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Automatic arrival time picking as accurate as picking by a seismologist (2)

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1. Introduction It becomes possible to increase the number of seismic stations owing to widely spread of internet and the development of cheap seismic observation instruments. However, it is difficult for operators to reading P and S wave arrivals for huge number of stations. We need an automatic processing system which can read P and S waves extremely precisely. We developed the automatic processing system which incorporated the know-how of seismologist in the last report (2009). The development used 10KHz sample data observed in West Nagano. We compared 76,000 P wave arrival times measured by operators and those by automatic system. The result of comparison shows that arrival time differences for 95% readings are less than 4 m sec. This result shows that we can develop precise P and S wave automatic reading program by incorporating the know-how about the reading of the expert. The present study developed an automatic reading system which uses waveform data with sampling frequencies in the range from 100 Hz to 250 Hz.
2. Method of P and S wave pickings
1) Determine 10 candidates of P and S wave arrival times near the approximate time by changing threshold levels of amplitude with interval of 20%. Rotation component shown by Horiuchi et al.(2 00) is used for the S wave reading.
2) Calculate time differences, average amplitudes, predominant frequencies, later part of average amplitudes, and displacement amplitudes for time sections between arrival times of candidate.
3) Select correct arrival times among candidates by using observed parameters in 2) and several parameters for the judgment. We determine parameters for the judgment with considering how a human being reads onset times.
4) Calculate hypocenter and check travel time residuals.
5) Search for arrival times among candidates having small residuals and acceptable to be selected as P or S wave onsets.
3. Result ERI has earthquake waveform data which are used for the testing of technical ability of the P and S wave readings. We used these data for the development of automatic system. There are 15 events and 11 are seismic or blast data, whose hypocenter can be located. The remaining four events are noise and remote events whose hypocenters are not determined. The automatic system determines accurate hypocenter for 11 events. The comparison of readings by ERI and by automatic system shows that 95% of readings are in the range from 0.0 sec to 0.04 sec. Only 1.6% of readings by ERI are larger than those by automatic system.

Keywords: automatic picking, P and S wave arrival times, hypocenter location, know-how, accurate, 100Hz sampling data