the Medium," *Critical Inquiry* 25, no. 2 (Winter 1999): 289–305, here 305. The "deadly" character of the generic lies in the fact that anything can appear as art at will (see Duchamp), and thus with the disappearance of the specific in art, the specificity of art also threatens to collapse, see De Duve, *Kant after Duchamp*, 1996, p. 274. On this, see Rebentisch, *Theorien der Gegenwartskunst zu Einführung*, 2013, pp. 106–16.

49 See Krauss, "*A Voyage on the North Sea*," 1999, p. 53. On Kentridge, see Rosalind Krauss, "'The Rock': William Kentridge's Drawings for Protection," *October*, no. 92 (Spring 2000): 3–35.

50 On the concept of the differentiation of the computer see Jens Schröter, *Das Netz und die virtuelle Realität. Zur Selbstprogrammierung der Gesellschaft durch die universelle Maschine* (Bielefeld: transcript, 2004). Rebentisch, *Theorien der Gegenwartskunst zu Einführung*, 2013, p. 106 explicitly notes that despite all intermedial transgression, "the sometimes more, sometimes less stable fields of the traditional arts" still exist. Original: "die mal mehr, mal weniger stabilen Felder der traditionellen Künste."

51 See Ian Andrews, "Post-digital Aesthetics and the Return to Modernism," https://ian-andrews.org/texts/postdig.pdf, (accessed December 21, 2021) and Dominic McIver Lopes, "Digital Art," in *Philosophy of Computing and Information*, ed. Luciano Floridi (Malden, MA: Blackwell, 2004), pp. 106–16.

(a) Virtual Sculpture

This is the construction of virtual sculptures in object space, either based on acquired data and/or free construction, that then have to be displayed on screens. I would like to examine one example: Jeffrey Shaw's 1994 interactive installation *The Golden Calf* (fig. 3).[52] The installation consists of a conical column, square in cross-section and about one meter high, on which lies a color display connected to the column by a thick black cable. The color display shows an abstract, empty space in which a virtual column, on which a virtual golden calf stands, can be seen. The title is, of course, an allusion to the famous biblical passage Exodus 32: 1–4, where the Israelites make themselves a false idol, a golden calf, around which they dance, while Moses receives the tablets of testimony. The viewers of Shaw's installation move intensely. Like the Israelites, they dance around the calf.[53]

The viewers (or users?) have in their hands a *fenestra aperta* (Alberti) organized in central perspective. Viewers move the window; they are in the role of the virtual camera. The viewers decide by their movement which viewpoint is chosen in relation to the object space. One can try to correlate the view of the real column with that of the virtual column, but this will not succeed, if only because the virtual column is less conical than the real column. The spaces are separate and yet connected, as the thick black cable makes clear. Its length limits the possible distance of the viewers, whereby the real column marks the point in real space to which the entire set up remains related. The display, the cable, and the real column are objects whose places cannot be occupied by other objects, while the virtual calf stands more or less exactly where the display rests in real space in the initial and final state of the installation. This problematization of the relationship between the real surrounding space and object space is heightened by the fact that reflections of the installation's particular location can be seen on the virtual golden calf. Shaw takes digital photographs of the surrounding space that are mapped onto the virtual model depending on the viewer's perspective. The golden calf itself is part of the demo software of the Silicon Graphics Workstation on which the installation is based—and, in this respect, self-reflexively refers to the technical-institutional source of computer graphics. Although Shaw does not construct a physically impossible virtual sculpture, he presents a complex reflection on sculpture in space, the role and movements of the viewers around a three-dimensional object,[54] and the relation between real and virtual space. He thereby also problematizes a seemingly natural and inevitable property of sculpture. Mel Bochner wrote: "Before anything else, a sculpture

52 On Shaw see also the text by Ursula Ströbele in this volume.

53 See this helpful video showing the reception: *Jeffrey Shaw: The Golden Calf, Responsive Installation 1994*, YouTube Video, 2:07 min., uploaded by "MediaArtTube," June 1, 2008, https://www.youtube.com/watch?v=paaacEIF6wU, (accessed December 12, 2021).

54 The spatiality of sculpture and how it evokes bodily movement has been a much-discussed topic. See Alex Potts, *The Sculptural Imagination: Figurative, Modernist, Minimalist* (New Haven, CT: Yale University Press, 2001). See Nicola Glaubitz and Jens Schröter, "Quälende Kuben und beruhigende Tableaus. Fragmente einer Diskursgeschichte des Flächen- und des Raumbildes," *Sprache+Literatur* 35, no. 1 (Summer 2004): 33–63.

