Wasserstein Metric and Seismic Exploration

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Abstract: In seismic exploration a wave field is generated at the surface and reflections from the earths interior are recorded. The purpose is to find properties such as wave velocity and location of reflecting sub layers. This is done in an inverse process where the measurements are compared to a computed wave field with unknown coefficients in the wave equation. It is a serious multiscale problem since the these coefficients vary on much smaller scales than the size of the domain to explore. We will discuss two aspects of this process. One is the fast computation of the wave field and the other the choice of metric in the comparison between the measurements and the computed wave field. We propose Wasserstein metric for this comparison and the metric can be determined by numerically solving the Monge-Ampère equation. Furthermore, the solution of the Monge-Ampère equation can be used in registration for monitoring reservoirs.

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