Development of a function in the home seismometer to discriminate seismic signal from noise event

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The receiving unit of earthquake early warning (EEW) is equipped with a CPU and memory and is on-line via the internet. The addition of an inexpensive seismometer and A/D converter would transform this receiver into a real-time seismic observatory, which we are calling a home seismometer. The installation of a home seismometer brings to the user various important, and potentially lifesaving, information such as the rapid warning of a large nearby earthquake by using locally observed data.

Home seismometers are located inside houses and therefore the background noise caused household activity may be extremely large. Since it is difficult to reduce the amplitude of these characteristic noises by a simple filter operation, large noise can produce frequent false alerts. Therefore, we needed to develop an algorithm to discriminate earthquake shaking from artificial noise sources. The predominant frequency of artificial noise is found to be several tens to several hundreds Hz. Our algorithm is to set the sampling frequency of the A/D converter to 500 Hz, while 100 Hz is the sampling frequency for the recording. We store both 500 Hz data and a subset 100 Hz data, which are calculated from low-pass filtering of the seismic signal on the ring buffer. We calculate short-term (0.5 sec) and long-term (30 sec) averages from the sampled data for purposes of event detection. When any event occurs, we calculate its predominant frequency from the average amplitude ratio of accelerations and their derivatives by using 500 Hz waveform data. We also calculate the duration of the trigger event. An empirical equation using these two parameters is then used to discriminate between noise and seismic signal. We tested our method on a set of 443 noise events and one seismic event and found that our algorithm can correctly distinguish between noise and earthquake for all events.