FUDAN UNIVERSITY

Applied Math Ph.D. Seminar

Eliminating Ratio Bias for Gradient-based Simulated Parameter Estimation

Speaker: Zehao Li (Peking University)

Time: 2025-06-12, 16:10 to 17:00

Location: Rm 1801, Guanghua East Tower

Advisor: Yijie Peng (Peking University)

Abstract: This article addresses the challenge of parameter calibration in stochastic models where the likelihood function is not analytically available. We propose a gradient-based simulated parameter estimation framework, leveraging a multi-time scale algorithm that tackles the issue of ratio bias in both maximum likelihood estimation and posterior density estimation problems. A nested simulation optimization structure is introduced, accompanied by comprehensive theoretical analyses, including strong convergence, asymptotic normality, convergence rates, and budget allocation strategies. These theoretical results provide crucial insights for algorithm design and hyperparameter selection. The framework is further extended to neural network training, offering a novel perspective on stochastic approximation in machine learning. Numerical experiments show that our algorithm can improve the estimation accuracy and save computational costs, making it effective for parameter estimation in stochastic systems.