Referee report on "Online Sequential Monte Carlo smoother for partially observed stochastic differential equations"

Overview

In this paper the authors proposes a new algorithm performing online smoothing of additive functionals in partially observed stochastic differential equations. In these models the transition densities of the latent data is usually unknown prohibiting many of the standard sequential Monte Carlo algorithms. In the paper the authors proposes using a general Poisson estimator for the transition density. The resulting algorithm is furnished with proofs of consistency and simulations illustrating its uses.

Major comments

The algorithm is interesting and is a good extension of the PaRIS algorithm. The paper contains all of the relevant information needed to believe in the algorithm. The theorems are relevant and the proofs are, as far as I can tell, correct.

I have two major comments that I think should be addressed before publishing.

First of all the whole presentation is written as given a fixed observation record $(Y_k)_{1\leq k\leq n}$, one of the main points of the PaRIS algorithm, which you rely on, is the ability to work with data streams of observations with a fixed memory usage. Maybe it would be a good idea to include this in the paper.

Secondly in the algorithm presented on page 9, it says to draw M samples from ζ_k while not mentioning what to do with these. This should be specified in the manuscript.

Minor comments

From the start you let X both denote the time continuous process and the discrete time observed process. I think this is quite confusing at times even if it is clear what is happening. Maybe if the time continuous process was denoted by $\tilde{X}$ or something similar the difference would be clear.

On page 3, you talk about not being able to extend the FFBSi algorithm to this class of models, but as far as I understand it the same sampling technique should be possible to draw from the approximative smoothing distribution.

Some other minor things I found,

- On page 4 line 28 q_k is defined as the transition from X_k to X_{k+1}, while on page 5 line 30 (equation 4) it is used as the transition from X_{k-1} to X_k, this also happens on page 10 line 35.
- On page 15, line 13, I believe that $h(m)$ has sneaked its way into the equation and should be removed.