On Deterministic and Statistical Methods for Large-scale Dynamic Inverse Problems

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Abstract

Inverse problems are ubiquitous in many fields of science such as engineering, biology, medical imaging, atmospheric science, and geophysics. Three emerging challenges on obtaining relevant solutions to large-scale and data-intensive inverse problems are ill-posedness of the problem, large dimensionality of the parameters, and the complexity of the model constraints. In this talk we discuss efficient methods for computing solutions to dynamic inverse problems, where both the quantities of interest and the forward operator may change at different time instances. We consider large-scale ill-posed problems that are made more challenging by their dynamic nature and, possibly, by the limited amount of available data per measurement step. In the first part of the talk, to remedy these difficulties, we apply efficient regularization methods that enforce simultaneous regularization in space and time (such as edge enhancement at each time instant and proximity at consecutive time instants) and achieve this with low computational cost and enhanced accuracy [1]. In the remainder of the talk, we focus on designing spatial-temporal Bayesian models for estimating the parameters of linear and nonlinear dynamical inverse problems [2]. Numerical examples from a wide range of applications, such as tomographic reconstruction, image deblurring, and chaotic dynamical systems are used to illustrate the effectiveness of the described approaches.

Keywords: dynamic inverse problems, Bayesian, large-scale, regularization, computerized tomography, dynamical systems

References

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