

# Complexity analysis of Bayesian learning of high-dimensional DAG models

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## Abstract

We consider MCMC methods for learning equivalence classes of sparse Gaussian DAG models when  $p = e^{o(n)}$ . The main contribution of this work is a rapid mixing result for a random walk Metropolis-Hastings algorithm, which we prove using a canonical path method. It reveals that the complexity of Bayesian learning of sparse equivalence classes grows only polynomially in  $n$  and  $p$ , under some common high-dimensional assumptions. Further, a series of high-dimensional consistency results is obtained by the path method, including the strong selection consistency of an empirical Bayes model for structure learning and the consistency of a greedy local search on the restricted search space. Under the assumption of equal error variance, we can further prove the rapid mixing and strong selection consistency of Gaussian DAG learning.