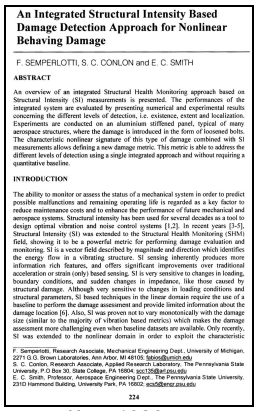

An Integrated Structural Intensity Based Damage Detection Approach for Nonlinear Behaving Damage

F. SEMPERLOTTI, S. C. CONLON and E. C. SMITH

ABSTRACT

An overview of an integrated Structural Health Monitoring approach based on Structural Intensity (SI) measurements is presented. The performances of the integrated system are evaluated by presenting numerical and experimental results concerning the different levels of detection, i.e. existence, extent and localization. Experiments are conducted on an aluminium stiffened panel, typical of many aerospace structures, where the damage is introduced in the form of loosened bolts. The characteristic nonlinear signature of this type of damage combined with SI measurements allows defining a new damage metric. This metric is able to address the different levels of detection using a single integrated approach and without requiring a quantitative baseline.

INTRODUCTION

The ability to monitor or assess the status of a mechanical system in order to predict possible malfunctions and remaining operating life is regarded as a key factor to reduce maintenance costs and to enhance the performance of future mechanical and aerospace systems. Structural intensity has been used for several decades as a tool to design optimal vibration and noise control systems [1,2]. In recent years [3-5], Structural Intensity (SI) was extended to the Structural Health Monitoring (SHM) field, showing it to be a powerful metric for performing damage evaluation and monitoring. SI is a vector field described by magnitude and direction which identifies the energy flow in a vibrating structure. SI sensing inherently produces more information rich features, and offers significant improvements over traditional acceleration or strain (only) based sensing. SI is very sensitive to changes in loading, boundary conditions, and sudden changes in impedance, like those caused by structural damage. Although very sensitive to changes in loading conditions and structural parameters, SI based techniques in the linear domain require the use of a baseline to perform the damage assessment and provide limited information about the damage location [6]. Also, SI was proven not to vary monotonically with the damage size (similar to the majority of vibration based metrics) which makes the damage assessment more challenging even when baseline datasets are available. Only recently, SI was extended to the nonlinear domain in order to exploit the characteristic

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Ключевые слова:

Содержание.

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