Nonlinear Sciences > Chaotic Dynamics

State and parameter estimation using Monte Carlo evaluation of path integrals

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Transferring information from observations of a dynamical system to estimate the fixed parameters and unobserved states of a system model can be formulated as the evaluation of a discrete time path integral in model state space. The observations serve as a guiding potential working with the dynamical rules of the model to direct system orbits in state space. The path integral representation permits direct numerical evaluation of the conditional mean path through the state space as well as conditional moments about this mean. Using a Monte Carlo method for selecting paths through state space we show how these moments can be evaluated and demonstrate in an interesting model system the explicit influence of the role of transfer of information from the observations. We address the question of how many observations are required to estimate the unobserved state variables, and we examine the assumptions of Gaussianity of the underlying conditional probability.

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