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# Vibration based identification of historical structures by machine learning under dynamic events and atmospheric conditions

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Experience gained from long-term vibration monitoring of historical structures underlines the importance of assessment and definition of the normality of a structure prior to any decision or prediction about its damage state. The modal parameters of masonry structures undergo transient variations under low amplitude excitation sources such as small seismic events, strong winds and explosions. Atmospheric factors such as temperature, wind, humidity and precipitation also influence modal parameters leading to seasonal and even daily periodic changes. In certain cases the level of variations induced by atmospheric conditions become comparable to those caused by natural or man-made hazards. Therefore for a reliable damage assessment, structure specific identification and evaluation of dynamic response parameters over long-periods of time becomes very important. In this respect, machine learning techniques are efficient tools to relate the changes in modal parameters and/or vibration levels to damage states while taking the structural response to atmospheric conditions into account, as with the help of such algorithms modal parameters can be reliably predicted making use of past data. In this study, these ideas are presented with real-life examples from five historical monuments in Istanbul instrumented with structural health monitoring systems, namely Hagia Sophia Museum, Sultanahmet Mosque, Süleymaniye Mosque, Fatih Mosque and Mihrimah Sultan Mosque.