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# A Study on the Performance of Low Cost MEMS Sensors in Strong Motion Studies

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Recent advances in sensors have helped the growth of local networks. In recent years, many Micro Electro Mechanical System (MEMS)-based accelerometers have been successfully used in seismology and earthquake engineering projects. This is basically due to the increased precision obtained in these downsized instruments. Moreover, they are cheaper alternatives to force-balance type accelerometers.
In Turkey, though MEMS-based accelerometers have been used in various individual applications such as magnitude and location determination of earthquakes, structural health monitoring, earthquake early warning systems, MEMS-based strong motion networks are not currently available in other populated areas of the country. Motivation of this study comes from the fact that, if MEMS sensors are qualified to record strong motion parameters of large earthquakes, a dense network can be formed in an affordable price at highly populated areas. The goals of this study are 1) to test the performance of MEMS sensors, which are available in the inventory of the Institute through shake table tests, and 2) to setup a small scale network for observing online data transfer speed to a trusted in-house routine.
In order to evaluate the suitability of sensors in strong motion related studies, MEMS sensors and a reference sensor are tested under excitations of sweeping waves as well as scaled earthquake recordings. Amplitude response and correlation coefficients versus frequencies are compared. As for earthquake recordings, comparisons are carried out in terms of strong motion(SM) parameters (PGA, PGV, AI, CAV) and elastic response of structures (Sa). Furthermore, this paper also focuses on sensitivity and selectivity for sensor performances in time-frequency domain to compare different sensing characteristics and analyzes the basic strong motion parameters that influence the design majors.

Results show that the cheapest MEMS sensors under investigation are able to record the mid-frequency dominant SM parameters PGV and CAV with high correlation. PGA and AI, the high frequency components of the ground motion, are underestimated. Such a difference, on the other hand, does not manifest itself on intensity estimations. PGV and CAV values from the reference and MEMS sensors converge to the same seismic intensity level. Hence a strong motion network with MEMS sensors could be a modest option to produce PGV-based damage impact of an urban area under large magnitude earthquake threats in the immediate vicinity.