

## **Simple ergodic variants of the Hamiltonian Monte Carlo method**

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The Hamiltonian (or Hybrid) Monte Carlo (HMC) method is a Markov Chain Monte Carlo technique that uses proposal moves computed with the help of an auxiliary Hamiltonian dynamics. It offers the potential of generating proposals that are far away from the current location of the chain and, at the same time, may be accepted with high probability. Unfortunately, the success of the method depends on choosing appropriately the values of two parameters: the duration of the Hamiltonian flow and the time-step of the numerical integrator. For some unfortunate values of the parameters, the method may perform poorly or even not be ergodic. We shall present simple variants of the standard HMC method that may be rigorously proved to be geometrically ergodic regardless of the choice of the parameter values. As the dimensionality of the target distribution increases, the efficiency of the new variant scales more favorably than that of the standard HMC method. Similarly, the new variants become increasingly advantageous than the standard method as the temperature parameter tends to infinity, thus making them more appealing in conjunction with tempering techniques. These properties are illustrated in several multimodal test problems taken from the statistics and statistical physics literature.

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