

Contents

Preface — V

Part I: **Mathematical aspects of data-driven methods in inverse problems**

Matthias J. Ehrhardt, Silvia Gazzola, and Sebastian J. Scott

On optimal regularization parameters via bilevel learning — 3

Martin Burger and Samira Kabri

Learned regularization for inverse problems — 39

Simon Arridge, Andreas Hauptmann, and Yury Korolev

Inverse problems with learned forward operators — 73

Marcello Carioni, Subhadip Mukherjee, Hong Ye Tan, and Junqi Tang

Unsupervised approaches based on optimal transport and convex analysis for inverse problems in imaging — 107

Luca Ratti

Learned reconstruction methods for inverse problems: sample error estimates — 163

Abhishake, Tapio Helin, and Nicole Mücke

Statistical inverse learning problems with random observations — 201

Duc Hoan Nguyen, Sergei Pereverzyev, and Werner Zellinger

General regularization in covariate shift adaptation — 245

Part II: **Applications of data-driven methods in inverse problems**

Andrea Aspri and Otmar Scherzer

Analysis of generalized iteratively regularized Landweber iterations driven by data — 273

Demetrio Labate and Heng Zhao

Integration of model- and learning-based methods in image restoration — 303

Gesa Sarnighausen, Anne Wald, and Alexander Meaney

Dynamic computerized tomography using inexact models and motion estimation — 331

Jonas Adler and Ozan Öktem

Deep Bayesian inversion — 359

Hwan Goh, Teemu Sahlström, and Tanja Tarvainen

Utilizing uncertainty quantification variational autoencoders in inverse problems with applications in photoacoustic tomography — 413

Derick Nganyu Tanyu, Jianfeng Ning, Andreas Hauptmann, Bangti Jin, and Peter Maass

Electrical impedance tomography: a fair comparative study on deep learning and analytic-based approaches — 437

Leon Frischauf, Otmar Scherzer, and Cong Shi

Classification with neural networks with quadratic decision functions — 471

Index — 495