VI International Conference on Computational Modeling of Fracture and Failure of Materials and Structures (CFRAC 2019)
12-14 June 2019, Braunschweig, Germany

Theory of fracture, crack propagation criteria and crack tracking algorithms

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In brittle or quasi-brittle materials under complex loading condition the nucleation and propagation of cracks is still under an extensive investigation. The key issue is given by the difficulty to predict the crack path, in particular when multiple loads are acting and the crack is expected to manifest unstable behaviors. Theory of fracture tries to describe mathematically the complex physics of the process, characterized by the change of topology due to the formation of new surfaces with unknown location and orientation. Theoretical formulations can be taken as the basis of numerical algorithms where the accuracy of the solution can be monitored or controlled.
Propagation of cracks satisfy physical criteria expressing the local attainment of the ultimate strength of the material. Recent formulations based on energetic reasoning opened an interesting avenue for the definition of new algorithms. Popular numerical techniques are based on finite element discretization, where fracture is described explicitly by reproducing newly created surfaces. Surfaces are inserted between solid elements, or cross solid elements. Phase-field approaches are attracting attention for the easiness of the implementation. Boundary element techniques have been also used with satisfactory results. Recent approaches disregard the presence of a classical mesh, avoiding the complication of disconnecting volume elements. Advanced numerical models of fracture are based on multi-scale descriptions and in some cases integrate different numerical techniques.
In this mini-symposium we would like to bring together researchers and scientist that are working on new theoretical approaches and advanced numerical algorithms to explore possible future developments of numerical methods for crack nucleation and crack tracking. New algorithms and new approaches are welcome, as well as improvement and applications of well settled formulations.