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Landslide Signal Mining from the Seismic Record – Case of Tsaoling Landslide in Chi- Chi Earthquake

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An earthquake-induced landslide, Tsaoling rockslide involved a mass movement of 125 million cubic meters, was triggered during 1999 Chi-Chi earthquake in central Taiwan. The seismic signal was recorded by the strong motion station about 700 m north of the landslide. The seismic signal contains the ground motion caused by earthquake and landslide. The recognition method on the landslide signal and the significant landslide signal frequency from the seismic record are presented in here. The short-time Fourier transform (STFT) is employed to identify the initiation and landing time and inducing seismic signal of the rockslide. 3 strong motion station records, the stations surround the landslide, are processed to obtain the basic earthquake time – frequency spectrum. Then, the seismic record of Tsaoling station is filtered out the basic earthquake signal to show up the landslide signal.
The study shows that the basic earthquake signal began with a band of low frequency waves from 0.1 to 18 Hz, and rose up to 30 Hz during the main shock; then, the high frequency decreased progressively from 20 to 10 Hz. On the other hand, Tsaoling landslide signal shows a high frequency band up to 60 Hz at the record time 32.5th to 35.5th sec which is estimated as the rock block cracking period. And dramatic excitation occurs during the 37.5th to the 41th sec, this period is estimated as the rock block sliding. At last, the high frequency of 30 Hz registered at the 76th sec. which is likely to correspond to the sliding mass impacting on the old debris dam.
Results suggest the significant frequency of 30-70 Hz found as in rockslide initiation and in sliding. It can be distinguished clearly from the most earthquake waves which have frequencies of less than 20 Hz, typically ranging between 0.1 Hz and 10 Hz.