Bayesian Nonparametric Drift Estimation for Stochastic Differential Equations

Dr. Yvo Pokern
(University College London)

July 16, 2014

A Gaussian prior measure is chosen on the space of drift functions by specifying its mean function and its precision operator as an appropriate differential operator. A Bayesian Gaussian conjugate analysis for the drift of non-linear diffusions is feasible using high-frequency data. In dimension one, by expressing the log-likelihood as a quadratic function of the drift, with sufficient statistics given by the local time of the process and the start and end points of the observed path, asymptotic consistency and posterior contraction rates are obtained. Computationally efficient posterior inference is carried out in dimension one and (not too much) higher using a finite element or pseudo-spectral method. This technology is then embedded in partially observed situations with parametrically modeled diffusivity adopting a data augmentation approach whereby missing data paths and draws from the unknown drift and diffusivity are iteratively generated. The methodology is illustrated using one and two dimensional examples from molecular dynamics, financial econometrics and animal movement ecology encompassing high as well as low frequency observations.