3 Jeffrey Shaw, *The Golden Calf*, Responsive Installation, Still taken during the exhibition *Interact!* (1997) at Wilhelm Lehmbruck Museum, Duisburg.

is an object-in-the-world, something in our shared space."[55] That is not directly the case for virtual sculpture, although its manifestation on a screen relates to our real space. Virtual sculpture is one way to reinvent sculpture and some of its parameters, such as spatiality and its relation to the moving body.

(b) 3D-Printed Sculpture

In this case, the sculptural object is in the same way as in (a) constructed in object space, either based on acquired data and/or free construction. But then it is not displayed two-dimensionally on a screen via a virtual camera, but printed with an additive printing system, a 3D printer. Now, Bochner's argument regarding the cospatiality of sculpture is valid again, since the sculptural objects inhabit the same space as the viewers' bodies. But firstly, these objects are normally quite small, since 3D printers for very big objects are very expensive. Secondly, the mentioned possibilities of "impossible" sculptural objects are reduced, since to be printable, objects need a certain materially possible form. Thirdly, since a 3D-printed sculpture is a print of a virtual template, it can— in principle—be printed on demand. In this way, a new form of reproducibility enters the sculptural field. Fourthly, the objects are often made of plastic, since this material can be handled easily with a 3D printer.

There are already a lot of artist experiments with 3D-printing in sculpture, for example Karin Sander's conceptual work *1:7,7 … Unlimited* (fig. 4). Visitors of an art fair are 3D-scanned and the resulting image is 3D-printed as a green-colored statuette. "Sander's

55 Bochner, quoted in Dobbe and Ströbele, *Gegenstand Skulptur*, 2020, p. 1.

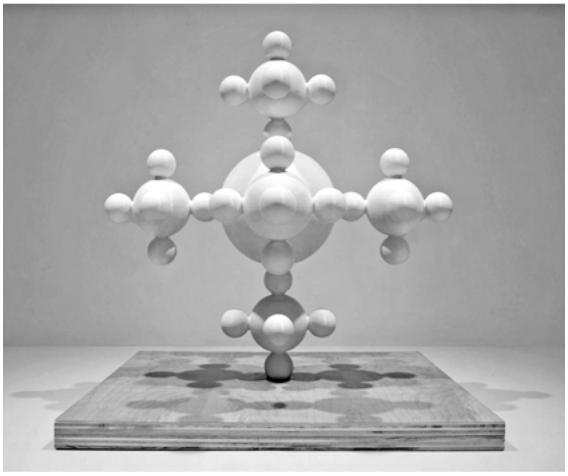
4 Karin Sander *1:7,7... Unlimited*, 2001, 3D body scan of the living person, 3D-printing, plaster material, pigment (chromium oxide hydrate green), Scale 1:7.7… Height: 20.6 cm. Exhibition view Galerie Ute Parduhn, Düsseldorf, Oct. 7–Nov. 14, 2005.

sculptures relinquish control over the forms and postures of the people reproduced here (on a scale of 1:7.7 …)—on the one hand to the subjects themselves and on the other to the disinterested, infinitely precise eye of the digital camera that scans them. Thus, *1:7,7 … Unlimited* is indeed a conceptual work, but it is one that both incorporates classical sculptural themes such as portraiture and self-portraiture and also constitutes a (three-dimensional) photograph—and thus a figurative sculpture."[56] Other artists like Gabriel Orozco also use the possibilities of 3D-printing, but more abstractly (fig. 5).[57]

While Sander uses scanned real-world data (the visitors) to produce a figurative 3D-printed sculptural object, Orozco constructs virtual objects mathematically and then prints these mathematical structures. These different positions oscillate between the poles of figurative and abstract and at the same time show the two principal sources for construction of virtual objects in object space: real-world data and mathematical construction, united in the necessity to use a certain scale of objects, since currently 3D printer can only produce relatively small objects. Orozco's abstract objects also emphasize mathematical structure and therefore reflect on the structurality of the virtual while simultaneously reducing the sculptural to basic structural and formal dimensions. At the same time, this reduced character might

56 See Karin Sander's website: https://www.karinsander.de/en/work/1-7-7-unlimited.

57 See also the exhibition *Out of Hand: Materializing the Postdigital* that took place from October 16, 2013 to June 1, 2014 in the Museum of Arts and Design, New York, https://madmuseum.org/exhibition/out-hand (accessed December 21, 2021). There is also a catalogue to that exhibition: Ronald T. Labaco, ed., *Out of Hand: Materializing the Postdigital*, exh. cat. Museum of Arts and Design New York (London: Black Dog, 2013).



