

Concentration inequalities for Feynman-Kac particle models and their applications

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In this lecture we present some new concentration inequalities for Feynman-Kac particle processes. We analyze different types of stochastic particle models, including particle profile occupation measures, genealogical tree based evolution models, particle free energies, as well as backward Markov chain particle models. We illustrate these results with a series of topics related to computational physics and biology, stochastic optimization, signal processing and Bayesian statistics, and many other probabilistic machine learning algorithms. Special emphasis is given to the stochastic modeling, and to the quantitative performance analysis of a series of advanced Monte Carlo methods, including particle filters, genetic type island models, Markov bridge models, and interacting particle Markov chain Monte Carlo methodologies.