“Functional inference and uncertainty quantification in high-dimensional stochastic systems”

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Problems that are intrinsically high-dimensional or that involve inference of functions arise in many contexts, including biological and biophysical systems. Three recent studies are presented. First, some results of a high-dimensional stochastic birth-death-immigration process and its application to a number of problems are discussed. Second, a Bayesian path-integral-based approach to regularization, functional inference, and uncertainty quantification is introduced. Finally, this approach to functional inference and uncertainty quantification is applied to problems in molecular biophysics, specifically, the reconstruction of bond energies from dynamic force spectroscopy data. We show that inclusion of bond-coordinate dependent mobilities is critical in potential-energy reconstruction and uncertainty quantification.