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Damage evaluation on a multi-story framed structures: comparison of results retrieved from algorithms based on modal and non-modal parameters

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Continuous monitoring based on vibrational identification methods is increasingly employed with the aim of evaluate the state of the health of existing structures and infrastructures and to evaluate the performance of safety interventions over time. In case of earthquakes, data acquired by means of continuous monitoring systems can be used to localize and quantify a possible damage occurred on a monitored structure using appropriate algorithms based on the variations of structural parameters. Most of the damage identification methods are based on the variation of few modal and/or non-modal parameters: the former, are strictly related to the structural eigenfrequencies, equivalent viscous damping factors and mode shapes; the latter, are based on the variation of parameters related to the geometric characteristics of the monitored structure whose variations could be correlated related to damage. In this work results retrieved from the application of a curvature evolution based method and an interpolation error based method are compared. The first method is based on the evaluation of the curvature variation (related to the fundamental mode of vibration) over time and compares the variations before, during and after the earthquake. The Interpolation Method is based on the detection of localized reductions of smoothness in the Operational Deformed Shapes (ODSs) of the structure. A damage feature is defined in terms of the error related to the use of a spline function in interpolating the ODSs of the structure: statistically significant variations of the interpolation error between two successive inspections of the structure indicate the onset of damage. Both methods have been applied using both numerical data retrieved from nonlinear FE models and experimental tests on scaled structures carried out on the shaking table of the University of Basilicata.

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