

Metastability and Monte Carlo Methods for Multiscale Problems

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We discuss large deviations, metastability and Monte Carlo methods for multiscale stochastic dynamical systems that are stochastically perturbed by small noise. In this talk we focus on rough energy landscapes. Large deviations deals with the estimation of rare events. Depending on the type of interaction of the fast scales with the strength of the noise we get different behavior, both for the large deviations and for the corresponding Monte Carlo methods.

We derive a control (equivalently a change of measure) that allows to design asymptotically provably efficient importance sampling schemes for the estimation of associated rare event probabilities, such as exit probabilities, and expectations of functionals of interest. Standard Monte Carlo methods perform poorly in these kind of problems in the small noise limit. In the presence of multiple scales one faces additional difficulties and straightforward adaptation of importance sampling schemes for standard small noise diffusions will not produce efficient schemes. We resolve this issue and demonstrate the theoretical results by examples and simulation studies. Time permitting we will discuss construction of efficient Monte Carlo methods for the related problem of escape from a stable equilibrium point.