Structural Damage Identification based on the Curvature Matrix of the Accelerance

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ABSTRACT

In this work, a damage identification method based on the curvature-matrix of the Frequency Response Function-FRF is proposed. This is used in the formulation of two indices to predict the damage location and to estimate the severity of the damage in a framed structure. To evaluate the effectiveness of the method, numerical simulations are performed in different damage scenarios simulated in a one-storey, one-bay frame using Timoshenko beam elements. The structural damage is simulated by reducing the shear and flexural stiffness of selected elements. The FRF-Accelerance for the undamaged and damaged frame is numerically obtained with the frequencies and mode shapes of the lower modes. The curvature of the Accelerance is calculated numerically using finite differences, based on an expansion of the Taylor series. The results obtained from the finite element numerical simulations indicate that the proposed indices can locate and estimate the damage severity for single damage scenarios in the analyzed frame. Although errors in the quantification of damage severity were obtained, for practical engineering purposes these could be acceptable. The proposed damage indices could serve as an alternative to the traditional techniques of damage identification through modal analysis.