5 Gabriel Orozco, *Untitled*, 2013, 3D-printed ABS plastic, Gabriel Orozco, 23 9/16 × 23 9/16 × 23 9/16 in. (60 × 60 × 60 cm). Printed by Ribuoli Digital, New York.

point to the limitations of the available technology as the geometric forms in early computer art once did (see fig. 2). But, compared to more irregular forms of sculptural abstraction, e. g., by David Smith,[58] Orozco's approach might seem boring, a typical case of "stiff regularity (such as that which borders on mathematical regularity) [that] is inherently repugnant to taste, in that the contemplation of it affords us no lasting entertainment."[59] His printed objects could even be criticized as too decorative. But that is not a principal argument against 3D sculpture; perhaps these approaches are only early steps. Anyway, the reproducible character of these virtual objects reiterates an aspect that was discussed by Rosalind Krauss in relation to Rodin—the relation between sculptural reproducibility, uniqueness, and "originality of the artist."[60] Sculptural templates could be sent by the artist via email and the printed out by the "viewer" anywhere—the relation between the sculptural and its reproduction will be reconfigured by 3D-printing, as will be the difference between artist and viewer. 3D-printed sculptural objects also reinvent sculpture and could reflexively problematize questions of scale, regularity, mathematical structure of the sculptural in relation to the virtual, and the reproducibility of the sculptural object.

(c) Augmented Reality Sculpture

The last form I want to discuss is Augmented Reality Sculpture (= AR sculpture). Augmented Reality means that on a display, often the display of a smart phone, the real background

58 See Potts, *The Sculptural Imagination*, 2001, pp. 158–77.

59 Immanuel Kant, *Critique of Judgement*, trans. by James Creed Meredith, ed. Nicholas Walker (Oxford: Oxford University Press, 2007), p. 73.

60 See Rosalind Krauss, "The Originality of the Avantgarde," in *The Originality of the Avantgarde and Other Modernist Myths* (Cambridge, MA: MIT Press, 1985), pp. 151–70, especially pp. 151–57.

6, 7 Sander Veenhof and Mark Skwarek, *Augmented Reality Art Invasion MoMA*, New York, 2010.

is overlayed with virtual objects. Object space is mapped onto real space, with the viewers again steering the virtual camera.[61]

These images document a project that took place on October 9, 2010. Visitors with the appropriate smartphones and AR software, called "Layar Augmented Reality browser," could participate in a virtual and unofficial exhibition at MoMA: "The virtual exhibition will occupy the space inside the MoMA building using Augmented Reality technology. The show will not be visible to regular visitors of the MoMA, but those who are using a mobile phone application called 'Layar Augmented Reality browser' on their iPhone or Android smartphones, will see numerous additional works on each of the floors."[62] In other words, AR sculpture occupies the space of the MoMA, and the authoritative selection of works and the narrative of their arrangement are subverted and undermined. In fig. 6–7 we can see how an additional virtual sculptural object is introduced into the authoritative space of the museum. This can certainly be understood as a subversive attack on MoMA's hegemonic function (however, the AR exhibition can also be seen as a recognition of MoMA's hegemonic role). Here, critical potentials of an AR art practice are hinted at. This practice in turn could challenge the stabilized, hierarchical spatial structures of the MoMA. In this sense, working

61 See Ronald T. Azuma, "A Survey of Augmented Reality," *Presence: Teleoperators and Virtual Environments* 6, no. 4 (1997): 355–85 and Paul Milgram, Haruo Takemura, Akira Utsumi, and Fumio Kishino, "Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum," *Proceedings of SPIE 2351.1* (1994): 282–92. See also Vladimir Geroimenko, *Augmented Reality Art: From an Emerging Technology to a Novel Creative Medium* (Cham: Springer, 2014). See https://www.jeffreyshawcompendium.com/portfolio/sculpture/ (accessed December 22, 2021), for an early experiment in AR sculpture by Jeffrey Shaw.

62 See http://www.sndrv.nl/moma/ (accessed December 12, 2021).

with AR sculpture might be a strategy to reinvent, in a digitally transformed way, questions of institutional critique and site-specificity that were connected to certain forms of (post-) modern sculptural interventions. Famously, Douglas Crimp discussed these in relation to Richard Serra, also in an exhibition at the MoMA.[63] But he emphasizes the controversial case of Serra's *Tilted Arc*, which was to be relocated, as its installation on the plaza of the Jacob K. Javits Federal Building in Lower Manhattan during the summer of 1981 resulted in fierce opposition: "But, for all its passion and eloquence, the testimony failed to convince the adversaries of *Tilted Arc*. To them the work was in conflict with its site, disrupted the normal views and social functions of the plaza, and, indeed, would be far more pleasant to contemplate in a landscape setting. Its size would presumably be less overwhelming to landscape surroundings, its rust-colored steel surface more harmonious with the colors of nature."[64] While a real sculptural intervention can disrupt a real place and thereby deconstruct the spatial normality of that place, AR sculpture is only individually located on a given smart phone and does not disrupt collective and public space. In this regard, AR sculpture could also be read as a taming of the critical function of site-specificity, but in certain contexts, perhaps where public space is controlled by authorities, it could have an important critical function. AR sculpture, again, problematizes Bochner's argument that sculpture is necessarily located in shared space and transforms problems of institutional critique and site-specificity.

