

Dimension-free mixing for high-dimensional Bayesian variable selection

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Abstract:

Yang et al. (Ann. Stat., 2016) proved that the symmetric random walk Metropolis-Hastings algorithm for Bayesian variable selection is rapidly mixing under mild high-dimensional assumptions. In this work, we introduce a novel Metropolis-Hastings algorithm, which still proposes new states via add-delete-swap moves but has a much faster mixing time independent of the number of covariates. The key idea is to use a locally informed proposal scheme with bounded weights. Motivated by the theoretical analysis of our algorithm, we further propose a method called ``two-stage drift condition" for studying convergence rates of Markov chains on general state spaces. Simulation studies show that the new algorithm can efficiently explore the posterior distribution under various settings. A real data example is also provided, where five genetic variants associated with cup-to-disk ratio are identified. Joint work with J. Yang, D. Vats, G. Roberts and J. Rosenthal.

Keywords:

Add-delete-swap sampler; Drift condition; Finite Markov chain; Informed MCMC; Rapid mixing