4.1.17. IMPACT DETECTION IN A COMPOSITE TAIL BOOM STRUCTURE WITH ULTRASONIC IMAGING AND GUIDED WAVES TECHNIQUES

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Sandwich components with thin skins of GFRP or CFRP and honeycomb cores are high performance components for aerospace structures with high specific. However these materials are impact sensitive.

The DLR part of the EU-project AISHA II (Aircraft integrated structural health assessment) is focused on a full-scale test of a 3.5 m long tail-boom oft the EC 135. This component consists of a honeycomb sandwich structure with CFRP and GFRP-skins.

For field inspections ultrasonic echo-technique has been further developed to for a one side access. The honeycomb structure only penetrates frequencies below 1 MHz. Because of the high sound attenuation, the excitation is carried out by a square burst transmitter. The harmonics and the scattering of the material are suppressed on the receiver side by filters. The C-scans clearly show the damaged areas.

A scanning technique like ultrasonic imaging is time consuming and therefore expensive. In opposite to longitudinal waves Guided Waves provide a global propagation and can easily be excited and received by piezo patches. Such a structural health monitoring system provides in principle a push-bottom inspection. However, Lamb waves are dispersive and for each frequency there are two wave modes in minimum so that the received signals are very complex.

A network of 40 piezo-patches has been glued at the inner side of a tail boom half-cell.

In dependence of the exciting frequency several wave modes are generated. There are modes propagating only in the thicker or thinner skin, or in the whole thickness.

In order to get more information about the Lamb wave propagation the wave fields have been scanned using a broadband capacitive sensor as a receiver. The full-wave A-scans are stored in a 3D-file. Out of this data, Lamb wave A-, B-, C- and D-scans and video animations can be calculated. Virtual sensors can be placed in the displayed scanning area and the received signal can be computed. Optimizations of sensor layouts and sensor positions are possible.

Video snap shots show the wave propagation and an interaction with defects like delaminations. The impact causes a mode conversion from the s-mode (fast mode) to the a-mode (slower mode). The a-mode from the excitation piezo-patch and the one from the impact interfere. Therefore the impact detection in the tail boom structure using Guided waves is a challenge.

This paper presents first results of the impact detection using ultrasonic echo-technique and Guided Waves excited and received by piezo patches. After optimization of the pulse parameter the ultrasonic imaging technique delivers a clear indication of impacts. The received signals of Guided Wave techniques are very complex due to mode conversions and reflections. The next step will be the development and application of mono mode sensors.