Sequential Monte-Carlo Methods for Applications in High Dimensions

Alexandros Beskos

[1] National University of Singapore, Singapore

Sequential Monte Carlo (SMC) methods are nowadays routinely applied in a variety of complex applications: hidden Markov models, dynamical systems, target tracking, control problems, just to name a few. Whereas SMC methods have been dramatically improved and refined in the last decades, they are still known to suffer from the curse of the dimensionality: algorithms can sometimes break down exponentially fast with the dimension of the state space. As a consequence, practitioners in high-dimensional Data Assimilation applications in atmospheric sciences, oceanography and elsewhere will typically use 3D-Var, 4D-Var or Kalman-filter type approximations that could provide biased estimates in the presence of non-linear model dynamics.

The talk will concentrate on a class of SMC algorithms and will look at methods that can reduce the cost of the algorithms as a function of the dimension of the state space. Explicit asymptotic results will clarify the effect of the dimension at the properties of the algorithm and could provide a platform for algorithmic optimisation in high dimensions. Current research on the relevance of SMC samplers in a Data Assimilation context, in the context of learning about the about the initial condition of the Navier-Stokes equation observed with error will also be presented.

Keywords:
Sequential Monte-Carlo; High Dimensions; Data Assimilation.