PDE-Constraint Optimization for Large-Scale Inversion of Geophysical Data

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Abstract

The inversion of geophysical data is the task of building three-dimensional maps of the Earth's subsurface from data collected on or above the surface. This problem can be formulated as an optimization problem minimizing the defect of prediction and measurements over the set of possible subsurface rock configuration subject to a physical model in the form of a PDE constraint. It is common practice to solve the problem using a 'first discretize then optimize' approach.

In the talk we will present a unified framework for geophysical inversion based on the concept of 'first optimize then discretize' solving an optimization problem in an appropriate Hilbert space. The discretization is based on the finite element method. The framework overcomes some of the computational limitation. It can be applied to a variety of cases including potential fields, waveform inversion and electromagnetic data and supports joint inversion of different data sets. We will show that in contrast to conventional approaches the problem representation remains sparse and allows running inversion for large spatial grids in parallel across thousands of processor cores with good scalability.

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