Geophysical Research Abstracts
Vol. 15, EGU2013-3668, 2013
EGU General Assembly 2013

Parallel Tempering for sampling and optimization in seismic inverse problems

Malcolm Sambridge

Research School of Earth Sciences, Australian National University, Canberra, ACT 0200, Australia
(Malcolm.Sambridge@anu.edu.au)

The field of seismology is rich with inverse problems. Seismologists are constantly seeking new ways to use seismic waveforms, and data products derived from them, to constrain subsurface structure in the form of Earth properties in 1-, 2- and 3 dimensions, as well as seismic sources in space and time. Every approach has its limitations and a virtual smorgasbord of methods exist, and have been applied over thirty years, with varying degrees of success. In this presentation we discuss a new class of approach. Parallel Tempering (PT) is a technique originating in the field of computational statistics that is finding increasing success for probabilistic sampling problems in astro and quantum physics, and more recently ocean acoustics but appears to be virtually unknown in the solid earth geosciences.

In seismology two classes of inference approach are common for nonlinear inverse problems, Bayesian (probabilistic) sampling and optimization. Parallel Tempering can be applied to both situations and is related to better known methods such as Simulated Annealing and Metropolis Sampling. PT is distinguished as it has a theoretical basis for being superior to both. PT is best viewed as a 'meta' algorithm. In a sense wrapping around existing optimization or Bayesian sampling methods to facilitate more robust performance (optimization) and more rapid exploration of parameter space (sampling). PT has generated much interest across the physical sciences with encouraging results emerging. This presentation will describe the basic ideas, and present results of implementations on seismic waveform inversion for both sampling and optimization.