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Structural Damage Detection via Incomplete Model Data Using Output Data Only

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Abstract : Structural failure is caused mainly by damage that often occurs on structures. Many researchers focus on obtaining very efficient tools to detect the damage in structures in the early state. In the past decades, a subject that has received considerable attention in literature is the damage detection as determined by variations in the dynamic characteristics or response of structures. This study presents a new damage identification technique. The technique detects the damage location for the incomplete structure system using output data only. The method indicates the damage based on the free vibration test data by using “Two Points - Condensation (TPC) technique”. This method creates a set of matrices by reducing the structural system to two degrees of freedom systems. The current stiffness matrices are obtained from optimization of the equation of motion using the measured test data. The current stiffness matrices are compared with original (undamaged) stiffness matrices. High percentage changes in matrices’ coefficients lead to the location of the damage. TPC technique is applied to the experimental data of a simply supported steel beam model structure after inducing thickness change in one element. Where two cases are considered, the method detects the damage and determines its location accurately in both cases. In addition, the results illustrate that these changes in stiffness matrix can be a useful tool for continuous monitoring of structural safety using ambient vibration data. Furthermore, its efficiency proves that this technique can also be used for big structures.

Keywords : damage detection, optimization, signals processing, structural health monitoring, two points–condensation
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