Auxiliary particle MCMC schemes for partially observed diffusion processes

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We consider Bayesian inference for parameters governing nonlinear multivariate diffusion processes using discretely observed data that may be incomplete and subject to measurement error. Typically, inference proceeds by replacing unavailable transition densities with an Euler-Maruyama approximation and adopting a high frequency imputation approach to allow sufficient accuracy of the approximation. We consider a recently proposed particle MCMC scheme which jointly updates parameters of interest and the missing data. We present a vanilla implementation based on a bootstrap filter before considering improvements based around an auxiliary particle filter. In particular, we focus on a linear noise approximation to the diffusion process and use this to construct both an efficient pre-weighting scheme and bridging mechanism. The methods are illustrated with some examples arising in systems biology.

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