A pseudo-marginal sequential Monte Carlo algorithm for random effects models in Bayesian sequential design

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Abstract

A particle filter approach will be presented that can be used for Bayesian sequential design for random effects models in the presence of model and parameter uncertainty. Our focus is on sequential design where determining the next 'best' design point is defined via a utility function which could, for example, focus on parameter estimation, model discrimination or a combination of these two objectives. Particle filters are run for each rival model, and the algorithm relies on a convenient estimator of the posterior model probabilities for each model to efficiently approximate utility values. Implementing particle filters for random effects models requires approximating the likelihood (for example, via Monte Carlo methods). Efficiency in computing is achieved via exploiting parallel computational architectures, which will be discussed. We motivate our research by the application of sequential design to a number of real world examples where nonlinear models are contemplated.

Keywords: Optimal design; Parallel computing; Random effects; Sequential Monte Carlo; Utility functions.