香港中文大學統計學系
Department of Statistics
THE CHINESE UNIVERSITY OF HONG KONG

SEMINAR

DEPARTMENT OF STATISTICS
THE CHINESE UNIVERSITY OF HONG KONG

Adaptivity of Diffusion Model to Manifold Structures.

INVITED SPEAKER

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TIME

Mar 4th, 2025 (Tue) · 2:30 pm - 3:30 pm

VENUE

LSB LT1 (1/F) · Lady Shaw Building LT1 · CUHK

ABSTRACT

Empirical studies have demonstrated the effectiveness of (score-based) diffusion models in generating high-dimensional data, such as texts and images, which typically exhibit a low-dimensional manifold nature. These empirical successes raise the theoretical question of whether score-based diffusion models can optimally adapt to low-dimensional manifold structures. We show that the forward-backward diffusion can adapt to the intrinsic manifold structure by showing that the convergence rate of the inducing distribution estimator depends only on the intrinsic dimension of the data, and demonstrate that the forward-backward diffusion can achieve the minimax optimal rate under the Wasserstein metric. We also extend our analysis by considering a class of conditional forward-backward diffusion models for conditional generative modeling, that is, generating new data given a covariate (or control variable). We extend our theory by allowing both the data and the covariate variable to potentially admit a low-dimensional manifold structure. In this scenario, we demonstrate that the conditional forward-backward diffusion model can adapt to both manifold structures, meaning that the derived estimation error bound (under the Wasserstein metric) depends only on the intrinsic dimensionalities of the data and the covariate.