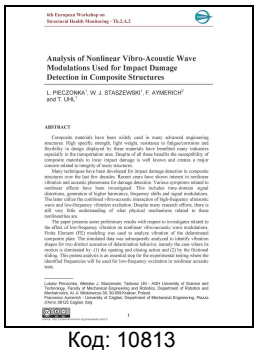

Код: 10813

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Analysis of Nonlinear Vibro-Acoustic Wave Modulations Used for Impact Damage Detection in Composite Structures

Дрезден, Германия, 2012 год

7 стр; формат: 23,5 x 16 см; библиографический список: 17 единиц

Composite materials have been widely used in many advanced engineering structures. High specific strength, light weight, resistance to fatigue/corrosion and flexibility in design displayed by these materials have benefited many industries especially in the transportation area. Despite of all these benefits the susceptibility of composite materials to incur impact damage is well known and creates a major concern related to integrity of many structures.

Many techniques have been developed for impact damage detection in composite structures over the last few decades. Recent years have shown interest in nonlinear vibration and acoustic phenomena for damage detection. Various symptoms related to nonlinear effects have been investigated. This includes time-domain signal distortions, generation of higher harmonics, frequency shifts and signal modulations. The latter utilize the combined vibro-acoustic interaction of high-frequency ultrasonic wave and low-frequency vibration excitation. Despite many research efforts, there is still very little understanding of what physical mechanisms related to these nonlinearities are.

The paper presents some preliminary results with respect to investigates related to the effect of low-frequency vibration on nonlinear vibro-acoustic wave modulations. Finite Element (FE) modeling was used to analyze vibration of the delaminated composite plate. The simulated data was subsequently analyzed to identify vibration shapes for two distinct scenarios of delamination behavior, namely the case where its motion is dominated by: (1) the opening and closing action and (2) by the frictional sliding. This pretest analysis is an essential step for the experimental testing where the identified frequencies will be used for low-frequency excitation in nonlinear acoustic tests.

Доклад. 6-я Европейская конференция по мониторингу технического состояния сооружений, 2012. Редакция Кристиана Боллера.

Ключевые слова:

Содержание