AGU FALL MEETING
San Francisco | 14–18 December 2015

S31B-02: Near-instantaneous Bayesian inversion and uncertainty estimation: Sampling from the prior

ABSTRACT

Wednesday, 16 December 2015
08:15 - 08:30
Moscone South - 305

Ideally, uncertainty estimation should be treated as an intrinsic part of solving an inverse problem, and techniques such as Markov Chain Monte Carlo (MCMC) inversion provide a route to achieving this. However, these approaches involve `posterior sampling', and the (often significant) computational investment is entirely targeted towards one specific dataset.

In those cases where similar inverse problems must be solved repeatedly (perhaps for multiple locations on the Earth's surface), or where results must be obtained within very limited timescales (e.g. earthquake early warning), this presents a barrier to use of methods such as MCMC. In such cases, approaches based on `prior sampling' may be preferable. This separates the computationally-expensive step (generating samples in the joint data-model space) from the dataset-specific inversion stage, and permits one set of samples to be recycled for many different datasets. The essential difference between prior and posterior sampling is the stage at which the solution is conditioned on a given dataset.

We show that prior sampling can be implemented effectively, using learning algorithms to assimilate and apply information on the mapping between data and model spaces. We illustrate that this can be successfully applied in a range of geophysical problems. By comparing solutions based on prior sampling to those obtained via posterior sampling, we show that results are compatible---although the less focussed nature of prior sampling typically leads to more conservative uncertainty estimates in any given case. Nevertheless, for certain classes of problems, prior sampling appears to be a promising way forward.

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