
Unbiased importance sampling for non-equilibrium steady states

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Abstract

We discuss weighted ensemble, an interacting particle method for Markov chains in which the interactions come from resampling. Compared to other such methods, weighted ensemble is unique in that it preserves total particle mass or weight. This makes weighted ensemble the only such method that can sample steady states of (reversible or not) Markov chains without a finite particle number bias. We discuss how to optimize weighted ensemble by allocating particles in space based on the solution of a certain Poisson equation. We show that, with enough particles, we can choose weighted ensemble parameters that lead to the lowest possible variance in any given ergodic average/time average estimate, among all such interacting particle methods. We give examples showing that this can lead to orders of magnitude gains over direct Monte Carlo sampling.

Keywords: Markov chains, interacting particle systems, importance sampling, weighted ensemble, steady state

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