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Statistical Guarantees for Denoising Reflected Diffusion Models

Tuesday, March 3, 2026 4:45 PM (45 minutes)

Denoising diffusion models can be interpreted through stochastic dynamics closely related to time-dependent PDEs, yet their practical implementations often rely on truncation heuristics that lack theoretical justification. We study denoising diffusion models driven by reflected diffusions, which naturally confine the dynamics to bounded domains and remove this mismatch between theory and practice. Under Sobolev smoothness assumptions, we establish minimax-optimal convergence rates in total variation distance, up to polylogarithmic factors. The analysis combines spectral methods with quantitative neural network approximation results, yielding rigorous statistical guarantees for this class of data-driven stochastic models.

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