V. Very Short Conclusion

By using a notion of virtuality derived from computer science, I tried to show that in particular forms of computer graphics, virtual objects can be constructed in an "object space" that then can be recorded by a virtual camera. In turn, these virtual objects, being described with spatial coordinate systems, have potentially a sculptural structure. Therefore, virtual sculptures that are freed from the material and even dimensional constraints of real sculpture can be constructed. That means that by using virtualization, the questions concerning the specificity of sculpture can be posed in a new way—which also means that the seemingly obsolete question of medium-specificity can be posed anew under virtual conditions. Some modernist questions can reappear with simulation, virtualization, and modeling. This necessitates a remark on virtual modernism as a contemporary aesthetic option. From this, finally, an attempt was made to list possible virtual-modernist expansions of the field of sculpture: virtual sculpture, 3D-printed sculpture, and AR sculpture.

63 Douglas Crimp, "Serra's Public Sculpture: Redefining Site Specificity," in *Richard Serra/Sculpture*, ed. Rosalind Krauss (New York: Museum of Modern Art, 1986), pp. 41–56.

64 Ibid., p. 42.

Credits

Buket Altinoba

1 Charles Willson Peale (1741–1827), *Reproduction of Explanation [& Illustration] of J. I. Hawkins's Physiognotrace*, 1803, watercolor on paper, 20.3 × 25.4 cm, Courtesy of Jefferson Papers, Library of Congress, Collection of the University of Pittsburgh Art Gallery, Pittsburgh, PA, https://uag.pitt.edu/index.php/Gallery/81/theme_item/1/set_item_id/11806; **2** Charles Willson Peale, *Smoke-Eater*, in Sidney Hart, "'To Encrease the Comforts of Life': Charles Wilson Peale and the Mechanical Arts," *The Pennsylvania Magazine of History and Biography* 110, no. 3 (1986): 323–57, here 340; **3** Christoph Scheiner, Frontispiece (book illustration), *Pantographice seu Ars Delineandi Res Quaslibet per Parallelogrammum Lineare seu Cauum, Mechanicum, Mobile*, published in Rome in 1630. Public domain: Wikipedia Commons, https://commons.wikimedia.org/wiki/File:Scheiner,_Christoph_—_Pantographice_sev_ars_Delineandi_res_Quasilbet_per_Parallelogrammum_Lineare_—_illustration.jpg; **4** Samuel Rayner, *Interior of the Mechanics' Institute (Derby Exhibition)*, 1839, hand-colored lithograph, Derby Museums. Public domain: Wikipedia Commons, https://en.wikipedia.org/wiki/Derby_Exhibition_(1839)#/media/File:Derbys_First_Exhibition_1839.jpg; **5** Benjamin Cheverton, *Machine for Reproducing Sculpture*, 1826, cast iron, oak (wood), plaster, and wrought iron. Science Museum Group Collection. © The Board of Trustees of the Science Museum, London; **6** Plaster bust of Benjamin Cheverton. Science Museum Group Collection. © The Board of Trustees of the Science Museum, London.

Michael Rottmann

1 Charles Csuri, with James Shaffer, *Sine Curve Man,* 1967, black ink, paper, Calcomp drum plotter model 565, punch cards, IBM 7094, 104 × 104 cm. Image courtesy of © CsuriVision Ltd; **2** Charles Csuri, *Numeric Milling,* 1968, wood, 3-axis milling machine, IBM 7094, punch cards, 36 × 56 × 22 cm. Image courtesy of © CsuriVision Ltd; **3** Robert Mallary, *Quad II*, 1968, computer-aided sculpture, plywood and laminate, IBM 1130, ca. 195.5 × 25.5 × 30.5 cm (without base). Image courtesy of Josh Powell/Estate of Robert Mallary. © Josh Powell; **4** Charles Csuri, plotter drawing of *Numeric Milling,* 1968, ink, paper, Calcomp Drum Plotter Model 565, punch cards, IBM 7094. Image courtesy of © CsuriVision Ltd; **5** Robert Mallary, plotter drawing, 1968, computer-generated Drawing with *TRAN 2*, ink on plotter paper, IBM 1130, plotter, ca. 30 × 40 cm. Image courtesy Josh Powell/Estate of Robert Mallary. © Josh Powell.

