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A new method for estimating epicentral distance using very initial phase of single station data

Shunroku Yamamoto[1*], Shunta Noda[1], Masahiro Korenaga[1], Shinji Sato[1], Naoyasu Iwata[1]

[1]Railway Technical Research Institute

Since estimation of epicentral distance using single station data plays is an essential part of the Shinkansen EEW system or the JMA EEW system, its accuracy and rapidness are expected to be improved. The B-delta method (Odaka et al., 2003) adopted by the present systems assumes that amplitude envelope of initial P-wave is effected by both epicentral distance and magnitude. On the other hand, Yamamoto et al. (2010) pointed out amplitude envelope of very initial phase (0.0 - 0.5 sec) has little relationship with magnitude by an analysis of real-time seismic intensities. Here, a new method for estimating epicentral distance is proposed on the basis of the result mentioned above.

The proposed method uses a fitting function, $y(t) = C\,t$, where y, t and C are amplitude envelope, time after P-wave detection and coefficient corresponding to epicentral distance respectively. Once coefficient C is obtained by fitting the function to observed envelope of the very initial phase, epicentral distance can be estimated from empirical relation between C and the distance. Band pass filter (10 - 20 Hz) is applied to recorded wave as a pre-process in order to reduce effects of surface amplification or rupture process.

To confirm performance of this method, estimation errors (RMS in log scale) are calculated by using 2237 waves of 23 earthquakes recorded by K-NET. Estimation errors are 0.303 and 0.316 for 0.5-sec and 2.0-sec time window respectively. The estimation error by this method using 0.5-sec time window is reduced by 4 % comparing with the error by the B-delta method using 2.0-sec time window. This result demonstrates very high potential of the method for EEW.

Keywords: earthquake early warning, single station, epicentral distance