



復旦大學
FUDAN UNIVERSITY

Applied Math
Ph.D. Seminar

Exploiting Locality Structure in High-Dimensional Diffusion Models

Speaker: Shuigen Liu (National University of Singapore)

Time: 2026-05-07, 15:10 to 16:00

Location: Rm 1801, Guanghai East Tower

Advisor: Weizhu Bao (National University of Singapore)

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Abstract: Diffusion-based methods provide a flexible framework for approximating and sampling high-dimensional probability distributions, but their practical performance is often limited by the difficulty of learning high-dimensional score functions. In this talk, we consider target distributions with locality structure and develop a localized diffusion model that explicitly exploits this property. Under locality assumptions, the score function can be well approximated using only neighborhood information, leading to a substantial reduction in effective complexity. We discuss both the algorithmic construction and theoretic properties, with particular emphasis on the trade-off between reduced statistical complexity and the localization error introduced by truncating long-range dependencies. Under realistic sample size scaling, we show both theoretically and numerically that a moderate localization radius can balance the statistical and localization errors, yielding better overall performance. Localized structure also facilitates parallel training, making localized diffusion models potentially more efficient for large-scale applications.