Three-dimensional fracture growth as a standard dissipative system: some general theorems and numerical simulations

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ABSTRACT

Crack propagation in brittle materials has been studied by several authors exploiting its analogy with standard dissipative systems theory. In recent publications, minimum theorems were derived in terms of crack tip “quasi static velocity” for two-dimensional fracture mechanics. Following the cornerstone work of Rice on weight function theories, Leblond and coworkers proposed asymptotic expansions for stress intensity factors in three dimensions. In view of the expression of the expansions proposed by Leblond, however, symmetry of Ceradini’s theorem operators was not evident and the extension to 3D of outcomes proposed in 2D not straightforward. Following a different path of reasoning, minimum theorems have been finally derived. Moving from well-established theorems in plasticity, algorithms for crack advancing have been finally formulated. Their performance is here presented within a set of classical benchmarks.