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# A nondestructive investigation of inserts in lightweight composite panels by ultrasonic C-scan and infrared thermography

H. Zhang[1], S. Sfarra[2], M. Genest[3], C. Ibarra-Castanedo[1], X. Maldague[1],
*[1]Department of Electrical and Computer Engineering, Computer Vision and Systems Laboratory, Laval University, 1065 av. de la Medecine, Quebec, G1V 0A6, Canada. [2]Department of Industrial and Information Engineering and Economics, Las.E.R. Laboratory, University of L'Aquila, Piazzale E. Pontieri no. 1, L'Aquila (AQ), I-67100, Italy. [3]Aerospace Portfolio, Structures, Materials and Manufacturing, National Research Council Canada, 1200 Montreal Road, Ottawa, K1A 0R6, Canada*

In the aeronautical industry, there is an increasing need for lightweight composites above all for the internal design. In this regard, the final products should not contain any inclusion of foreign material in order to not compromise both the aesthetical beauty and the mechanical properties subjected to vibrational loads. In this work, the infrared thermography (IRT) and the ultrasonic C-scan (UT) methods were used to retrieve the unknown positions of sub-superficial inserts in five lightweight composite panels. They were randomly inserted during the manufacturing stage. In particular, the samples investigated herein are three glass fiber reinforced polymers (GFRP) and two carbon fiber reinforced polymers (CFRP) used as laminates or as skins for honeycombs. They were provided by the Società Elicotteristica Italiana (S.E.I.), Monteprandone (Italy).

An example is reported in Fig. 1. It shows both the schematization of the cross-section and the front view of a honeycomb core (HC) covered with two skins of GFRP.

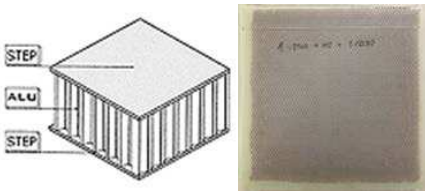


Figure 1. An example of HC covered with two skins of GFRP investigated herein. In this case, the inner defects are unperceivable to the naked eye.

A comparison between two different approaches centered on square pulse and flash thermographic scenarios is reported. The raw thermograms were processed by using advanced techniques such as the principal component thermography (PCT) and the partial least square thermography (PLST) which enhanced the visibility of the defects. In addition, the UT method applied both in reflection and in transmission modes were showed interesting advantages from a diagnostic point-of-view above all when its results are compared with the thermographic results. Fig. 2 shows the clear detection (see the blue area) of a defect realized in plastic material, having an unknown size, and positioned inside the HC.

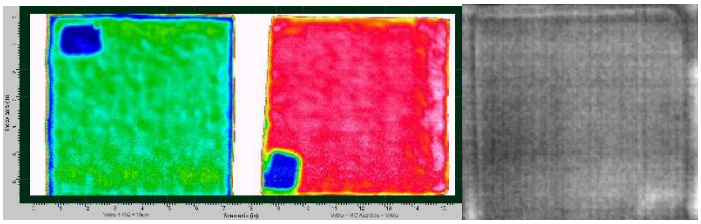

Figure 2. An example of UT and IRT results inherent to the sample reported in Fig. 1

Pros and cons of both methods when applied on lightweight composite panels will be in-depth explained into the final manuscript.