ASSESSMENT OF ENVIRONMENTAL EFFECTS FOR VIBRATION-BASED DAMAGE DETECTION OF HISTORIC MASONRY TOWERS

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Structural Health Monitoring (SHM) [1] is generally defined as a multi-disciplinary process involving: (a) the repeated or continuous measurement of the response of a structural system through arrays of appropriated sensors; (b) the extraction from measured data of features, which are representative of the health condition and (c) the statistical analysis of these features to detect any novelty or abnormal change in the investigated system.

Among the different SHM approaches, the one based on the continuous measurement of the dynamic response is especially suitable to masonry towers as those structures are generally sensitive to ambient excitation and exhibit a cantilever-like dynamic behaviour, so that the successful monitoring of the dynamic characteristics can be obtained by permanently installing a few high-sensitivity accelerometers (or seismometers) in the upper part of the building [2-5]. On the other hand, masonry towers are very common Cultural Heritage buildings in Italy and often exhibit high vulnerability to seismic actions, as it has been dramatically testified also by the recent Italian events, such as the ones hitting the Emilia region in 2012 and the Central Italy in 2016.

The use of a limited number of sensors and automated Operational Modal Analysis (OMA) in SHM implies the choice of resonant frequencies as features to be assumed as representative of the structural condition. Since the modal frequencies are also sensitive to factors other than structural changes − such as the environmental conditions − and especially the temperature might affect the variation of resonant frequencies in ancient towers [2-5], an effective approach of damage detection and SHM should include the removal (or minimization) of the temperature effects on identified frequencies.

The paper firstly focuses on selected results obtained by continuously monitoring the dynamic response of three historic towers in Italy [2], [4-5] in order to highlight the possible effects of changing temperature on the resonant frequencies; subsequently, the removal of environmental effects (needed for an effective performance assessment and damage detection) is addressed and discussed using the data acquired on a challenging historic tower.

References

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