Master’s Thesis Presentation

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“Beyond Vanilla Metropolis-adjusted Langevin Algorithms: A Simulation-based Survey”

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Abstract

Langevin Monte Carlo (LMC) methods have become pivotal in the field of computational statistics, offering a framework to efficiently sample from complex, high-dimensional distributions. In particular, the Metropolis-adjusted Langevin Algorithm (MALA) emerges as a key variant that enhances the standard LMC approach by incorporating a Metropolis-Hastings acceptance step to correct discretization errors. This thesis explores a variety of MALA modifications beyond its vanilla formulation – under a generic framework that incorporates preconditioning and irreversibility in the Langevin SDE. We present these variants of MALA and highlight our improvement on FisherMALA, which uses sample trajectories to adaptively estimate the Fisher covariance matrix as a preconditioner. Through simulations on both synthetic and real-world datasets, this survey not only benchmarks the performance (efficiency, convergence rates, etc.) of each algorithm but also provides a critical analysis of their applicative realms and limitations, offering good insights for both theoretical development and practical implementation in statistical computation.