

Intermittent crack dynamics in heterogeneous materials

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ABSTRACT

The dynamics of a planar crack propagating within a brittle disordered material is investigated. We perform experiments where a crack is made propagated at the interface between a thick PDMS layer and a rigid substrate patterned with heterogeneities of controlled size, density and strength. The large velocity fluctuations of the front shown on the spatio-temporal diagram of lower panel of Fig. 1 are investigated at the scale of the material heterogeneities. They are shown to be reminiscent of the pinning/depinning evolution of a long-range elastic line driven in a random array of defects. The critical comparison between experiments and theoretical predictions evidences the central role played by the overhangs present along the front (see the top panel of the Fig. 1) that significantly alter the nature of the intermittency emerging from the collective pinning of the crack. Our results also shed light on the statistics of velocity fluctuations measured in other experiments of crack propagation in disordered materials.

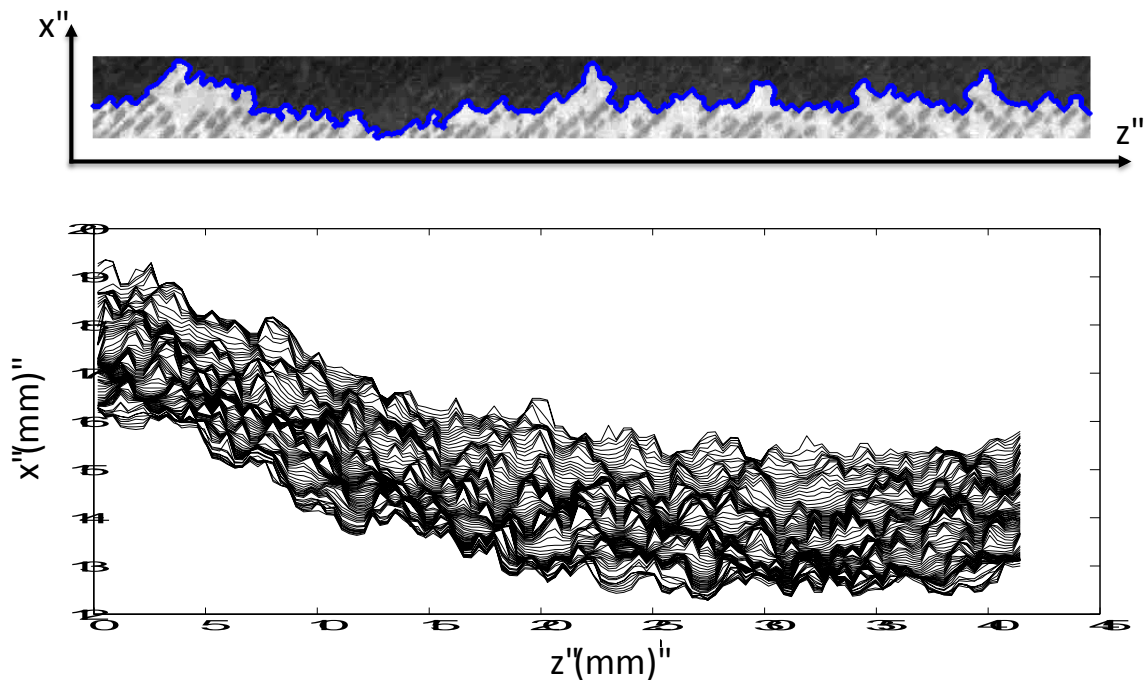


Fig. 1: The top panel represents a typical snapshot of the crack front (in blue) pinned by randomly located heterogeneities (in grey). The lower panel shows the spatio-temporal evolution of the front in the fractured plane. The dark regions correspond to a large waiting time, respectively a low velocity, while the light grey regions correspond to the low waiting time, respectively a low crack speed.