

Provable convergence and limitations of geometric tempering for Langevin dynamics

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Geometric tempering is a popular approach to sampling from challenging multi-modal probability distributions by instead sampling from a sequence of distributions which interpolate, using the geometric mean, between an easier proposal distribution and the target distribution. In this paper, we theoretically investigate the soundness of this approach when the sampling algorithm is Langevin dynamics, proving both upper and lower bounds. Our upper bounds are the first analysis in the literature under functional inequalities. They assert the convergence of tempered Langevin in continuous and discrete-time, and their minimization leads to closed-form optimal tempering schedules for some pairs of proposal and target distributions. Our lower bounds demonstrate a simple case where the geometric tempering takes exponential time, and further reveal that the geometric tempering can suffer from poor functional inequalities and slow convergence, even when the target distribution is well-conditioned. Overall, our results indicate that geometric tempering may not help, and can even be harmful for convergence.