**APPLICATION of SUPERVISED Machine Learning to AVS30 estimation based on Horizontal-to-vertical spectral ratio**

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Average S-wave velocity (Vs) to 30 m depth (AVS30) is the one of the most important proxies to estimate site amplification in earthquake engineering. Invasive and non-invasive methods, such as velocity loggings or active/passive surface wave methods, have been generally used to directly measure the AVS30. Those methods, however, are expensive and time consuming and only used in large construction projects. The AVS30 is also indirectly estimated by empirical methods based on geology, geomorphology, elevation, or slope angle etc. Those methods are inexpensive but obviously not accurate. We intend to use a horizontal-to-vertical spectral ratio (H/V) to roughly estimate the AVS30. The measurement of H/V is much easier and quicker compared with active surface wave methods (e.g., MASW) or microtremor array measurements (MAM). The inversion of the H/V, however, is essentially non-unique and it is impossible to obtain unique Vs profiles only from H/V spectra. Calculating accurate theoretical H/V spectra is difficult and time consuming. We apply supervised machine learning to roughly estimate the Vs profiles or AVS30 from H/V spectra together with other available information, such as site location or geomorphology etc. Our machine learning consists of a fully-connected neural network with one hidden layer. The pairs of the observed H/V spectra (input layer) and Vs profiles (output layer) are used as training data. Input layer consists of an observed H/V spectrum resampled to 20 samples in a frequency range between 0.2 and 20 Hz, site coordinate (latitude and longitude), and geomorphological information. Output layer is a velocity profile obtained from the velocity loggings, active/passive surface wave measurements, or inversion of H/V. The Vs profiles from the ground surface to 90 m depth are represented as 12 layers. We have applied machine learning to several different sites in U.S. and Japan. Number of training data pairs are 100 to 1000 depending on the sites. This presentation introduces a study at Napa Valley in California from among those application examples. We measured MAM and H/V at approximately 100 sites in and around the Napa Valley. The pairs of H/V spectra together with their coordinate and Vs profiles obtained from the inversion of the dispersion curve compose the training data. We consider the Vs profiles and their AVS30 obtained from the inversion as true values. Trained neural network predicts Vs profiles from observed H/V spectra. The AVS30 calculated from predicted Vs profiles are reasonably consistent with those calculated from true Vs profiles obtained from the dispersion curves. The results implied that machine learning could roughly estimate Vs profiles or AVS30 from H/V spectra together with available other information.