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Damage detection and quantification using mode curvature variation on framed structures: analysis of the preliminary results

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Continuous monitoring based on vibrational identification methods is increasingly employed for the evaluation of the state of health of existing buildings after strong motion earthquake. Different damage identification methods are based on the variations of damage indices defined in terms modal (eigenfrequencies, mode shapes, and modal damping) and/or non-modal parameters. Most of simplified methods for structural health monitoring and damage detection are based on the evaluation of the dynamic characteristics evolution associated to the fundamental mode of vibration of a monitored structure. Aim of this work is the upgrade of an existing method for damage localization on framed structures during a moderate/destructive earthquake. The existing version of the method is based on the comparison of the geometric characteristics (with particular reference to the mode curvature) exhibited by the structures, related to fundamental mode of vibration, before and during an earthquake. The approach is based on the use of a nonlinear filter, the band-variable filter, based on the Stockwell Transform able to extract the nonlinear response of each mode of vibration. The new version of the method provides the possibility to quantify a possible damage occurred on the monitored structure linking the mode curvature variation with the maximum inter-story drift. This paper shows the preliminary results obtained from several simulations on nonlinear numerical models of reinforced concrete framed structures, designed for only gravity loads, without and with the presence of infill panels. Furthermore, a correlation between maximum mode curvature difference and maximum inter-story drift has been defined for the different numerical models in order to quantify the structural damage.

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