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A MODEL FOR THE QUASISTATIC EVOLUTION OF CRACKS WITH SPURS OF SUPERCRITICAL PROPAGATION

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ABSTRACT

We present a mathematical model for the quasistatic evolution of cracks that may present spurs of supercritical propagation, in two dimensions. We consider a body with an initial crack that evolves due to a pre-defined loading plan parameterized by some loading parameter. A classical quasistatic evolution would indicate that the crack grows by satisfying Griffith's criterion together with some directional condition, such as the Principle of Local Symmetry. During these evolutions, it is possible for the crack to display "spurs" of supercritical propagation, that is, the crack grows a finite length for an infinitesimal increment of the loading parameter. Dynamic fracture considerations may become important, and the quasistatic model does not have a prediction for the crack path under these conditions.

With the hypothesis that in some situations dynamic effects do not significantly affect the propagation path, we introduce a model that extends the classical quasistatic evolution above and allows the energy release rate at the crack tip to be larger than the surface energy, thus enabling the appearance of spurs of supercritical propagation. The model incorporates the possibility of crack arrest and kinking. In the presentation we will discuss the salient features of the model, and illustrate its predictions by computing the propagation of thermally-driven cracks on thin plates, and some comparisons with experimental results.

REFERENCES

[1] Chiaramonte, M. M., Grossman-Ponemon, B. E., Keer, L. M., & Lew, A. J. (2020). Numerical analyses of crack path instabilities in quenched plates. *Extreme Mechanics Letters*, 40, 100878.