

ACMS Statistics Seminar

Changxiao Cai
University of Michigan
Tuesday, October 14, 2025
154 Hurley Hall
3:30 PM – 4:30 PM

Towards Statistical and Algorithmic Foundations of Diffusion Models

Score-based diffusion models have emerged as a foundational paradigm for modern generative modeling, achieving remarkable success across diverse applications from image synthesis to scientific computing. Despite their empirical prominence, fundamental questions about their theoretical foundations remain: How efficient can diffusion samplers be? What are the fundamental statistical limits of these samplers? I will present recent theoretical advances that address both the computational and statistical frontiers of diffusion models. First, introducing a novel accelerated stochastic sampler that provably reduces iteration complexity under minimal assumptions, offering sampling speedups without sacrificing statistical optimality. Second, presenting the first comprehensive end-to-end analysis for deterministic ODE-based samplers, establishing (near-) minimax optimal statistical guarantees under mild assumptions on the target distribution. Together, these results provide a rigorous mathematical foundation that narrows the gap between the practical success and theoretical understanding of diffusion models. This is joint work with Gen Li.

The Department of Applied and Computational
Mathematics and Statistics
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