Ursula Ströbele

1 Herbert W. Franke, ORCHID, 1984–1992, computer-based animation, screenshot, collection of the ZKM | Karlsruhe © Herbert W. Franke, ZKM | Karlsruhe; **2** Herbert W. Franke, *Spindle*, 1993, loop. Courtesy of the artist; **3** Jeffrey Shaw, Theo Botschuijver, *Virtual Sculpture*, 1981, ZKM | Center for Art and Media Karlsruhe, ZKM-01-0162-02-03081. © Jeffrey Shaw, Theo Botschuijver, photo: © ZKM | Center for Art and Media Karlsruhe; **4** Raqs Media Collective, *Hollowgram*, 2017, holographic projection, dimensions variable. Courtesy of Frith Street Gallery, London; **5** Banz & Bowinkel, *Mercury,* 2016–17, interactive virtual reality installation for HTC Vive, site specific/dimensions variable, components: customized computer, head-mounted display (HMD), 3D-printed porcelain interface button, web cameras, monitor, plexiglass, various cables; set up in a black anodized aluminum frame structure. Courtesy of the artists; **6** Banz & Bowinkel*, Palo Alto,* 2017–18, interactive virtual reality installation for HTC Vive, site specific/dimensions variable, components: customized computer, head-mounted display (HMD), monitor, carpet, various cables; set up in a four-color powder-coated aluminum frame structure. Courtesy of the artists; **7** Morehshin Allahyari, *Material Speculation: ISIS*, *King Uthal*, 2015–16, download link and folder, https://rhizome.org/editorial/2016/feb/16/morehshin-allahyari/; **8** Morehshin Allahyari and Daniel Rourke, sound design by Andre Young, *The 3D Additivist Manifesto*, 2015, 10:11 min., https://additivism.org/manifesto.

Sasha Sobrino

1 Skawennati, *Dancing With Myself*, 2015. Diptych: machinimagraph and photograph; **2** Activating AbTeC Island, 2018; **3** Skawennati, *Celestial Tree*, 2017. Machinimagraph from *She Falls for Ages*; **4**. The *Celestial Tree* installed in the Sculpture Garden on AbTeC Island; **5** The Celestial Tree logo from *She Falls for Ages*, 2017; **6** Skawennati installing her sculpture *The Celestial Tree* on the Promenade Fleuve-Montagne for the *Path of Resilience* exhibition in 2017; **7** Skawennati, *The Celestial Tree*, 2017. Steel, aluminum, and retro-reflective sheeting; **8** Skawennati, *A Slice of Skyworld*, 2021. Virtual installation. Courtesy of New Art City; **9** xox (left) and I chatting in the bedroom of the Residency of the Guardian of the Celestial Tree, 2022.

Alexandra Weigand

1 Iñigo Manglano-Ovalle, *Phantom Truck*, 2007. Installation view at Documenta Halle, Kassel, Documenta XII, 2007. Photo: Eli Ping Weinberg; **2** Slide 21 of the "Remarks to the United Nations Security Council, Secretary Colin L. Powell, New York, February 5, 2003," U.S. Department of State Archive, https://2001-2009.state.gov/secretary/former/powell/photos/2003/17324.htm; **3** Philipp Messner, *La Produzione della Costruzione*, 2007. Installation view at ArGe Kunst, Bolzano, 2007. Photo: Matthaeus Kostner; **4** Erwan and Ronan Bouroullec, *Console with Vase and Bowl*, 2001 for Italian design company Cappellini. Photo: © Cappelllini; **5a** Julian Mayor, 3D-computer rendering of the *General Dynamic* chair, 2003–04. Image: © Julian Mayor. **5b** Julian Mayor, *General Dynamic*, 2004. Photo: Armel Soyer, **6a** Front Design, *Sketch Furniture*, 2005, design process; http://frontdesign.se/sketch-furniture-performance-design-project. **6b** Front Design, *Sketch Furniture*, 2005. http://frontdesign.se/sketch-furniture-performance-design-project; **7** SANAA, *New Museum*, New York, 2007. View of the museum building at 235 Bowery. Photo: Dean Kaufmann.

