Automatic inspection of surface breaking cracks using laser scanning thermography

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In this work, we report on a method for automatic inspection of components using laser scanning thermography, in which the relative motion is performed by a robot to fully inspect complex test objects such as turbine blades. We demonstrate our evaluation algorithms with the aim of automatically detecting surface defects on calibrated specimens. We show the influence of the excitation laser, which can be varied in terms of spot geometry, wavelength, and scan scheme. Additionally, we show some advantages, versatility, and current challenges of using a programmed robot for non-destructive evaluation in thermography.

Overview – Schlichting *et al*. [1] proposed an efficient algorithm, based on the Sobel-derivatives along horizontal and vertical directions, to detect surface breaking cracks by analysis of thermographic films obtained from flying spot tests. Recently, we have developed a similar algorithm, based on the Canny approach, for automatic surface defect detection.[2] The detection algorithms are combined with automatic thermographic testing using a previously simulated scanning path in a 3D environment. This allows to visualize and optimize the scanning parameters before actual measurement. Additionally, it improves reproducibility of the tests, because the defined scanning path can be made independent of the positioning of the specimen on the robot arm. However, some limitations in the accuracy of the positioning of the robot arm will be discussed. On the other hand, different configurations of the thermographic setup can be combined with such a robot arm: A blue laser is a better alternative compared to a NIR laser for testing some metals, like Cu. The scanning parameters, such as scanning speed, input power, spot dimension, camera frame rate might be optimized for the crack sizes one is looking for. The aim will be to have a 3D representation of the detected surface defects on the CAD model of the tested specimen.

References

[1] J. Schlichting, M. Ziegler, A. Dey, C. Maierhofer, M. Kreutzbruck. Efficient data evaluation for thermographic crack detection. Quant. Infrared Thermogr. J. 8 (2011) 119-23. https://doi.org/10.3166/qirt.8.119-123.

[2] N.W. Pech-May, M. Ziegler, Surface breaking crack detection algorithm for flying spot and line thermography based on the Canny approach. SPIE Future Sensing Technologies 2021: Proc. SPIE (2021). https://doi.org/10.1117/12.2603913.