



Multilevel Sequential² Monte Carlo for Bayesian Inverse Problems

J. Latz¹, I. Papaioannou¹, and E. Ullmann¹

¹Technische Universität München, Germany

The identification of parameters in mathematical models using noisy observations is a common task in uncertainty quantification. We employ the framework of Bayesian inversion: we combine monitoring and observational data with prior information to estimate the posterior distribution of a parameter. Specifically, we are interested in the distribution of a diffusion coefficient of an elliptic PDE. In this setting, the sample space is high-dimensional, and each sample of the PDE solution is expensive.

To address these issues we propose and analyse a novel Sequential Monte Carlo (SMC) sampler for the approximation of the posterior distribution. Classical, single-level SMC constructs a sequence of measures, starting with the prior distribution, and finishing with the posterior distribution. The intermediate measures arise from a tempering of the likelihood, or, equivalently, a rescaling of the noise. The resolution of the PDE discretisation is fixed. In contrast, our estimator employs a hierarchy of PDE discretisations to decrease the computational cost. Importantly, we construct a sequence of intermediate measures by decreasing the temperature and increasing the discretisation level at the same time. We present numerical experiments in 2D space, comparing our estimator to single-level SMC and other alternatives.