Geophysical Research Abstracts
Vol. 16, EGU2014-7700-3, 2014
EGU General Assembly 2014

Parametric and Non-Parametric Vibration-Based Structural Identification Under Earthquake Excitation

Fragkiskos P. Pentaris (1) and George N. Fouskitakis ()

(1) Dept. of Electronic and Computer Engineering, Brunel University, Uxbridge,UK, (2) Dept. of Electronic Engineering, Technological Educational Institute of Crete, Chania, Crete, Greece

The problem of modal identification in civil structures is of crucial importance, and thus has been receiving increasing attention in recent years. Vibration-based methods are quite promising as they are capable of identifying the structure's global characteristics, they are relatively easy to implement and they tend to be time effective and less expensive than most alternatives [1]. This paper focuses on the off-line structural/modal identification of civil (concrete) structures subjected to low-level earthquake excitations, under which, they remain within their linear operating regime. Earthquakes and their details are recorded and provided by the seismological network of Crete [2], which "monitors" the broad region of south Hellenic arc, an active seismic region which functions as a natural laboratory for earthquake engineering of this kind. A sufficient number of seismic events are analyzed in order to reveal the modal characteristics of the structures under study, that consist of the two concrete buildings of the School of Applied Sciences, Technological Education Institute of Crete, located in Chania, Crete, Hellas. Both buildings are equipped with high-sensitivity and accuracy seismographs – providing acceleration measurements – established at the basement (structure's foundation) presently considered as the ground's acceleration (excitation) and at all levels (ground floor, 1st floor, 2nd floor and terrace). Further details regarding the instrumentation setup and data acquisition may be found in [3]. The present study invokes stochastic, both non-parametric (frequency-based) and parametric methods for structural/modal identification (natural frequencies and/or damping ratios). Non-parametric methods include Welch-based spectrum and Frequency response Function (FrF) estimation, while parametric methods, include AutoRegressive (AR), AutoRegressive with eXogeneous input (ARX) and Autoregressive Moving-Average with eXogeneous input (ARMAX) models[4, 5]. Preliminary results indicate that parametric methods are capable of sufficiently providing the structural/modal characteristics such as natural frequencies and damping ratios. The study also aims – at a further level of investigation – to provide a reliable statistically-based methodology for structural health monitoring after major seismic events which potentially cause harming consequences in structures.

Acknowledgments

This work was supported by the State Scholarships Foundation of Hellas.

References

[1] J. S. Sakellariou and S. D. Fassois, "Stochastic output error vibration-based damage detection and assessment in structures under earthquake excitation," Journal of Sound and Vibration, vol. 297, pp. 1048-1067, 2006.

[2] G. Hloupis, I. Papadopoulos, J. P. Makris, and F. Vallianatos, "The South Aegean seismological network – HSNC," Adv. Geosci., vol. 34, pp. 15-21, 2013.

[3] F. P. Pentaris, J. Stonham, and J. P. Makris, "A review of the state-of-the-art of wireless SHM systems and an experimental set-up towards an improved design," presented at the EUROCON, 2013 IEEE, Zagreb, 2013.

[4] S. D. Fassois, "Parametric Identification of Vibrating Structures," in Encyclopedia of Vibration, S. G. Braun, D. J. Ewins, and S. S. Rao, Eds., ed London: Academic Press, London, 2001.

[5] S. D. Fassois and J. S. Sakellariou, "Time-series methods for fault detection and identification in vibrating structures," Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, vol. 365, pp. 411-448, February 15 2007.