MEASUREMENT AND IDENTIFICATION PROTOCOLS FOR HORIZONTAL-TO-VERTICAL SPECTRAL RATIO PEAKS

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Abstract[1]

Peaks in horizontal-to-vertical spectral ratios (HVSR) of Fourier amplitudes from three-component recordings are used to identify site resonances, which are an important component of site response. We address two topics: (1) how should HVSR peaks be identified; and (2) are there appreciable differences in HVSR derived by using different instruments recording microtremors and seismic strong ground motions? We propose to identify peaks by considering peak amplitudes relative to neighboring ordinates and peak width. The procedure incorporates a regression tree algorithm that can be tuned to conform with user preferences toward relatively "conservative" or "liberal" peak identification (producing relatively few or many sites with peaks, respectively). Recommended parameters for both cases are provided. We then investigate the consistency of microtremor-based HVSR (mHVSRs) derived from seismometers and accelerometers, which show a high rate of false negatives (missed peaks) from accelerometers. In contrast, mHVSRs derived from co-located temporary and permanent instruments (optimized to record teleseismic signals) have about 60–80% consistency, with no apparent bias in peak assessments between instrument types. This indicates that mHVSR from accelerometers is not reliable, but that mHVSR can be reliably obtained with similar levels of quality from temporary or permanent seismometers. Lastly, we compare seismometer-based HVSR from microtremor and earthquake sources (mHVSR versus eHVSRs). Results are consistent for 60–70% of sites (i.e., both either do, or do not, have significant peaks; and when peaks are present, they occur at similar frequencies, <20% change). For sites with an mHVSR peak, the false-positive rate is nearly 50%, whereas for sites without an mHVSR peak the false-negative rate is relatively low (about 20%). The false positive rate is sufficiently high that the use of eHVSR to derive site response models is likely too optimistic (overestimates model effectiveness); mHVSR is preferred for consistency with information available in forward applications.

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[1] Wang, P, P Zimmaro, SK Ahdi, A Yong, JP Stewart (in review). Measurement and identification protocols for horizontal-to-vertical spectral ratio peaks, submitted to *Bulletin of the Seismological Society of America*.