Ann Inst Stat Math (2014) 66:577–609
DOI 10.1007/s10463-014-0455-z

SPECIAL ISSUE: BAYESIAN INFERENCE AND STOCHASTIC COMPUTATION

# Static-parameter estimation in piecewise deterministic processes using particle Gibbs samplers

**Axel Finke · Adam M. Johansen · Dario Spanò**

Received: 12 March 2013 / Revised: 4 February 2014 / Published online: 27 March 2014


**Abstract** We develop particle Gibbs samplers for static-parameter estimation in discretely observed piecewise deterministic process (PDPs). PDPs are stochastic processes that jump randomly at a countable number of stopping times but otherwise evolve deterministically in continuous time. A sequential Monte Carlo (SMC) sampler for filtering in PDPs has recently been proposed. We first provide new insight into the consequences of an approximation inherent within that algorithm. We then derive a new representation of the algorithm. It simplifies ensuring that the importance weights exist and also allows the use of variance-reduction techniques known as backward and ancestor sampling. Finally, we propose a novel Gibbs step that improves mixing in particle Gibbs samplers whose SMC algorithms make use of large collections of auxiliary variables, such as many instances of SMC samplers. We provide a comparison between the two particle Gibbs samplers for PDPs developed in this paper. Simulation results indicate that they can outperform reversible-jump MCMC approaches.