Limit Theorems for Cloning Algorithms

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Abstract

Dynamic rare events of time-additive observables in Markov processes can be cast in terms of Feynman-Kac semigroups generated by a tilted version of the original generator. The McKean interpretations of those semigroups lead to non-linear Markov processes, which are numerically accessible by Monte Carlo sampling via particle approximations, i.e. ensembles of processes evolving in parallel subject to a mean-field selection interaction. We discuss several choices of McKean models and particle filters, including cloning algorithms which have attracted interest in the theoretical physics literature, and provide a mathematical framework for comparison based on the martingale characterization of (Feller) Markov processes. We adapt results from the sequential Monte Carlo literature to derive estimates for convergence rates and asymptotic variances of such algorithms, and apply them in the context of current fluctuations for stochastic lattice gases such as zero-range or exclusion processes. This is joint work with Letizia Angeli (Heriot-Watt) and Adam Johansen (Warwick).

Keywords: cloning algorithm, dynamic large deviations, interacting particle systems, Feynman, Kac formula

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