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Elastic Reverse Time Migration (RTM) From Surface Topography

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Abstract:
Seismic Migration is a promising data processing technique to construct subsurface images by projecting the recorded seismic data at surface back to their origins. There are numerous Migration methods. Among them, Reverse Time Migration (RTM) is considered a robust and standard imaging technology in present day exploration industry as well as in academic research field because of its superior performance compared to traditional migration methods. Although RTM is extensive computing and time consuming but it can efficiently handle the complex geology, highly dipping reflectors and strong lateral velocity variation all together. RTM takes data recorded at the surface as a boundary condition and propagates the data backwards in time until the imaging condition is met. It can use the same modeling algorithm that we use for forward modeling. The classical seismic exploration theory assumes flat surface which is almost impossible in practice for land data. So irregular surface topography has to be considered in simulation of seismic wave propagation, which is not always a straightforward undertaking. In this study, Curved grid finite difference method (CG-FDM) is adapted to model elastic seismic wave propagation to investigate the effect of surface topography on RTM results and explore its advantages and limitations with synthetic data experiments by using Foothill model with topography as the true model. We focus on elastic wave propagation rather than acoustic wave because earth actually behaves as an elastic body. Our results strongly emphasize on the fact that irregular surface topography must be considered for modeling of seismic wave propagation to get better subsurface images specially in mountainous scenario and suggest practitioners to properly handled the geometry of data acquired on irregular topographic surface in their imaging algorithms.