Mean Field Simulation for Monte Carlo Integration (Chapman & Hall/CRC Monographs on Statistics & Applied Probability)

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In the last three decades, there has been a dramatic increase in the use of interacting particle methods as a powerful tool in real-world applications of Monte Carlo simulation in computational physics, population biology, computer sciences, and statistical machine learning. Ideally suited to parallel and distributed computation, these advanced particle algorithms include nonlinear interacting jump diffusions; quantum, diffusion, and resampled Monte Carlo methods; Feynman-Kac particle models; genetic and evolutionary algorithms; sequential Monte Carlo methods; adaptive and interacting Markov chain Monte Carlo models; bootstrapping methods; ensemble Kalman filters; and interacting particle filters.

Mean Field Simulation for Monte Carlo Integration presents the first comprehensive and modern mathematical treatment of mean field particle simulation models and interdisciplinary research topics, including interacting jumps and McKean-Vlasov processes, sequential Monte Carlo methodologies, genetic particle algorithms, genealogical tree-based algorithms, and quantum and diffusion Monte Carlo methods.

Along with covering refined convergence analysis on nonlinear Markov chain models, the author discusses applications related to parameter estimation in hidden Markov chain models, stochastic optimization, nonlinear filtering and multiple target tracking, stochastic optimization, calibration and uncertainty propagations in numerical codes, rare event simulation, financial mathematics, and free energy and quasi-invariant measures arising in computational physics and population biology.

This book shows how mean field particle simulation has revolutionized the field of Monte Carlo integration and stochastic algorithms. It will help theoretical probability researchers, applied statisticians, biologists, statistical physicists, and computer scientists work better across their own disciplinary boundaries.

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