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# Predicting Crack Paths Using 'Elastic Charges'

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## Abstract

Predicting crack trajectories remains a central challenge in theoretical fracture mechanics, primarily due to the non-local and history-dependent nature of crack propagation. In this study, we introduce a novel theoretical framework that represents cracks as distributions of elastic charges, which can be effectively approximated by charges localized at the crack tip. This framework captures the non-local nature of cracks while enabling a simplified, point-like description of crack dynamics akin to the treatment of particle motion in Newtonian mechanics.

We apply this framework to predict crack trajectories in two distinct scenarios. First, we analyze crack propagation in residually stressed flat sheets, using the framework to predict crack paths in elastomer sheets containing dislocations. Second, we extend our approach to tearing in thin sheets, incorporating mode III cracks, and apply it to the well-known "poster problem."

Our predictions demonstrate excellent agreement with experimental observations, highlighting the potential of this approach to advance our understanding of crack dynamics.

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