Towards Automatic Model Comparison: An Adaptive Sequential Monte Carlo Approach

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Model comparison for the purposes of selection, averaging and validation is a problem found throughout statistics and related disciplines. Within the Bayesian paradigm, these problems all require the calculation of the posterior probabilities of models within a particular class. Substantial progress has been made in recent years, but there are numerous difficulties in the practical implementation of existing schemes. This paper presents adaptive sequential Monte Carlo (SMC) sampling strategies to characterise the posterior distribution of a collection of models, as well as the parameters of those models. Both a simple product estimator and a combination of SMC and a path sampling estimator are considered and existing theoretical results are extended to include the path sampling variant. A novel approach to the automatic specification of distributions within SMC algorithms is presented and shown to outperform the state of the art in this area. The performance of the proposed strategies is demonstrated via an extensive simulation study making use of the Gaussian mixture model and two challenging realistic examples. Comparisons with state of the art algorithms show that the proposed algorithms are always competitive, and often substantially superior to alternative techniques, at equal computational cost and considerably less application-specific implementation effort.

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