Flash Thermography of Composites: Evaluation of Advanced Post-Processing Approaches

Gaétan Poelman[a,b] , Saeid Hedayatrasa[a,b] , Joost Segers[a] , Wim Van Paepegem[a] and Mathias Kersemans[a]

[a] *Department of Materials, Textiles and Chemical Engineering (MaTCh), Ghent University, Technologiepark-Zwijnaarde 46, 9052 Zwijnaarde, Belgium*

[b] *SIM Program M3 DETECT-IV, Technologiepark Zwijnaarde 48, B-9052 Zwijnaarde, Belgium*

Gaetan.Poelman@UGent.be

Abstract

Carbon fiber reinforced polymers (CFRP) are composite materials that offer a high stiffness-to-weight ratio in comparison to traditional metals, which explains their increasing use in many high-end applications (e.g. aerospace). However, composites are prone to internal damage that may deteriorate the structural integrity, and thus require reliable and non-destructive testing (NDT) approaches. Infrared thermography (IRT) is a promising NDT technique which provides fast, full-field measurements, and in which hidden defects are detectable based on their thermal signatures.
In flash thermography (FT), which is the thermographic technique of interest for this contribution, the component's surface temperature is rapidly elevated through the application of an intense optical flash. Subsequent recording of the cooling down of the stimulated surface, by means of a high-end infrared camera, allows to detect defects by searching for anomalies in the surface temperature (due to heat build-up above the defect). Considering the anisotropic diffusivity and high damping of thermal waves in CFRP, advanced post-processing techniques are indispensable to detect deep defects (> 2 mm in CFRP).
In this paper, FT is performed on several CFRPs with various defects (flat bottom holes, Teflon inserts and barely visible impact damage). This thermographic dataset is then analyzed using various post-processing techniques, including pulsed phase thermography (PPT), principal component thermography (PCT), thermographic signal reconstruction (TSR) and dynamic thermal tomography (DTT), in order to improve the defect detectability and assessment. The performance of the employed processing techniques is critically evaluated.
Acknowledgements: The authors acknowledge both the Research Foundation Flanders (FWO grants 12T5418N and 1148018N) and the SBO project DETECT-IV (Grant no. 160455), which fits in the SIM research program MacroModelMat (M3) coordinated by Siemens (Siemens PLM software, Belgium) and funded by SIM (Strategic Initiative Materials in Flanders) and VLAIO (Flemish government agency Flanders Innovation & Entrepreneurship). The authors express their gratitude towards Honda R&D Co. for supplying material for this research.

Keyword optical technique: Flash thermography

Keyword application: Non-destructive testing of composites

I prefer: ☐ POSTER PRESENTATION ☒ ORAL PRESENTATION ☐ NO PREFERENCE

Abstract of the MBL-OPTIMESS 2019 Conference
18(short course),19 and 20 September 2019, Antwerp - Belgium