Mara-Johanna Kölmel

1 Morehshin Allahyari, *She Who Sees the Unknown: Aisha Qandisha*, 2019, installation with 3D-printed resin sculpture, reflecting pool, and HD video. Photo: Don Hall, MacKenzie Art Gallery. Courtesy of the artist; **2** Morehshin Allahyari, *She Who Sees the Unknown: Aisha Qandisha*, 2019, installation with 3D-printed resin sculpture, reflecting pool, and HD video. Photo: Don Hall, MacKenzie Art Gallery. Courtesy of the artist; **3** Morehshin Allahyari, *She Who Sees the Unknown: The Laughing Snake*, 2019, installation with 3D-printed plastic sculpture, mirrored room, and interactive hypertextual narrative, at *Refiguring the Future*, Hunter College, New York. Courtesy of the artist; **4** Shirin Fahimi, *Umm al Raml Sand Narratives: First Story*, 2021, screenshots, augmented reality. Open this link on a mobile device to see the effect preview: https://www.instagram.com/umm.al.raml/?hl=de. Courtesy of the artist; **5** Shirin Fahimi, *Avaz-e-Eshgh in the House of Fire & Rose in the House of Water*, from *Umm al Raml's Sand Narratives*, 2022, digital render-

ing of 3D models. Courtesy of the artist; **6** Shirin Fahimi, *Umm al Raml's Sand Narratives*, 2022, exhibition view at articule, Montreal. Photo: Guy L'Heureux. Courtesy of the artist; **7** Morehshin Allahyari, *Material Speculations: ISIS, King Uthal*, 2015–16, download link and folder, https://rhizome.org/editorial/2016/feb/16/morehshin-allahyari/. Courtesy of the artist; **8** John Craig Freeman, *Border Memorial: Frontera de los Muertos*, 2012, augmented reality public art, Lukeville border crossing, Arizona. Photo: John Craig Freeman. Courtesy of the artist; **9** Gabriella Torres-Ferrer, *Monumenta*, 2018–present, participative unique website, http://monumenta.co/#en. Courtesy of the artist.

Elizabeth Anne Johnson

1 Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Proposed Rabbit Ears Antenna Placement on General Lee in New Orleans at Lee Circle for Prospect.3 New Orleans,* 2013, silver gelatin print, 8 × 10 in, © 2013 Mary Ellen Carroll/MEC, studios; **2** Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Proposed Tower Location for Prospect.3 New Orleans,* 2013, ink and colored pencil and marker on vellum, 8 × 10 in, © 2013 Mary Ellen Carroll/MEC, studios; **3** Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Empty Plinth with General Lee Removed at Lee Circle for Prospect.3 New Orleans*, 2017, silver gelatin print, 8 × 10 in, © 2017 Mary Ellen Carroll/MEC, studios.

Claudia Giannetti

1 Abraham Palatnik, Desenho para o projeto de peça *Cinecromática 02,* Item 29 (Drawing for the piece project Cinecromatic 02, Item 29), April 1956. 110 × 70 × 20 cm. Photo: Vicente de Mello. © Abraham Palatnik; **2** Abraham Palatnik, *Aparelho Cinecromático* (Cinecromatic Apparatus), 1969/1986, wood, metal, synthetic linen, light bulbs, and motor. 112.5 × 70.5 × 20.5 cm. Photo: Everton Ballardin. Courtesy Nara Roesler, São Paulo. © Abraham Palatnik; **3** Abraham Palatnik, *Objetos Cinéticos* (Kinetic Objects), exhibition view, 2012, curated by Frederico Morais. Photo: Everton Ballardin. Courtesy Nara Roesler, São Paulo. © Abraham Palatnik; **4** Nicolas Schöffer, *CYSP 1*, 1956, aluminum and mixed media (computer, traction motor, direction motor, two microphones, two photoelectric cells, nineteen micromotors), height: 2.6 m. © Nicolas Schöffer, Photo: DR. © Adagp, Paris; Archives de Nicolas Schöffer, Collection Eléonore de Lavandeyra Schöffer/© VG Bild-Kunst, Bonn 2023; **5** José Luis Alexanco, genesis of *Mouvnt*, 1969, eight elements, intervened on photographs on baryta paper, 50 × 100 cm. Courtesy of the artist and Galería Maisterravalbuena, Madrid. © Galería Maisterravalbuena/© VG Bild-Kunst, Bonn 2023; **6** José Luiz Alexanco, *Mouvnt*, 1969, plotter output print on paper, 100 × 70 cm. Courtesy of the artist and Galería Maisterravalbuena, Madrid. © Galería Maisterravalbuena/© VG Bild-Kunst, Bonn 2023; **7** Analívia Cordeiro, *Materialization of Sight II*, 2015, computer-assisted sculpture, blue polyamide, 28.43 × 22.42 × 21.38 cm. Photo: Edouard Fraipont. © Analívia Cordeiro; **8** Analívia Cordeiro, *Tribute to Oskar Schlemmer I*, 2016, computer-assisted sculpture, red polyamide, 23.36 x 16.74 x 10.31 cm. Photo: Edouard Fraipont. © Analívia Cordeiro.

