PARAMETER ESTIMATION IN THE WRONG MODEL CLASS: THE PERFORMANCE OF MCMC TECHNIQUES ON DATA WITH NO INTRINSIC DYNAMICS

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The use of Bayesian inference in parameter estimation is becoming common, both for linear models and for nonlinear, potentially chaotic, systems. One reason for this popularity is the *natural way* in which this approach incorporates information on, for example, different types of observational noise as experimental information, and then exploits this information in parameter estimation. There are examples in which the use of stochastic models on chaotic systems, through the use of the implementation of Markov Chain Monte Carlo (MCMC) techniques, provides impressively accurate, unbiased parameter estimates.

We explore the Bayesian (model based) approach to parameter estimation using methods of surrogate data, to determine which aspects of the data the inferences are based on. This approach is constructed with that of McSharry and Smith ((1999) *Phys. Rev. Lett.* **83**, 21,4285–4288) which, in its simplest implementation, largely ignores dynamic correlations.

In particular, the MCMC model based method is applied both to time series data, and to surrogate data sets (for example, random draws from the observed) for which the dynamical information supplied by the model does not usefully apply.

Surprisingly, the MCMC estimations for both data sets are often indistinguishable. We discuss several possible origins of the shortcomings of the Bayesian approach,

one original the other following Judd ((2003) *Phys. Rev. E* **67**, 026212). Consistency tests are suggested to help recognise the validity and limitations of the approach in the case of parameter estimation for a grid frequency model in conjunction with non-linear ensembles and cost function methods.