Engineering Fracture Mechanics 183 (2017) iii–iv

Contents lists available at ScienceDirect

Engineering Fracture Mechanics

journal homepage: www.elsevier.com/locate/engfracmech

Editorial

Special Issue on 'Modern Imaging Techniques in Fracture and Damage Analyses': Selected papers from the 21st European Conference of Fracture (ECF 21), held in Catania, Sicily, Italy, on 20–24 June 2016

This Special Issue of Engineering Fracture Mechanics contains selected papers invited on the basis of presentations made at the 21st European Conference on Fracture (ECF 21), held in Catania, Sicily, Italy, 20–24 June 2016. The Conference was very successful being accompanied by beautiful views, ambience and weather. This conference was officially recognised by the European Structural Integrity Society (ESIS). It was organised by Francesco Iacoviello (IGF President), Giuseppe Andrea Ferro, Donato Firrao and Luca Susmel as Chairmen. Support for the conference organisation was also provided by the MTS, GOM, Instron, Anton Paar, w+b ag, Rumul, Italsigma and was run by the Italian Group of Fracture. The conference provided an interactive forum with about 650 delegates from 44 countries. There were over 660 paper presentations most of which are described in a special issue of Procedia Structural Integrity.

The conference covered a very diverse range of topics. One theme that emerged as a relatively new and exciting topic for ECFs was the use of imaging/full-field techniques and for this reason we decided to invite attendees to contribute to a collection of papers that cover this topic as a special issue.

The 14 papers selected for this special issue demonstrate the wide range of full-field/imaging methods now being exploited to better understand the behaviour of fracture. Methods such as high resolution X-ray diffraction, thermoelasticity/thermography [pp. 1–12, pp. 13–25, pp. 53–65], 2D [pp. 26–38, pp. 39–52, pp. 53–65, pp. 79–83, pp. 94–108, pp. 109–124] and 3D [pp. 125–146] digital image correlation (DIC), confocal laser scanning microscopy [pp. 147–158] and X-ray microtomography [pp. 159–169, pp. 170–179] and laminography [pp. 180–189] are now being used to map the total or elastic strain fields, stress fields or to image crack propagation, damage mechanisms, crack opening displacements or to identify and quantify key crack-tip shielding mechanisms. In many cases these full field measurements are being combined with numerical modelling of the crack-tip stress field [pp. 39–52, pp. 170–179, pp. 66–78] to turn such full field image data into key fracture mechanics parameters.

Of course thermoelastic stress mapping is a well-established technique – here it is used to look at the effect of repair and reinforcement strategies on the stress distribution around fatigue cracks [pp. 1–12]. The period of last 10 years has seen an explosion in the use of DIC to provide total crack-tip strain fields at the surface of materials with software and camera developments radically improving the strain mapping accuracy. Even more recently 3D imaging methods have been combined to provide 3D images of displacement or total strain fields. Indeed, one of the strength of majority of the full-field imaging methods covered in this special issue is that they can be applied to a very wide range of materials from metals and alloys (e.g. [pp. 94–108, pp. 170–179]), to elastomers [pp. 79–93], to fiber reinforced composites [pp. 39–52], to marble [pp. 109–124] and bone [pp. 125–146]. Further, at the conference we heard how the spatial resolution of X-ray diffraction is sufficient to image the elastic strain field local to cracks for direct correlation with the plastic strain recorded by DIC. X-ray tomography and laminography are able to provide complementary information about the defects that give rise to failure or the morphology, or opening of the primary or nucleation of secondary microcracks during crack propagation. In this respect, the paper [pp. 180–189] is noteworthy in using high resolution synchrotron radiation X-ray laminography to study cracks generated by rolling contact fatigue because the crack opening is typically small and the cracks hard to detect. By acquiring images non-destructively at various stages of loading these techniques allow the measurement of crack closure and crack opening and the local crack driving force compared to that nominally applied.

http://dx.doi.org/10.1016/S0013-7944(17)30938-4

This collection of papers highlights an exciting future direction of fracture studies complementing conventional far-field crack parameters with local full-field maps or images of the 2D exterior surface or whole 3D body. We are sure that this emerging topic will shine even more brightly in Belgrade at ECF22 and we look forward to catching up on progress then.

Andrea Spagnoli
Università di Parma, Italy

Youshi Hong
Institute of Mechanics, Chinese Academy of Sciences, China

Giacomo Risitano
Università di Messina, Italy

Luca Susmel
University of Sheffield, UK

Philip J. Withers
Manchester University, UK

Vittorio Di Cocco
Università di Cassino e del Lazio Meridionale, Italy