

A Simple Approach to Reliability Assessment of Structures via Anomaly Detection

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Abstract : Operational Modal Analysis (OMA) is widely applied as a method for Structural Health Monitoring for structural damage identification and assessment by tracking the changes of the identified modal parameters over time. Unfortunately, modal parameters also depend on such external factors as temperature and loads. Any structural condition assessment using modal parameters should be done taking into consideration those external factors, otherwise there is a high chance of false positives. A method of structural reliability assessment based on anomaly detection technique called Mahalanobis Squared Distance (MSD) is proposed. It requires a set of reference conditions to learn healthy state of a structure, which all future parameters are compared to. In this study, structural modal parameters (natural frequency and mode shape), as well as ambient temperature and loads acting on the structure are used as features. Numerical tests were performed on a finite element model of a carbon fibre reinforced polymer composite beam with delamination damage at various locations and of various severities. The advantages of the demonstrated approach include relatively few computational steps, ability to distinguish between healthy and damaged conditions and discriminate between different damage severities. It is anticipated to be promising in reliability assessment of massively produced structural parts.

Keywords : operational modal analysis, reliability assessment, anomaly detection, damage, mahalanobis squared distance

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