On smoothing of time series for high frequency seismic signal duration measurements

*Tatsuhiko Hara[1]

1. IISEE, BRI

Hara (2007) developed a procedure to measure high frequency seismic signal durations (hereafter referred to as HFSDs) from broadband seismograms recorded in the teleseismic distance range. In this procedure, the narrow high band-pass filter (2-4 Hz) is applied to a broadband seismogram, and the squares of each data point is calculated; then the moving window average is applied to smooth the time series, and a HFSD is measured using the smoothed time series. The width of the window is set to one sixth of the time from the arrival of a P wave to the time when the amplitude of the squared time series is the maximum, which is referred to as a peak time by Hara (2008). Hara (2008) showed that the frequency distributions of the peak times normalized by twice the centroid time shift showed the peaks around 50 per cent, which supports the effectiveness of this smoothing procedure.
Since an estimate of a HFSD is available after the above mentioned procedure is carried out, if this estimate is used to set the width of the window for smoothing of each time series, HFSD measurement accuracy may be improved. In this study, we set one twelfth of the HFSD estimate to the width, and calculated smoothed time series again, and measured HFSDs from them. We analyzed shallow earthquakes whose moment magnitudes are greater than or equal to 7.2 that occurred in between 1994 and 2017. We used broadband waveform data recorded at the GSN stations in the epicentral distance range between 30 and 85 degrees, which were retrieved from the IRIS DMC. The differences between the newly measured HFSDs and those obtained by the procedure of Hara (2007) are about 5 per cent on average. The median absolute deviations of the newly measured HFSDs are smaller by about 21 per cent on average than those obtained by the procedure of Hara (2007), which suggests that the procedure in this study is helpful to reduce the scatters of the measurements.