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# Data assimilation with dissipative nonlinear dynamical systems: Optimal Gaussian asymptotics for the posterior measure

*Tuesday, March 3, 2026 2:45 PM (45 minutes)*

We consider a Bayesian update procedure to predict future states of infinite-dimensional non-linear dynamical systems. We focus on dissipative systems, in which information is lost exponentially fast over time. While, from an inverse problem perspective, this is expected to make inference difficult, it turns out to be extremely useful from a statistical perspective. When a Gaussian process prior is assigned to the initial condition of the system, we will explain how the posterior measure, which provides the update in the space of all trajectories arising from a discrete sample of the dynamics, is approximated by a Gaussian random field obtained as the solution to a linear parabolic PDE with Gaussian initial condition. This approximation holds in the strong sense of the supremum norm on the regression functions, showing that predicting future states of such systems admits root(N)-consistent estimators, even when a nonparametric model for the parameter is maintained. We further derive a functional minimax theorem that describes the Cramer-Rao lower bound for estimating the states of the system, which is attained by our data assimilation algorithm.

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