Jens Schröter

1 Schema of the virtual camera, in Timothy Binkley, "Refiguring Culture," in *Future Visions: New Technologies of the Screen*, ed. Philip Hayward and Tana Wollen (London: BFI, 1993), pp. 92–122, here p. 104; **2** A. Michael Noll, The Digital Computer as a Creative Medium, 1967; **3** Jeffrey Shaw, *The Golden Calf*, Responsive Installation, Still taken during the exhibition *Interact!* (1997) at Wilhelm Lehmbruck Museum, Duisburg. Courtesy Jeffrey Shaw; **4** Karin Sander, *Karin Sander 1:7,7... Unlimited*, 2001, 3D body scan of the living person, 3D-printing, plaster material, pigment (chromium oxide hydrate green), Scale 1:7.7… Height: 20.6 cm. Exhibition view Galerie Ute Parduhn, Düsseldorf, Oct. 7–Nov. 14, 2005. Photo © Galerie Ute Parduhn, Düsseldorf; **5** Gabriel Orozco, *Untitled*, 2013, 3D-printed ABS plastic, Gabriel Orozco, 23 9/16 × 23 9/16 × 23 9/16 in. (60 × 60 × 60 cm). Printed by Ribuoli Digital, New York. Courtesy of the artist and Marian Goodman Gallery. © Gabriel Orozco; **6, 7** Sander Veenhof and Mark Skwarek, *Augmented Reality Art Invasion MoMA*, New York, 2010. Image: screencapture of announcement website.

Biographies

Buket Altinoba is a researcher in the DFG project titled *Machines for Reproducing Sculpture: Competition of Reproduction Techniques 1770–1880* at the Institute of Art History of the Ludwig Maximilian University in Munich. Before holding a visiting professorship at the University of Regensburg, she worked as a research assistant at the Institute for Art and Architectural History at the Karlsruhe Institute of Technology (KIT). She participated as a fellow in the Mathilde Planck Lectureship Program at the State Academy of Fine Arts Stuttgart and was a PhD fellow at the Karlsruhe University of Arts and Design (HFG). Her PhD on the subject of the Istanbul Academy of Art (2012) was published under the title *The Istanbul Academy of Art from Its Foundation until Today: Modern Art, Nation Building and Cultural Transfer in Turkey* (Berlin 2016).

Claudia Giannetti is a theoretician, writer, and exhibition curator, with a transdisciplinary background in music, contemporary art, aesthetics, and the relationship between art, science, and technology. For eighteen years, Giannetti was director of institutions and cultural centers, including L'Angelot Kunstverein, MECAD | Media Centre of Art & Design, and Canariasmediafest (Spain); Edith-Russ-Haus for Media Art (Germany); and Fundação Eugénio de Almeida (Portugal). She is the curator of more than a hundred and fifty international exhibitions in major museums. She has been a professor in Spanish and Portuguese universities for the past two decades, and a guest lecturer at several universities worldwide. She has published numerous catalogues and articles, as well as fourteen books in different languages, including: *Media Culture* (1995); *Ästhetik des Digitalen: Ein intermediärer Beitrag zu Wissenschaft, Medien- und Kunstsystemen* (2004); *The Discreet Charm of Technology—Arts in Spain* (2008); *Something Other Than Photography: Photo & Media* (2013); *AnArchive—A Minimal Encyclopedia* (2013); *WhatsAppropriation—The Art of Revisiting Art* (2015); *Image and Media Ecology: Art and Technology* (2017).

Elizabeth Anne Johnson is senior lecturer in critical and contextual studies at the Cambridge School of Art, Anglia Ruskin University. She is currently developing a book investigating how contemporary artists are using digital technologies to pioneer new socially-engaged models of monumentality. Previously she has held positions as the Henry Moore Foundation Post-Doctoral Research Fellow at University College London, Associate Research Fellow in the Vasari Research Centre for Art and Technology at Birkbeck, and Arts and Humanities Research Council Research Fellow at the Archives of American Art, Smithsonian Institution. She holds a PhD in humanities and cultural studies from the London Consortium, University of London. Her writing has been published in Sculpture Journal, Archives of American Art Journal, and reproduced in the Whitechapel Gallery and MIT Press Documents of Contemporary Art series on *The Object*.

