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Regularised Fracture Models Based on Representative Crack Elements

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The energetic description of a crack dates back to Griffith, who has related the required energy to create a crack increment to the available potential energy in the system. A variational formulation of the crack problem

$$\mathcal{E}(\boldsymbol{u}, \mathcal{B}^\Gamma) = \int_{\mathcal{B}\setminus\mathcal{B}^\Gamma} \psi(\nabla \boldsymbol{u}) \, \mathrm{d}V + \int_{\mathcal{B}^\Gamma} \phi(\llbracket \boldsymbol{u} \rrbracket) \, \mathrm{d}A \rightarrow \min_{\boldsymbol{u}, \mathcal{B}^\Gamma} \tag{1}$$

is known as *free discontinuity problem*, where the size and location of the crack domain $\mathcal{B}^\Gamma$ is unknown. Two regularisations for this problem have been developed and are applied to fracture, namely phase-field fracture [1] and eigenfracture [2].

The prediction of the crack state (opened/closed) and the forces, which can be transferred through a crack, are essential for the post-fracture behaviour but also for the calculation of the potential energy available to drive the crack. The authors have proposed to determine the deformation kinematics of a crack from discrete crack models and to couple them to the regularised fracture model by means of computational homogenisation. We have derived efficient numerical solution schemes for this *Representative Crack Models* in the context of phase-field fracture [3] and eigenfracture [4].

In this talk, we focus on the application to material and geometrical nonlinearities and we compare numerical Γ-convergence of the energy terms in Eq. (1) to common phase-field and eigenfracture models.

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