

Simulations of acousto-ultrasonics in bonded assemblies: parametric study.

Adhesive joints are increasingly used for instance in bonded assemblies for engineering applications. Despite their advantages, the effectiveness of bonded joints can be compromised due to the presence of adhesion defects or damage in the joint. Moreover, the performance and durability of an adhesive bond depends on the stability of the interface between the adhesive and the adherend. Consequently, a development of non-destructive testing (NDT) techniques becomes necessary to assess the quality of the joint.

In this context, the acousto-ultrasonic (AU) method for detecting and identifying defects in bonded assemblies and monitoring their evolution over time is used. The acousto-ultrasonic technique is a combination of ultrasonic (UT) and acoustic emission (AE) testing. The technique uses an ultrasonic pulser to generate a stress wave and at least one AE receiver. The analysis is based on the traditional acoustic emission analysis. The acousto-ultrasonic approach provides a potential alternative to use acoustic emission and ultrasonic techniques, alternating active and passive control.

The aim of our study is to evaluate and to validate the ability of the acousto-ultrasonic technique (AU) to identify several types of defects or damage in model bonded assemblies. Several parameters may affect the method such as for instance the size of the specimen, choice of sensor, position of the sensor, characteristic of the emitted signal. Based only on experimental tests, it is not possible to determine the influence of all of these parameters. Numerical methods would allow to go further and to establish a quantitative relationship between the signal and the kind of defect.

Several parameters need to be investigated: - the characteristics of the emitting source (for instance Chirp type or mono-frequency signals), - the nature of the defects in the adhesive joint, - the boundary conditions, - the sensor and actuator locations - the measurement noise, - the aging of the bond, - the effect of damage in substrates, - the effect of the substrates compared to the joint.

The objective of the project is to simulate the acousto-ultrasonic signal using finite elements (Abaqus software) in order to study the influence of a possible joint defect and establish a link between the defect characteristic (for instance size, shape) and the signal descriptors.

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