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Nonlinear Least Squares for Inverse Problems

Theoretical Foundations and Step-by-Step Guide for Applications

This book provides an introduction into the least squares resolution of nonlinear inverse problems. The first goal is to develop a geometrical theory to analyze nonlinear least square (NLS) problems with respect to their quadratic wellposedness, i.e. both well-posedness and optimizability. Using the results, the applicability of various regularization techniques can be checked. The second objective of the book is to present frequent practical issues when solving NLS problems. Application oriented readers will find a detailed analysis of problems on the reduction to finite dimensions, the algebraic determination of derivatives (sensitivity functions versus adjoint method), the determination of the number of retrievable parameters, the choice of parametrization (multiscale, adaptive) and the optimization step, and the general organization of the inversion code. Special attention is paid to parasitic local minima, which can stop the optimizer far from the global minimum: multiscale parametrization is shown to be an efficient remedy in many cases, and a new condition is given to check both wellposedness and the absence of parasitic local minima. For readers that are interested in projection on non-convex sets, Part II of this book presents... *more on <http://springer.com/978-90-481-2784-9>*

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