

Langevin diffusion and approximate sampling from a smooth and log-concave density

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Abstract

Sampling from various kinds of distributions is an issue of paramount importance in statistics since it is often the key ingredient for constructing estimators, test procedures or confidence intervals. In many situations, the exact sampling from a given distribution is impossible or computationally expensive and, therefore, one needs to resort to approximate sampling strategies. However, there is no well-developed theory providing meaningful nonasymptotic guarantees for the approximate sampling procedures, especially in the high-dimensional problems. This paper makes some progress in this direction by considering the problem of sampling from a distribution having a smooth and log-concave density defined on \mathbb{R}^p , for some integer $p > 0$. We establish nonasymptotic bounds for the error of approximating the true distribution by the one obtained by the Langevin Monte Carlo method and its variants. We illustrate the effectiveness of the established guarantees with various experiments. Underlying our analysis are insights from the theory of continuous-time diffusion processes, which may be of interest beyond the framework of distributions with log-concave densities considered in the present work.