

Guest editorial: Characterization of crack tip fields

Joint special issues of the *International Journal of Fatigue* (IJFatigue, Elsevier) and *Fatigue & Fracture of Engineering Materials & Structures* (FFEMS, Wiley) containing selected and fully peer-reviewed papers from the 6th IJFatigue and FFEMS Joint Workshop on Characterisation of Crack and Notch Tip Fields held in Dubrovnik, Croatia, over April 12–14, 2022.

The sixth workshop in this series that focusses on crack and notch tip fields had originally been intended to be held in 2021, but in the light of the unavoidable travel disruptions heralded by the Covid pandemic, the organizing committee decided to postpone the meeting until 2022. Delegates could then choose to attend either online or in-person, with most of the delegates sensibly deciding that the whole purpose of this type of workshop rests in the personal discussion and its interactive nature, and therefore attended in person. This allowed them to experience the historic city of Dubrovnik and the coastline of Croatia, as well as exchange ideas to further understanding of crack and notch tip fields.

For the last 50 years, single-parameter characterization of the crack/notch tip field using fracture mechanics parameters like K , J , or $CTOD$ has been extremely powerful in advancing predictive technologies for critical or subcritical crack growth. It has also become clear over recent decades that the approximation inherent in single-parameter approaches has limitations, particularly in dealing with crack growth phenomena arising from crack tip shielding. This has naturally led to a considerable research effort toward alternative approaches to understand the physics of fatigue crack growth rate, determine better similitude parameters, and predict remnant life. Endeavors have ranged across, for example, energy, plastic zone size or area, and multiparameter models. These research endeavors have been greatly aided by the development and availability of advanced full-field experimental measurement techniques, including digital image correlation (DIC), thermographic stress analysis, and electronic speckle pattern interferometry (ESPI) for 2D and 3D measurements of crack and notch tip fields.

While the research future seems brighter than it has ever been in terms of instrumentation, numerical modeling, and even crack tip field models, interaction between people working with different techniques and ideas on

similar problems remains fairly elusive. It was with this in mind that this workshop series was started in 2011 in Forni di Sopra, Italy, with strong support from the Italian Fracture Group. Subsequent conferences have taken place in Malaga, Spain (2013); Urbino, Italy (2015); Bonifacio, Corsica, France (2017); Heidelberg, Germany (2019); and now Dubrovnik, Croatia (2022).

The workshop has retained the successful format, based on a largely invited group of delegates, of allowing adequate time for discussion after each paper and after each session, if possible. The conference committee firmly believe that time for delegate interaction after each session is key to encouraging networking and the development of new ideas. A final overall discussion session summarizes the work presented and focuses on identifying key themes for future research. In common with previous workshops, the major remaining problem areas were identified:





- Understanding accuracy, repeatability, compatibility, and correlation between various experimental techniques is a key to making further progress as two techniques can often be used in combination on a single specimen to enhance the information obtained.
- The use of multiple full-field experimental measurement techniques (volumetric as well as surface) has to be encouraged along with interaction with numerical modeling groups.
- Incorporating nonlinearity effects on the physics of crack growth into models is crucial if further advances are to be made in predicting fatigue crack growth mechanisms.
- Fatigue is, by its nature, a chaotic process, and incorporation of the theories of chaos may lead to new insights into (at least) a better probabilistic framework for life prediction based on better crack physics models.
- Harmonizing the needs of engineering applications with academic research is somewhat of a Cinderella topic in the fatigue community, and promoting a better interaction between the two would be valuable.

The papers selected for these joint special issues of IJFatigue and FFEMS present a range of research that

illustrates both the complexity of the topic and presents some of the current research endeavors that are giving detailed consideration to a number of these aspects.

The next IJFatigue and FFEMS Joint Workshop on Characterisation of Crack Tip Fields is proposed to take place in Padua, Italy, in 2024, and details will be circulated closer to the time.

Finally, the guest editors of this special issue warmly thank all the delegates and authors for their contributions and hope that this overview of current thinking in the area of crack and notch tip fields in relation to fatigue and fracture is useful for the research community.

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