BLIND TESTING OF DEFORMABLE LAYER TOMOGRAPHY USING NEAR-SURFACE FIRST ARRIVALS

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It is beneficial to both the developers and users of seismic imaging algorithms to learn their applicability and limitations. Using the first-arrival dataset generated by the session chairs for an unknown synthetic near-surface velocity model, we have started to conduct a series of tests using deformable layer tomography (DLT). In this method we parameterize the target model with a number of thickness-varying layers and the velocity function of each layer can be constant, gradient, or laterally varying. We use traveltimes of first arrives and reflections to invert for either the layer geometry, or the layer velocity function, or both simultaneously. We use a multi-scale scheme to regularize the inversion for layer geometry and velocity functions. Details of the DLT method and field data examples are available in our publications.

In this blind test, the objective is to estimate a 300-meter-wide near-surface P-wave velocity model using 10,100 first arrivals. We designed the velocity model building work in several steps. Firstly, we estimated the long-wavelength model by restricting the DLT to invert for the layer geometry of some constant-velocity layers. This step has resulted in a multi-layer model whose traveltime residues have a standard deviation of less than 1.2 ms. Secondly, we fixed the layer geometry, and invert for the laterally varying velocity functions. The solution from this step has reduced the standard deviation of the traveltime residuals to about 1.05 ms, which is close to the 1-ms standard deviation of the added noise. We plan to quantify the resolution and to characterize the multiple models of similar levels of data fitness. Together with other researchers in this session, we expect to learn a great deal about the behaviors of different methods and characteristics of all nonunique solutions.