# A Technique for Automatic Detection of Onset Time of P- and S-phases in Strong Motion Records (Applying to Velocity Records)

# Takashi Akazawa[1]

[1] G.R.I.

1. Introduction

In the 1970's and the 1980's, automatic detecting algorithms were very actively being investigated, and many automatic hypocenter determination systems that employed these algorithms were established. The accuracy of the AR-AIC (autoregressive Akaike Information Criteria) method, frequently used to automatic detection of the onset time of seismic waves, depends heavily on the reliability of the detection interval. The goal of this work was to produce an automatic detection algorithm of onset time of both P- and S-phases in any strong motion record without any specific settings. In this work an automatic detecting technique of this kind applicable to the velocity records is suggested, and the accuracy of the detection is examined.

2. Method

The onset times are calculated as follows:

(1) The three-component acceleration records are calculated from the velocity records.

(2) The predominant direction of polarization of wave motion is estimated using horizontal components of the acceleration records.

(3) The acceleration and velocity records for the predominant direction are calculated.

(4) 10 Hz low-pass filter is applied to the vertical acceleration record, and then STA/LTA (Short-Term Average / Long-Term Average) ratio is applied. At this step the detection interval was from the first count to the peak-value count on the vertical acceleration data; time window for STA was 0.5sec, LTA - 5.0sec

(5) 20 Hz low-pass filter is applied to the vertical velocity component, and then AR-AIC method is applied to the third power of filtered record. Minimum value of the AIC is considered as the onset time of P-phase. Detection time interval at this step: from the first count to the peak-value count on the STA/LTA ratio calculated in (4)

(6) The same low-pass filter is applied to the horizontal predominant component of the velocity record, and the AR-AIC method is applied to the third power of filtered record. Again, minimum value of the AIC is considered as the onset time of S-phase. The detection interval: from the count considered as the onset time of P-phase in step (5) to the peak-value count on the horizontal predominant component of the acceleration record.

3. Accuracy of detection

To examine the accuracy of detection by the suggested algorithm, the author applied it to records, among obtained at all CEORKA sites in 2001, with easily identifiable by eye P and S onset times. As result, above algorithm was able to detect P- and S-phase arrivals in 97% of rock site records, and P-phase arrivals in 97% and S-phase arrivals in 94% in sedimentary site records. These results show that the suggested algorithm has good detecting ability. However, this algorithm was not able to detect S-phase arrival for some records obtained in sedimentary sites because of the existence of converted-phases from P to S at the basement. This phenomenon degrades detecting ability of S-phase arrivals. In case of presence of heavy microtremors and with strong background noise before P-arrival, this algorithm sometimes was unable to detect P-arrivals too. In addition, this algorism has a great difficulty to detect S- arrivals in records without any visible amplitude S-arrival.

Acknowledgements

The author is very thankful to CEORKA for providing strong motion records.