

Multilevel optimization-based sampling for large-scale inverse problems

Chuntao Chen

Lappeenranta University of Technology

`Chuntao.Chen@lut.fi`

Coauthor(s): Tiangang Cui, Youssef Marzouk

We combine the Multilevel Monte Carlo and the optimization-based samplers, including Randomized-and-Then-Optimize (RTO) and Implicit Sampling, to address the challenges that classical MCMC faces, and implements the samplers in computationally costly Bayesian inverse problems including an ODE model and a PDE problem. Simulations using the optimization-based samplers like RTO can be parallelized which allows us to develop efficient MCMC algorithms or self-normalizing estimators to solve the inverse problems. Multilevel Monte Carlo is proven to significantly reduce the computational cost of Monte Carlo simulation, which helps us further improve the RTO method. To adapt the multilevel method on the optimization-based samplers, we develop the complexity theorem for multilevel self-normalizing estimators. The corresponding numerical experiments produce good results on RTO method, showing a high effective sample ratio in the importance sampling scheme, and the variances of the self-normalizing estimators converge when discretization size decreases.