Model Fusion under Probabilistic and Interval Uncertainty, with Application to Earth Siences

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Abstract

One of the most important studies of the earth sciences is that of the Earth's interior structure. There are many sources of data for Earth tomography models: first-arrival passive seismic data (from the actual earthquakes), first-arrival active seismic data (from the seismic experiments), gravity data, and surface waves; see, e.g., Averill et al. (2007); Hole (1992). Currently, each of these datasets is processed separately, resulting in several different Earth models that have specific coverage areas, different spatial resolutions and varying degrees of accuracy. These models often provide complimentary geophysical information on earth structure (P and S wave velocity structure).

Combining the information derived from each requires a joint inversion approach. Designing such joint inversion techniques presents an important theoretical and practical challenge. While such joint inversion methods are being developed, as a first step, we propose a practical solution: to fuse the Earth models coming from different datasets. Since these Earth models have different areas of coverage, model fusion is especially important because some of the resulting models provide better accuracy and/or spatial resolution in some spatial areas and in some depths while other models provide a better accuracy and/or spatial resolution in other areas or depths.

The models used in this paper contain measurements that have not only different accuracy and coverage, but also different spatial resolution. We describe how to fuse such models under interval and probabilistic uncertainty.

The resulting techniques can be used in other situations when we need to merge models of different accuracy and resolution.

References

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