Attaining the optimal Gaussian diffusion acceleration

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Abstract

The problem of skew-symmetric perturbation of reversible diffusions originates from the desire to accelerate the convergence to the underlying probability distribution. In the case of Gaussian diffusions, the dynamics of spectral gaps lead to an interesting inverse eigenvalue problem. In the present paper, we have studied this type of perturbation via two aspects. One is to study the limiting behavior of perturbation for a specially selected skew-symmetric matrix as the magnitude of the perturbation goes to infinite. This matrix represents the best direction of the perturbation in the sense that it works universally. Asymptotic convergence is established for all eigenvalue curves. The other is to study the attainability by means of a recursive algorithm allowing the construction of a skew-symmetric perturbation that realizes the optimal rate of convergence directly. As such, this paper describes how the optimal rate of Gaussian diffusion acceleration can be achieved both theoretically and numerically.

Keywords: diffusion, convergence rate, acceleration, Ornstein-Uhlenbeck process, reversible process, inverse eigenvalue problem, stability matrix, recursive algorithm