The Shifted Fracture Method

Kangan Li[1], **Antonio Rodríguez-Ferran**[2], **Guglielmo Scovazzi**[1*]

[1] Department of Civil and Environmental Engineering, Duke University, Durham NC 27708, U.S.A.
guglielmo.scovazzi@duke.edu
[2] Laboratori de Càlcul Numèric (LaCàN), Universitat Politècnica de Catalunya, Barcelona, Spain

We propose the Shifted Fracture Method (SFM), a new framework for computational fracture mechanics, which is based on the idea of an approximate fracture geometry representation combined with approximate interface conditions.

Our approach evolves from the shifted boundary method [1] and the interface method [2], and introduces the concept of an approximate fracture surface composed of the full edges/faces of an underlying grid that are geometrically close to the true fracture geometry. The original interface conditions are modified on the surrogate fracture, by way of Taylor expansions, to achieve a prescribed level of accuracy.

The SFM does not require cut cell computations or complex data structures, since the behavior of the true fracture is mimicked with specific integrals on the approximate fracture. Furthermore, the energetics of the true fracture are represented within the prescribed level of accuracy and independently of the grid topology.

The computational framework will be presented in its generality and then applied in the specific context of cohesive zone models, with an extensive set of numerical experiments.

We demonstrate in particular how the SFM correctly captures the energy released as the fracture propagates, independently of the grid geometry.

We also show how the SFM can be combined with phase-field approaches to simulate crack branching and merging.

References

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