

# Amplitude saturation of the NIED Hi-net waveforms and simple criteria for recognition

# Katsuhiko Shiomi[1]; Kazushige Obara[1]

[1] NIED

Conventionally, the maximum output of a high-sensitivity seismograph is larger than the maximum input of A/D converter with low bit. In that case, the amplitude saturation appears as a clip at a certain level, and easy to be recognized. However, NIED Hi-net uses 24 bit A/D converter that is able to record waveforms with velocity-amplitude up to 5 cm/s. Therefore, the saturation caused by the mechanic limit of the seismograph becomes not easy to recognize. For example, we found some unusual waveforms for the Tottori earthquake (M7.3), 2000 and the Tokachi-Oki earthquake (M8.0), 2003. It was hard to judge whether the waveforms are saturated or not. There is a need to find simple criteria for the Hi-net waveform data users.

Each Hi-net station is equipped with a three-component short-period velocity seismograph of natural frequency 1 Hz and strong motion accelerographs (KiK-net) at the bottom of a borehole as well. The full-scale mechanical displacement is 2 mm peak-to-peak corresponding to the maximum velocity of 1.26 cm/s, and to the maximum acceleration of 7.9 gal at 1 Hz. We selected 10 earthquakes with KiK-net recorded maximum acceleration close to 7.8 gal. Then, the Hi-net waveforms recorded at the same station and the same component are used to analyze. We find the following characteristics of the corresponding Hi-net waveform data. (1) It is very difficult to recognize whether the waveforms are saturated or not from the velocity records, directly. (2) Spectral ratios between the KiK-net and the Hi-net waveforms are unstable. (3) The differential velocity (acceleration) of the Hi-net record has pulse-like noises. (4) The integral velocity (displacement) waveforms are clipped (2.0 mm for vertical component and 1.1 mm for horizontal component) at a certain level and/or the base line of the seismograms varies significantly.

Thus, when the earthquake is large and the acceleration recorded at a station is close to 7.9 gal, we integrate the corresponding Hi-net velocity records and if the amplitude of the vertical component is close to 1.6 mm and that for the horizontal component is close to 0.9 mm, we should consider that the velocity seismograms are saturated. Applying these criteria to the Hi-net waveforms of the Tokachi-Oki earthquake, 2003, we find that almost all components are saturated for stations within 300 km from the source.