Laboratory and Field Testing of Commercial Rotational Seismometers

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ABSTRACT

There are a small number of commercially-available sensors to measure rotational velocities in the frequency and amplitude ranges appropriate for earthquake strong motions on the ground and in structures. However, the behavior of these sensors has not been thoroughly tested and characterized for earthquake monitoring purposes. To address this need, the authors, with assistance from colleagues in the U.S. and Taiwan, have developed performance test methodologies and performed initial testing of two such rotational velocity sensors: the Eentec™ model R-1™ and the PMD™ model RSB-20™. Both are magnetohydrodynamic rotational-velocity sensors, the latter with force feedback. Two examples of each sensor and two 19-bit data acquisition units (Kinemetrics six-channel K2) were obtained courtesy of the Central Weather Bureau of Taiwan and the Institute of Earth Sciences, Academia Sinica for testing in late 2006. Both sensor models have three orthogonal sensors with sensitivities of 50 V/rad/s. The data acquisition units also have internal force-balance linear accelerometers.

Additional samples of the R-1™ were obtained for further testing in 2007. Performance testing of these sensors consists of: 1) noise floor measurements at both an urban site and a seismically-quiet site; 2) cross-axis measurements on a linear shake table, at strong-motion levels to 1 g; 3) field measurements of known rotations using the NEES SFSI Test Structure at Garner Valley; and 4) field measurements of microtremor and earthquake ground motions at existing seismic array site GVDA (Garner Valley Downhole Array). Results of these tests are analyzed not only to characterize the performance of these specific sensors but also to define performance-envelope needs for rotational sensor deployments.