
Data Assimilation – New Challenges in Random and Stochastic Dynamical Systems

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Abstract

The proliferation of data, together with carefully crafted mathematical models, means that in many areas of science and engineering the data and model should be considered in conjunction. Taking this perspective leads to new and interesting challenges in mathematical analysis. Since the data is often noisy, and in some cases the model is uncertain, interaction with probability arises naturally. This talk will be devoted to studying the conjunction of data and model in the context of time-evolving problems, a subject frequently referred to as data assimilation.

Predicting the state of a chaotic dynamical system whose initial condition is uncertain is difficult even in short time intervals. However in the presence of partial and noisy observations of the system, the question arises as to whether the initial uncertainty can be kept small in the infinite time horizon. We show that studying this problem leads to interesting questions relating to nonlinear Markov chains in discrete time. We also describe continuous time limits, leading to new nonlinear stochastic PDEs, such as families of damped-driven interacting Navier-Stokes equations, coupled through their empirical covariance. Theorems and numerical illustrations concerning this subjects will be presented.

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