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TITLE: AUTOMATIC ANALYSIS OF ULTRASONIC DATA FOR LARGE AND COMPLEX CFRP AIRCRAFT COMPONENTS

ABSTRACTS

Automated analysis is increasingly used in the aerospace industry to efficiently process the tremendous amount of data generated by automated or robotized UT inspections. Major time savings and reliability improvements can be expected from automated approaches. However, their application on large and complex CFRP structures in a context of production still faces numerous challenges: analysis of 3D parts with 2D tools and criteria, defect detection in steep thickness variations, in the complex geometric features’ vicinity or close to the interfaces.

This paper describes a method for the automated analysis of ultrasonic data and its deployment on various carbon fiber reinforced plastics (CFRP) parts constituting the aft fuselage of Airbus A220 aircraft. The method was specifically designed to overcome the obstacles encountered for such large and complex structures. A program based on existing tools of the commercial software Ultis® was created and optimized to achieve a fully automated process, including thickness measurement, porosity assessment, defect detection and report generation.

New pre- and post-processing tools were developed and added to the main Ultis® program, such as a C-scan projection optimizer that minimizes defects distortion during 3D to 2D transition. An approach was proposed for the efficient segmentation of complex parts which allows challenging features such as co-cured stringers, ply drop-offs or multiple thickness variations to be addressed within the same program. A novel defect detection algorithm capable of automatically extracting the relevant indications from a collection of A-scans was also developed. This algorithm is adaptive and takes local thickness and signal variations into account. It complements Ultis® native detection tools by yielding significantly better results for defects close to the backwall surface.

The overall automated method was tested on CFRP reference panels containing a variety of artificial defects (various sizes, depths and materials) as well as on real complex structures of the Airbus A220: the rear pressure bulkhead and the aft fuselage skins. Detection performance is discussed, including considerations about probability of detection, number of false positives and analysis time. Results suggest that the method meets the detection requirements, even for challenging defects and areas, while significantly reducing the analysis time.

KEYWORDS

Ultrasonics | Automated data analysis | CFRP composites | Aerospace |