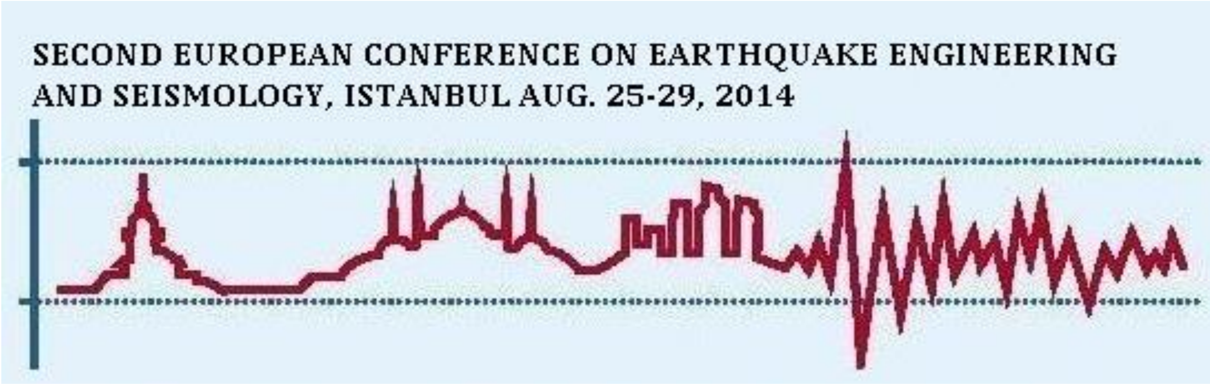


# POTENTIAL OF SMART PHONES IN SEISMOLOGY AND STRUCTURAL HEALTH MONITORING

H. Serdar KUYUK[1] and Muharrem AKTAS[2]

Smart phones sensors have the potential to be the next walking stations for earthquake early warning systems or for structural health monitoring. When we think that current advanced traditional seismic networks only have stations every 10 km, walking stations would be the next great improvement. Smart phones can provide intensity of an earthquake to emergency responders and may provide invaluable information to track frequency changes of structural vibration. In recent years, many Apps made available to use acceleration of phone sensors from earthquake detection to structural health monitoring. Researchers use mobile phone apps to collect, share or process data for technical, scientific as well as educational purposes. There are challenges to use the smartphones for the purpose due to high self-noise and low signal to noise ratio of the sensors. Although challenges are substantial such as unknown goodness and robustness of data, smart phones still have the potential to transform seismology particularly real-time seismology.

In this study, three sensors, a high, a low cost and those in smart phones are employed to investigate the reliability of mobile phones to detect ground vibration. Data obtained from low-cost and smart phone sensors are compared with reference Capacitive Force Micromachined (with 32-bit high resolution, and 120 db dynamic range) strong motion sensors. Sinusoidal forced vibration induced to a unidirectional shake table with frequency ranging from 0.1 to 4 Hz and with an amplitude ranging from 0.1 to 1 g. Amplitudes obtained from both tested and reference sensors are subtracted to calculate amplitude residuals that are used to investigate frequency dependency. Moreover, the ability of smart phones to identify the frequency content of complex ground motion is investigated. To do so, an artificial non-stationary synthetic signal series with a sum of various time varying frequency functions containing sine signals are applied to uni-directional shake table and response is recorded. Records from three sensors are used to investigate their frequency content in time domain with wavelet analysis that can detect abrupt frequency changes in a non-stationary signal.

The frequency limits, for which mobile phones are successful to distinguish, are reported and their potential to capture frequency content of ground motion is discussed in detail. Furthermore, sensitivity and level of instrumental self-noise, effects of variability of sample per seconds of smart phones, resolution of records, frequency and phase responses are also discussed. Hence this study concludes with information regarding to usability of smart phones to capture ground motion by addressing their frequency and amplitude boundaries along with recommendation for future Apps developments in seismic studies.

[1] Asst. Prof. Dr., Sakarya University, Sakarya, Turkey, serdarkuyuk@gmail.com
[2] Asst. Prof. Dr., Sakarya University, Sakarya, Turkey, maharrema@sakarya.edu.tr