Prospects of Structural Damage Identification Using Modal Analysis and Anomaly Detection

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Structural Health Monitoring *Operational Modal Analysis* *Anomaly Detection*

Abstract Structural health monitoring (SHM) has significant importance in providing reliability, safety, and economical sensibility for structures. High sensitivity and precision of SHM techniques can be quite demanding. Some SHM testing procedures require structures, for example, wind turbine blades or aircraft structures, to be taken out of operation, which increases costs and causes downtime. Other techniques include sophisticated signal processing and data analysis, which require skilled personnel. An alternative is to use a form of system identification technique called Operational Modal Analysis, during which an operator performs structural vibration measurements without disrupting normal operation of structure.

The aim of the current study is to develop a machine learning algorithm, which is able to identify damaged states of a structure, based on the assessment of its modal parameters. The assessment of the structural health is performed using machine learning technique called Anomaly Detection. The proposed method establish a description of normality using features representing undamaged conditions and then test for abnormality which indicates presence of damage in structure. Structure under test is one-meter-long laminated composite beam. The finite element model of the beam is developed using eight-node shear-deformable shell elements. Damage in the beam is introduced as delamination between the plies representing 5% of the total area of the beam. Numerical modal analysis is carried out to obtain modal frequencies and corresponding mode shapes for the first three bending modes of both the healthy and damaged beams. The results of the numerical experiments show possibilities of the proposed structural health monitoring method to identify damage in composite structures under varying modal parameters.

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1.6 Other	☐

2. Environment

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2.2 High operating temperatures	☐
2.3 Ageing	☐
2.4 Corrosion	☐
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2.6 Other	☐

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5. Approach/Method

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