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Travel time and attenuation measurements for triplicated seismic waveforms by Simulated Annealing

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Chevrot (2002, GJI) incorporated Simulated Annealing (SA) to optimally measure delay times from waveform data recorded by a seismograph array. Garcia et al. (2004, JGR) extended this method to measurements of travel times of triplicated core phases. SA is Monte Calro inversion based on the analogy between optimization problem and physical annealing process. SA is an efficient method to measurements of travel time of phases that have relatively small amplitude and is highly contaminated by other phases due to triplication. Usually, to improve S/N, slant stacking is used as the conventional approach. However, such methods require relatively large number of data traces. Here, we try to apply that algorithm to estimate travel time, amplitude and unelastic attenuation of triplicated phases which can be used to construct a structural model. The preliminary synthetic test presented below indicates that the method works reasonably.

In Iritani et al. (2008, ASC), we applied SA to measure travel times from synthetic waveform data computed by modified IASP 91 model for several realistic problems. We assumed that every phase has the identical waveforms. This assumption means that we ignore the effects of unelastic attenuation and caustics. We confirmed reasonable agreements even for the data with higher contamination or with the distance ranges in the vicinity of the cusp. However, the systematic delay (0.5s) are observed. This systematic delay should be partly due to unmodelled unelastic attenuation.

In this study, we extend our method to include the effects of attenuation and confirm whether the observed synthetic errors are improved. We adjust the unelastic attenuation term to our model, and measure travel times of 36 synthetic triplicated S, SdS, ScS by SA (epicentral distance is between 45 - 75 degree) computed for a modified IASP91 model which has +3% velocity jump at 1000km above CMB. In our preliminary results, statistical features of travel time models show that the systematic delay become small. We plan to further improve our method. We also plan to apply our method to observed waveform data.