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ANISOTROPIC MESH ADAPTATION FOR THE CRACK PATH DETECTION IN QUASI STATIC BRITTLE MATERIALS

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In the quasi-static brittle fracture setting, a realistic numerical detection of crack paths is a challenging issue. We deal with the Francfort-Marigo model which requires minimizing the well-known Mumford-Shah functional. To deal with a smoother functional, we consider the Γ-approximation of the Francfort-Marigo model via the Ambrosio-Tortorelli functional. From a modeling viewpoint, the quasi-static approximation is dealt with by assuming that the crack is induced by an applied displacement slowly changing in time.

It is a well-established fact that simulations are often biased by the numerical discretization, usually leading to non-realistic results. In particular, a non-optimal computational mesh may force the fracture to evolve along a non-physical direction, following the edges of the triangulation. This issue can be successfully tackled by resorting to anisotropic adapted meshes, which allow one to obtain solutions reliable from a physical viewpoint and with a relatively small computational cost.

To drive mesh adaptation, we propose a specific theoretical tool, i.e., an a-posteriori anisotropic estimator for a suitable discretization error of the functional. Through anisotropic meshes we are able to locate, size and orient the mesh elements in order to follow the intrinsic directionalities of the solution at hand. For this reason, these meshes are successfully employed to model phenomena exhibiting strongly directional features. This justifies our choice of employing anisotropic meshes to follow crack propagation.

In this talk, after introducing the Ambrosio-Tortorelli model in the case of plane-strain elasticity, we focus on the anisotropic mesh adaptation strategy. We finally assess the reliability and efficiency of the proposed approach on some benchmark tests.