On sharp-interface cohesive models with a relaxed bulk energy

Andrea Rodella*[1], Corrado Maurini[2], Jean-Jacques Marigo[3], and Stefano Vidoli[1]

[1]Università degli Studi di Roma "La Sapienza" – Italy
[2]Institut Jean Le Rond dÁlembert – Sorbonne Universite, Sorbonne Université – France
[3]Institut Jean Le Rond dÁlembert – Sorbonne Universite, Sorbonne Université – France

Abstract

This study investigates the challenge of unrealistic stress predictions that arise when associating cohesive interface energy with standard linear elasticity, building upon findings in (1). We focus on anti-plane elasticity under mode III loading, leveraging the Linear Elastic Fracture Mechanics (LEFM) solution (2). The traditional approach can lead to situations where predicted stress components exceed the fracture strength of the material.

To address this, we incorporate a relaxed bulk energy approach from (3). This approach utilizes a quadratic law for small strains, transitioning to linear growth upon reaching a critical strain threshold specific to the material. This modification ensures a well-posed problem, paving the way for a viable solution.

We validate our approach through numerical simulations showcasing crack nucleation and propagation along a predefined path. The results show adherence to the stress yield condition, supporting the effectiveness of our methodology in overcoming the limitations of the traditional approach.

Reference

(1) Marigo, J.-J., "Modelling of fracture by cohesive force models: A path to pursue", European Journal of Mechanics - A/Solids, 102, 105088, (2023).
(2) Abdelmoula, R., Marigo, J.-J., Weller, T., "Construction d'une loi de fatigue à partir d'un modèle de forces cohésives : cas d'une fissure en mode III", Comptes Rendus Mécanique, 337, 53-59, (2009).
(3) Braides, A., Buttazzo, G., and Bouchitté, G., "Relaxation results for some free discontinuity problems", Journal für die reine und angewandte Mathematik, 458, 1-18, (1995).

*Speaker