Defect Detection in Composite Materials by Thermographic Software

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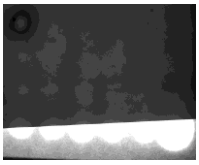
This research flyer demonstrates how thermographic inspection techniques and software analysis can detect defects in composite materials, particularly the highly relevant impact damage. Composite materials are increasingly being used for surface transport such as buses, trucks, trams and trains. The benefits of using composite materials over conventional materials like steel and aluminium are that they offer the potential for higher strength and stiffness together with superior corrosion immunity, lower weight and a reduction in cost. However, the materials and structures are non-homogeneous meaning that traditional monitoring and analyses are unsuitable for the detection, and characterisation, of composite defects. Composite materials are particularly susceptible to impact damage that may not be visible to surface inspection, hence, the importance of NDT techniques like thermography and the ability for thermographic software to detect defects .

Aim of Thermographic Software Analysis of Defects in Composite Materials

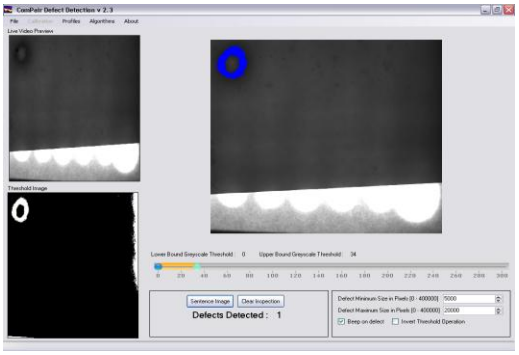
The purpose of KCC's involvement is to develop software that is easy for inspection engineers to use, can profile different defect types and can automatically detect, and ideally characterise, potential defects in inspected composite materials. In particular, this case study relates to the software detection of thermographic inspections of impact related defects that are particularly hazardous to the health of products made with composites.

Impact Damage in Composite Material Detected using Thermographic Software

The thermographic NDT technique relies on the defect, or anomaly, being revealed as a temperature difference between the sound structure and the defect. The test strategy requires an external source of energy to produce heat in the structure with the resulting heat transfer producing thermal energy that is propagated through radiation. The emissivity produces a thermographic image, in this case, detected by a Near-Infra Red (NIR) inspection.

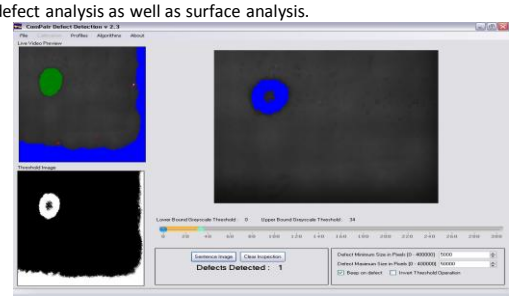


Impact defect I1 is shown on the left as a raw NIR image and was provided courtesy of G-Tronix Ltd. The impact is the result of a 60J load acting over a circular area of 6.5mm.



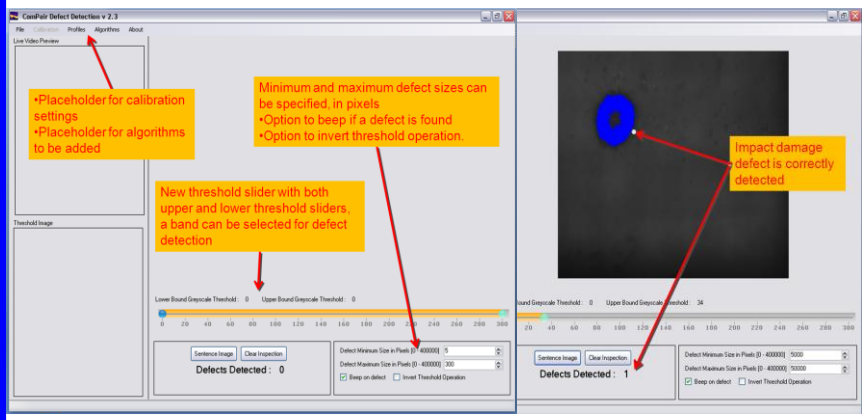
Impact damage images on a 6mm thick Glass Fibre laminated prepreg (test sample provided by Hexel) was captured using thermographic techniques in the form of a raw NIR image. This has been correctly analysed with KCC's thermographic software. The images above relate to an image taken from the top side and those below refer to the same defect taken from the underside. Importantly, while the impact damage is only visible from one side, the software detects it in both thermographic images . Hence, thermography software defect detection is proven for sub-surface defect analysis as well as surface analysis.

Impact defect I1 back is shown n the left , again a raw NIR image provided by G-Tronix Ltd, is the same impact related defect I1 but imaged from the underside.



Detection Features of the KCC Thermographic Software

The software interface and functionality has been designed to assist engineering analysis of composite materials using thermographic techniques with a particular emphasis made to detect impact related defects. Impact related defects require algorithms to identify the particular greyscale band that characterises impact damage with a specific composite material. Hence, a greyscale threshold slider was developed that enabled selection of the target greyscale, the capture of this as a "Profile" and a pixel-defined area so a specific defect size can be identified. The KCC thermography software successfully detects defects caused by impact damage.



The screenshots above highlight the areas of interest in the newly developed user interface for the ComPair project in light of the data that are available at the present time and allowing for the development of future algorithms.

Conclusion

The KCC Sentence software successfully identified an impact related defect on a glass fibre laminated composite using a raw NIR image. This confirms defects can be automatically detected in composite materials using thermographic software.

Thus calibrated, a profile was recorded for impact damage and this successfully identified other impact related defects. In addition, although the impact damage is visible from only one side, the thermographic approach detected the defect in images taken from alternate sides proving that the technique is capable of sub-surface analysis.

Acknowledgements

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The funding is under the aegis of the Seventh Framework Programme, which includes surface transport and aeronautics.

http://www.compairproject.com/

For more information on defect detection of impact damage in composite materials by thermographic software see the following websites:

www.kccltd.com, • www.compairproject.com • www.twi.co.uk • www.gtronix.co.uk

For composite materials see www.hexcel.com