BISP8

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BAYESIAN INFERENCE IN STOCHASTIC PROCESSES

Importance sampling of discretely observed multivariate diffusion processes via the Girsanov theorem

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A challenge in state and parameter inference in discretely observed multivariate diffusion processes modeled with stochastic differential equations (SDEs) is that the direct evaluation of the transition density is generally intractable. This makes the implementation of particle filters and the related particle Markov chain Monte Carlo (MCMC) methods with non-trivial importance distributions hard, because the importance weights depend on the transition density. One approach is to use imputation or discretization based approximations, but this introduces discretization errors. Methods which avoid these errors have recently been developed based on, for example, the Exact Algorithm.

Here we study another method which avoids the intrinsic discretization error in the following sense. The method uses the Girsanov theorem to form a set of SDEs which have the importance weights as their solutions. No discretization error is introduced provided that we can sample from the SDEs exactly. We show how the method can be applied to particle filtering based state estimation and particle MCMC based parameter estimation in discretely observed SDE models, and how recent nonlinear Kalman filtering and smoothing methods can be used for constructing importance distributions for the method. We also discuss theoretical properties of the method.

Keywords:
stochastic differential equation; multivariate diffusion process; Girsanov theorem; Importance sampling; Bayesian inference.

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