

Preface

Special Issue: In honor of Joel Spruck

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This special issue published in *Advanced Nonlinear Studies* is dedicated to Joel Spruck on the occasion of his retirement. Joel Spruck is a J.J. Sylvester Professor in the Department of Mathematics at Johns Hopkins University (Figure 1).



Figure 1: Joel in his office.

Joel graduated from Columbia university in 1967 and obtained his PhD from Stanford University under the supervision of Robert S. Finn in 1971 with the thesis “Infinite boundary value problems for surfaces of constant mean curvature.” After postdoctoral studies at the Courant Institute, he was assistant professor at Univ. of Minnesota, an associate professor at Brooklyn College at CUNY, where he was promoted full professor in 1979 and then moved first to Univ. of Massachusetts in Amherst before moving to Hopkins in 1992.

Joel has worked extensively on fully nonlinear elliptic equations with applications to geometry, mean curvature flow, free boundary problems with geometric constraints, semilinear elliptic equations and mathematical physics. Many of his works were highly influential in the field of geometric analysis.

His series of papers with Caffarelli and Nirenberg on fully nonlinear equations were among the first to develop a general theory of second-order elliptic differential equations which are fully nonlinear, with a regularity theory that extends to the boundary. Those papers have been highly influential in the field of geometric analysis since many geometric partial differential equations are amenable to their methods. In particular, their work on implicitly defined fully nonlinear elliptic equations (functions of the eigenvalues of a matrix or tensor) has been particularly important for subsequent developments.

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In collaboration with David Kinderlehrer, Louis Nirenberg and Luis Caffarelli, Joel wrote important papers on free boundary regularity and existence of solutions with geometric constraints. With Basilas Gidas and Luis Caffarelli he developed a measure theoretic version of moving planes and developed the theory of asymptotic symmetry with important applications to semilinear elliptic equations and the Yamabe problem.

In collaboration with L.C. Evans, Joel successfully applied PDE techniques to define and study a global in time generalized mean curvature flow. This work stimulated the development of moving interface and phase transition problems. Working with Bo Guan, he greatly extended the scope of the CKNS papers by establishing the “subsolution existence theorem” which allows domains of arbitrary geometry assuming the existence of a subsolution. This is particularly powerful for the real and complex Monge-Ampere equation and leads to many important geometric applications.

The previous works is just a sample of the contributions by Joel to the fields of geometry and PDEs. He also mentored more than 10 graduate students over the years. His honors include an address as an invited speaker at the International Congress of Mathematicians in Zurich, in 1994; a Guggenheim Fellowship in 1999–2000. He is an Inaugural Fellow of the American Mathematical Society (AMS) and was a Simons fellow in 2012–2013.

Joel provided much leadership to the department in his 30 years of service. He served on the Johns Hopkins Academic Council and he was a very effective chair. He worked with the administration to usher in an era of growth, which included the establishment of the J.J. Sylvester postdoc program as well as growth of the senior faculty.

In this special issue we collected many articles from some of the leading researchers in the fields of interest to Joel Spruck, who want to pay tribute to Joel’s generosity, friendship and mentoring over all these years. As the guest editors of this special issue, we are grateful to all contributors and reviewers for making this special issue possible. We also thank the journal *Advanced Nonlinear Studies* for providing this opportunity.