6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Damage detection in two-dimensional plates via infrared thermography

Manuel Pena[1] and María–Luisa Rapún*[1]

[1] E.T.S.I. Aeronáutica y del Espacio, Universidad Politécnica de Madrid,
Madrid 28040, Spain,
m.penar@alumnos.upm.es, marialuisa.rapun@upm.es

Keywords: *Inverse Problems, Thermography, Damage Detection, Topological Derivative*

Recently, active infrared thermography has been used for the detection and characterization of defects (cavities, cracks, inclusions) in a wide range of fields, including medical, building, and aircraft structures diagnosis. When applied to damage detection in metallic plates, the method consists on heating the piece to be inspected with some kind of lamp, getting a thermogram (a color image produced by a thermal camera) of the surface of the piece. Thermograms are then studied to try to determine the properties of the media that may have gave that response. In this way, information from the whole surface can be collected very fast. In comparison with other remote testing techniques, like ultrasonics, thermographic inspection is safer, more non-intrusive and non-contact. However, on the other hand, heat transport is short range and the associated signal to noise ratio is less favorable than in other techniques. Therefore, in many cases, efficient data processing tools are required to successfully interpret thermograms.

In this talk we propose to process thermograms by using a mathematical tool called topological derivative. This derivative can be interpreted as an indicator function of the location, shape and size of the defects. It is a one-step method that does not need any a priori information about the size, number or shape of the defects. It has already been used in a two dimensional thermal propagation problem in an unbounded media in [1] with very good results. In this work we will use it to process steady and time-harmonic thermograms. We will show how to efficiently combine thermograms corresponding to several positions of the lamp and/or several frequencies by implementing some ideas proposed in [2]. Some numerical experiments corresponding to flawed aluminium plates will be shown.

REFERENCES

[1] A. Carpio and M.L. Rapún, Domain reconstruction using photothermal techniques. *Journal of Computational Physics*, Vol. **227**, pp. 8083-8106, 2008.

[2] J.F. Funes, J.M. Perales, M.L. Rapún and J.M. Vega, Defect detection from multifrequency limited data via topological sensitivity. *J. Math. Imaging Vis.*, Vol. **55**, pp. 19-35, 2016.