Johann Radon Institute for Computational and Applied Mathematics Austrian Academy of Sciences (ÖAW)

Group Seminar

Optimization and Optimal Control

On sparse minimization and optimal sensor placement

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Abstract

This talk will serve as a brief introduction to my recent work on optimization problems in certain spaces of vector measures with a particular focus on their efficient algorithmic solution. By now, measure-valued optimization variables have become an established tool since they allow for minimizers which are supported on a set of Lebesgue measure zero, e.g. a finite number of distinct spatial points. Moreover, it is well-known that their sparsity is enhanced by a suitable, nonsmooth, regularization. This makes sparse optimization problems appealing for various tasks such as actuator placement and inverse problems, e.g. acoustic inversion. However, their efficient numerical solution is a challenging problem since the measure space generally lacks properties such as reflexivity and smoothness which are desirable for the statement and analysis of efficient, function-space based, solution algorithms. In this talk we propose a new method, the Primal-Dual-Active-Point algorithm, which is able to cope with these difficulties and admits a linear rate of convergence if certain structural assumptions on the problem are met.
As a main application we consider a novel approach to the placement of measurement sensors in an infinite dimensional Bayesian inverse problem. The identification of a distributed parameter entering a partial differential equation from pointwise measurements of the associated state is considered. We formulate a suitable optimal sensor placement problem and model the distribution of the measurement sensors as a regular Borel measure on the spatial domain. This leads to a non-smooth but convex optimization problem. Results concerning its well-posedness and a suitable approximation framework are presented. The theoretical findings are illustrated by extensive numerical examples.