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Validation simulations for the variational approach to fracture.

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Abstract

In this article, we focus of the validation of Francfort and Marigo's variational approach to fracture based on some classical fracture experiments. We show that this approach can be used to faithfully account for unknown crack paths even for complex loadings and geometry. We revisit the backtracking algorithm, aimed at avoiding some spurious local minimizers of the total fracture energy and introduce a variant, the deep backtracking algorithm.

Keywords: Variational approach to fracture, brittle fracture, validation, phase-field methods

1. Introduction

The modeling of crack geometry (path) has been one of the most challenging and elusive aspects of fracture mechanics and has captured the interest of scientists in different disciplines for many years. The difficulty in this endeavor is two-fold: deriving proper models capable of predicting potentially complex unknown crack paths, and coming up with numerical schemes capable of dealing with the unknown crack geometry without remeshing. The later issue has been tackled with some success by methods based on enriching the approximation space trough cohesive [51, 62] or extended [7, 49] finite elements, or non-local approximations based on phase-fields [38, 47, 46], level sets [3, 12] or eigendeformation [58].

Francfort and Marigo's variational approach to fracture [30, 18, 19] aims at addressing both issues simultaneously by providing a rigorous model derived from Griffith's concept of energy restitution between bulk and surface energies, and providing an efficient numerical implementation capable of handling complex unknown crack path. Over the past decade, this approach was applied to

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