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Cracks dynamics under tensional stress – a DEM approach

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Breaking and fragmentation of solid materials is an extremely complex process involving scales ranging from an atomic scale (breaking inter-atomic bounds) up to thousands of kilometers in case of catastrophic earthquakes (in energy scale it ranges from single eV up to 10^{24} J). Such a large scale span of breaking processes opens lot of questions like, for example, scaling of breaking processes, existence of factors controlling final size of broken area, existence of precursors, dynamics of fragmentation, to name a few. The classical approach to study breaking process at seismological scales, i.e., physical processes in earthquake foci, is essentially based on two factors: seismic data (mostly) and the continuum mechanics (including the linear fracture mechanics). Such approach has been gratefully successful in developing kinematic (first) and dynamic (recently) models of seismic rupture and explaining many of earthquake features observed all around the globe. However, such approach will sooner or latter face a limitation due to a limited information content of seismic data and inherit limitations of the fracture mechanics principles. A way of avoiding this expected limitation is turning an attention towards a well established in physics method of computational simulations – a powerful branch of contemporary physics. In this presentation we discuss preliminary results of analysis of fracturing dynamics under external tensional forces using the Discrete Element Method approach. We demonstrate that even under a very simplified tensional conditions, the fragmentation dynamics is a very complex process, including multi-fracturing, spontaneous fracture generation and healing, etc. We also emphasis a role of material heterogeneity on the fragmentation process.