Mara-Johanna Kölmel is a curator, lecturer, and art historian with a special interest in (post-)digital art and culture. She obtained her MA in Art History at the Courtauld Institute of Art and holds a BA in Cultural Studies from Leuphana University Lüneburg where she has also completed her PhD on *Sculpture in the Augmented Sphere: Reflections at the Intersection of Corporeality, Plasticity, and Monumentality*. Her research explores the fundamental expansion of sculpture through digital technologies and examines how speculative, feminist, and decolonial sculptural concepts take on new meaning and immediacy in light of the digital. Mara has performed international curatorial roles for the Biennale of Sydney, Kunsthalle Hamburg, Arko Art Center, and Akademie Schloss Solitude, also realizing exhibitions with Approved by Pablo in London and peer to space in Berlin. She has presented her research at conferences internationally and recently published the anthology *Dada Data: Contemporary Art Practice in the Era of Post-Truth Politics* (coedited with Sarah Hegenbart) for Bloomsbury.

Verena Kuni is a scholar in the field of art, culture and media studies. She is a professor for visual culture studies at the Goethe University, Frankfurt am Main. Among her passions is the development of inter- and transdisciplinary projects and programs at the intersections of theory and practice. Her research and teaching, projects and publications focus on transfers between material and media cultures; media of imagination; technologies of transformation; DIY and critical making; toys and/as tools; workshops, toolboxes, and kits for inventive methods and methodologies; creative entanglements between imagination and invention; (in)visibilities and (im)materials; visual epistemologies and (con)figurations of knowledge; biotopes, biotopias, and technonaturecultures; alternate realities; and (trans)formations of time. More at www.kuniver.se

Michael Rottmann is an art historian and media theorist. His research focuses on the history and theory of art and (digital) media in the twentieth and twenty-first century. After professional training in IT and some programming experience, he studied fine arts/art history and mathematics in Stuttgart and Vienna. He graduated with a thesis on analogue and

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Jens Schröter has been chair for media studies at the University of Bonn since 2015. From 2018, he has been director (together with Anja Stöffler, Mainz) of the DFG research project *Van Gogh TV: Critical Edition, Multimedia Documentation and Analysis of Their Estate*. Together with Anna Echterhölter, Andreas Sudmann, and Alexander Waibel, he is director of the VW Main Grant *How Is Artificial Intelligence Changing Science?* and together with Christoph Ernst, he is director of the project *Informations- und Datenvisualisierungen der Corona-Pandemie*. In summer 2017, he had a senior fellowship at IFK Vienna, Austria; in winter 2018, he had a senior fellowship at IKKM Weimar; in winter 2021–22, he had a fellowship and the Center of Advanced Internet Studies. Recent publications include *Medien und Ökonomie* (2019) and, together with Christoph Ernst, *Media Futures: Theory and Aesthetics* (2021).

Sasha Sobrino is an arts administrator, artist, independent curator, and recovering academic living and working in Toronto. She holds multiple degrees in art history and fine art, and her research engages with new media art practices, with a focus on decolonial and narrative works. Her artistic practice is preoccupied with costume, representation, and sexuality in contemporary subcultures. Sasha is the Executive Director of the Canadian Association of Professional Image Creators.

Ursula Ströbele is a research associate at Zentralinstitut für Kunstgeschichte Munich and head of the Study Centre for Modern and Contemporary Art. In 2021–22, she was a visiting professor at HBK Braunschweig, and in 2019 she was artistic director of Kunstverein Arnsberg. From 2012 to 2018, she was a research associate at the University of the Arts Berlin, and cofounder of the *Theory of Sculpture* network. She holds a PhD from HHU Düsseldorf (*The Reception Pieces of the Académie Royale de Peinture et de Sculpture 1700–1730*). In 2020, she finished her habilitation on the sculptural aesthetics of the living since the 1960s (Hans Haacke and Pierre Huyghe). Her current research interests include digital, time-based phenomena of the sculptural, art and (queer) ecologies, twentieth-century women sculptors, infrastructures of modernity, and,ephemeral media images.

Alexandra Weigand is a Munich-based designer and art historian who works as a curator, lecturer, and researcher in the fields of design, architecture, and art. Her work includes the co-publication *Virtual Aesthetics: Considering Perception at the Dawn of the 21st Century* (Kyrene 2008) and the research and exhibition project *Flow of Forms/Forms of Flow. Design Histories between Africa and Europe* with the eponymous publication (with K. Pinther, 2018). Between 2017 and 2020, she was part of an international DFG research group at Ludwig Maximilian University in Munich, researching design and urbanism in Lagos, Nigeria. For the exhibition *Look at This* at Pinakothek der Moderne Munich in 2021, she was part of the international curatorial team as an academic advisor. Since autumn 2020, she is co-directing the design research project *New Parameters of Making* with partners in Germany, Ethiopia, and Nigeria (funded by the German Federal Foreign Office).