
A Griffith description of fracture for non-monotonic loading conditions and its phase-field implementation

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Abstract

In the first part of this talk, I will present a generalization of the classical Griffith energy competition for crack growth in nominally elastic brittle materials to arbitrary *non-monotonic* quasistatic loading conditions, which include monotonic and cyclic loadings as special cases. Centered around experimental observations, the idea consists in: i) viewing the critical energy release rate G_c *not* as a material constant but rather as a material function of both space \mathbf{X} and time t , ii) one that decreases in value as the loading progresses, this solely within a small region around crack fronts, with the characteristic size l of such a region being material specific, and iii) with the decrease in value of G_c being dependent on the history of the elastic fields in said small region. By construction, the proposed Griffith formulation is able to describe any Paris-law behavior of the growth of large cracks in nominally elastic brittle materials for the limiting case when the loading is cyclic. For the opposite limiting case when the loading is monotonic, the formulation reduces to the classical Griffith formulation. I will illustrate additional properties of the proposed formulation via a parametric analysis and direct comparisons with representative fatigue fracture experiments on a ceramic, mortar, and PMMA. In the second part of the talk, I will present the formulation of a phase-field theory of nucleation and propagation of fracture that is consistent with the new Griffith description of crack growth.

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