Automatic Picking of Teleseismic P- and S-Phases using an Autoregressive Prediction Approach

Johannes Stampa, Máté Timkó, Marcel Tesch, and Thomas Meier
Christian-Albrechts-Universität zu Kiel, Institut für Geowissenschaften, Geophysik, Germany (johannes.stampa@ifg.uni-kiel.de)

In the recent decade, the amount of available seismological broadband data has increased steeply. Picking later arriving phases such as S-phases is difficult, and there are few manual picks available for these phases. Data sets of manual picks can also be problematic, since phase arrival picks are sensitive to the parameters of the filtering, which are often unknown, and the individual picking behavior of the analysts. This necessitates the adoption of automatic techniques for determining teleseismic phase arrival times consistently over a large data set.

In this work, a robust automatic picking algorithm based on autoregressive prediction in a moving window is explained. In this algorithm, a characteristic function is calculated as the autoregressive prediction error in a moving window. This characteristic function is then transformed with the Akaike-Information Criterion to obtain the phase arrival time estimate. This estimate is further improved in a second iteration of a similar scheme in a smaller time window.

The algorithm is applied to a global data set including AlpArray stations, covering a time period from 1995 to present, to obtain arrival times for teleseismic P- and S-phases. Residuals to theoretical travel times and to local averages are shown. Different methods for automatically evaluating the quality of individual picks are used, based on signal to noise ratio of the seismic trace and impulsiveness of the arrival. The picking errors are estimated by comparison with manual picks and neighboring stations as well as statistical methods. The quality evaluations suggest potential of using these automatically determined phase arrival times for a travel time tomography.