

# Interplay between Process Zone and Material Heterogeneities for Dynamic Cracks

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## ABSTRACT

In the context of dynamic fracture propagation along an heterogeneous domain, it has been shown in [1] how the presence of small-scale heterogeneities can impact the rupture dynamics of a crack. In the particular case of a mode-II crack propagating along a line, evidences that such heterogeneities facilitate the supershear transition mechanism have been provided. The macroscopic behavior is controlled by the interaction between the microstructure and the process zone size, which is the intrinsic length scale controlling heterogeneous dynamic rupture. It has also been shown that the shortening of the process zone size with increasing crack speed allows an interaction with smaller heterogeneities. The work of [2] presents the interaction of slip fronts with a heterogeneous pattern of stripes aligned within the direction of the crack propagation for a three-dimensional system. In this case, the process zone size is again the lengthscale controlling the rupture dynamics.

In this study, we extend these earlier works to the general case of a dynamic crack propagating along a 2D plane, with various patterns of heterogeneities. Using an elastodynamic boundary integral formulation coupled with a cohesive zone model, we systematically study the interaction of the crack front with such microstructure. Occurrence of supershear transition and front distortion are extensively investigated for several heterogeneities patterns, starting from a regular checkerboard to random microstructure distributions.

## REFERENCES

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- [2] Kammer, D.S., Pino Muñoz, D. and Molinari, J-F. Length scale of interface heterogeneities selects propagation mechanism of frictional slip fronts. *J. Mech. Phys. Solids* (2016) **88**:23-34