Inverse Problems (L24)

Matthias Ehrhardt & Lukas Lang

Solving an inverse problem is the task of computing an unknown quantity from observed measurements. Inverse problems are among the most important problems in a variety of subjects such as physics, biology, medicine, engineering, and finance; including tomography (e.g. computed tomography (CT)), machine learning, computer vision, and image processing. Computing a solution to an inverse problem is not straightforward for three basic reasons: either it may not exist, may not be unique, or small errors in the measurements get heavily amplified which renders the solution useless. In this course we address mathematical aspects of inverse problems that are needed to find stable and meaningful solutions—from founding concepts to modern numerical algorithms.

Pre-requisites

This course assumes basic knowledge in linear algebra and analysis (e.g. linear analysis or analysis of functions).

Literature

1. P. C. Hansen. *Discrete Inverse Problems: Insight and Algorithms.* Fundamentals of Algorithms, SIAM Philadelphia, 2010, ISBN: 9780898718836.
2. H. W. Engl, M. Hanke and A. Neubauer. *Regularization of Inverse Problems.* Vol. 375, Springer Science & Business Media, 1996, ISBN: 9780792341574.
3. O. Scherzer, M. Grasmair, H. Grossauer, M. Haltmeier and F. Lenzen. *Variational Methods in Imaging.* Applied Mathematical Sciences, Springer New York, 2008, ISBN: 9780387309316.

Additional support

Four examples sheets will be provided and four associated examples classes will be given. There will be a one-hour revision class in the Easter Term.