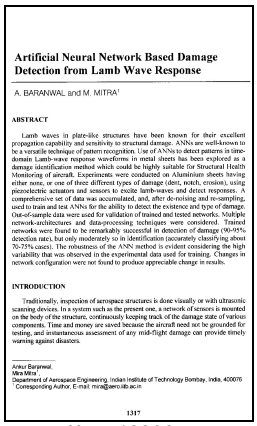

Artificial Neural Network Based Damage Detection from Lamb Wave Response

A. BARANWAL and M. MITRA[1]

ABSTRACT

Lamb waves in plate-like structures have been known for their excellent propagation capability and sensitivity to structural damage. ANNs are well-known to be a versatile technique of pattern recognition. Use of ANNs to detect patterns in time-domain Lamb-wave response waveforms in metal sheets has been explored as a damage identification method which could be highly suitable for Structural Health Monitoring of aircraft. Experiments were conducted on Aluminium sheets having either none, or one of three different types of damage (dent, notch, erosion), using piezoelectric actuators and sensors to excite lamb-waves and detect responses. A comprehensive set of data was accumulated, and, after de-noising and re-sampling, used to train and test ANNs for the ability to detect the existence and type of damage. Out-of-sample data were used for validation of trained and tested networks. Multiple network-architectures and data-processing techniques were considered. Trained networks were found to be remarkably successful in detection of damage (90-95% detection rate), but only moderately so in identification (accurately classifying about 70-75% cases). The robustness of the ANN method is evident considering the high variability that was observed in the experimental data used for training. Changes in network configuration were not found to produce appreciable change in results.

INTRODUCTION

Traditionally, inspection of aerospace structures is done visually or with ultrasonic scanning devices. In a system such as the present one, a network of sensors is mounted on the body of the structure, continuously keeping track of the damage state of various components. Time and money are saved because the aircraft need not be grounded for testing, and instantaneous assessment of any mid-flight damage can provide timely warning against disasters.

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Код: 10399

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Издательство DEStech Publications, Lancaster, 2011 год

8 стр; формат: 23,5 x 16 см; библиографический список: 6 единиц
ISBN: 978-1-60595-053-2

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Ключевые слова:

Содержание.