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Minisymposium — Recent progress in regularization theory

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Abstract. This minisymposium was held at the International Conference – Inverse Problems: Modeling and Simulation, May 26–30, 2008, in ldeniz, Fethiye, Turkey.

1. Introduction

Many problems in practice are so-called *inverse problems*. They can be linear as, e.g., computerized tomography or nonlinear as, e.g., impedance tomography. Most inverse problems have in common that they are *ill-posed* in the sense that their solution is unstable under data perturbations.

Numerical methods that can cope with this problem are so-called *regularization methods*. The analysis of such methods for linear problems is relatively complete. The theory for nonlinear problems is developed to a much lesser extent (see, e.g., [3, 6]).

It was the aim of this minisymposium to bring together young researchers that are working in the field of regularization methods. We all enjoyed discussing mathematics at the conference but also had fun in the evenings in the pool or even in a karaoke show.

14 researchers gave a talk on their results in this minisymposium. From several of these you can find a contribution in this special issue having mostly an overview or survey character.

2. Contributions

Many results about convergence and convergence rates are known for regularization in Hilbert spaces (see the two references mentioned above). However, for several interesting problems, especially sparsity, an analysis in Banach spaces is needed. We had the following seven contributions in that field (in alphabetical order):

Kristian Bredies, An iterative thresholding-like algorithm for inverse problems with sparsity constraints in Banach space (see [2]).

Torsten Hein, Regularization in Banach spaces – convergence rates by approximate source conditions (see [4]).

Dirk Lorenz, On the role of sparsity in inverse problems (see [8]).

Christiane Pöschl, A convergence rates result in Banach spaces with non-smooth operators (see [11]).

Ronny Ramlau, Regularization of inverse problems with sparsity constraints.

Frank Schöpfer, Acceleration of the generalized Landweber method in Banach spaces via sequential subspace optimization (see [13]).

Dennis Trede, Optimal convergence rates for Tikhonov regularization in Besov scales (see [9]).

It is well known that regularization methods only yield good results if the regularization parameter is chosen in an appropriate way and that this choice has to depend on the noise level if one is interested in convergence results for the so-called *worst cae error*. However, in many applications one has not good estimates for the noise level and, therefore, one is interested in results about *heuristic parameter choice rules*. There were two contributions in that field (see [1] and also [10]):

Bauer Frank, Choosing regularization parameters in an optimal way without knowing the noise level.

Kindermann Stefan, Convergence results for the quasi-optimality criterion for (iterated) Tikhonov regularization

Finally, we had four contributions dealing with the solution of special inverse problems and one contribution from the filed of regularization in Hilbert spaces.

Harbrecht Helmut, Fast methods for three-dimensional electric impedance tomography.

Kuegler Philipp, Online parameter identification in time dependent differential equations.

Lahmer Tom, Modified Landweber iterations in a multilevel algorithm applied to inverse problems in piezoelectricity (see [7]).

Meyer Marcus, On a parameter identification problem in linear elasticity (see [5]).

Schieck Matthias, On the interplay of qualification, conditional stability and general source conditions in regularization theory (see [12]).

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