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Non Destructive Testing of CFRP by active infrared thermography using uncooled IRFPA camera mounted on mobile system

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Transport infrastructures and buildings play a significant role in the economy of countries. However, in European countries, transport infrastructures aging (>40 years) and traffic increase require to develop in-situ efficient reinforcement solutions. Among current practices, mechanical retrofitting by gluing carbon fiber reinforced polymer (CFRP) on structures implies following rigorous installation procedures [1]. Studying and developing fast and efficient non destructive techniques to control the quality of the gluing in outdoor and construction environments is still a field of investigation. In the literature, some methods are proposed to detect and quantify the defects, such as, flash and lock-in thermography techniques [2], pulsed flying spot [3], shearography [4], although thes approaches are mainly developed for in-door industrial applications or in laboratory conditions. Furthermore, these civil engineering structures may have extremely large surfaces to inspect in often difficult condition, hard to reach and remote locations.

Recently, the MIVIM laboratory at Laval University in collaboration with the company Visiooimage inc. have developed and improved the Robotized Inspection by Thermography and Advanced processing (RITA) for the inspection of aeronautical components in the framework of a Canadian-Belgian collaborative project: it is a robotic arm (6-axis) that allows inspection of complex-shaped specimens [5]. In the present study, this system is used to heat a specimen with a linear optical source under two scanning modes (line scan or flying line) while a thermal infrared camera records thermal image sequences. In the line scan method both the heating source and the IR camera move simultaneously while in flying line only the heated source move over the inspected specimen. The line scan approach has also been investigated for a full reinforcement process based on thermoplastic CFRP gluing on concrete structure using a dedicated 4 m linear test bench developed at IFSTTAR [6].

In this paper, we present algorithms developed to reconstruct thermogram whatever the configuration of the moving set-up and an inverse method to estimate the depth map of defects in CFRP specimen. Results obtained are discussed. Finally, conclusion and perspectives are proposed.

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