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Disorder of the Front of a Tensile Tunnel – Crack Propagating in Some Inhomogeneous Medium

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We study the time evolution of the shape of the front of a tunnel-crack loaded in mode I and propagating quasistically according to some Paris-type law in some inhomogeneous material. The two parts of the front are assumed to remain symmetrical for simplicity, and differ only slightly from straight lines at each instant, and a first-order perturbation approach is used. The degree of geometrical disorder of the front is evaluated via the autocorrelation function of the perturbation. It is found that this autocorrelation function increases without bound for large times. Its rate of growth is much larger than for the problem, envisaged by Rice and coworkers, of a semi-infinite crack propagating dynamically in a brittle medium with random toughness. This difference essentially arises from presence of some characteristic length in the problem envisaged here, namely the mean half-width of the crack. This induces an effect of instability of crack front perturbations with large wavelengths which is typical of finite crack geometries.

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