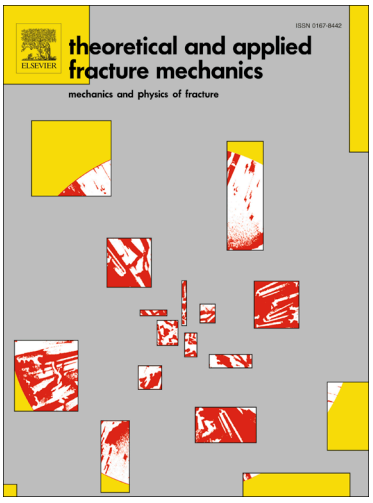


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# Frictional Crack Initiation and Propagation in Rocks under Compressive Loading

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## Abstract

Crack initiation and propagation in a brittle material such as a rock are affected by the friction between crack surfaces. Choosing an appropriate fracture criterion for frictional crack surfaces plays an important role in determining fracture parameters. To this end, a two-dimensional crack propagation code (TDCPC) was developed in this study based on the displacement discontinuity method (DDM) to predict the crack propagation path under the effect of friction. In this study, three classes of fracture criteria were defined: 1) classical fracture criteria (maximum tangential stress criterion, minimum strain energy density criterion, and maximum strain energy release rate criterion) under mixed mode loading without the effect of friction (CFC-I-II), 2) classical fracture criteria under the pure mode II (shear fracturing) without the effect of friction (CFC-II), and 3) the Swedlow criterion which takes into account the effect of friction between crack surfaces (SW-II). A special element (Swedlow-element) was developed and used in the displacement discontinuity method to predict crack trajectories under the effect of friction. The Swedlow criterion was developed to study the fracture process under bi-axial loading. Results indicated that CFC-I-II are not valid for frictional crack surfaces. Crack propagation paths predicted by CFC-II and SW-II under uniaxial loading proved that friction coefficient has a significant effect on the crack initiation angle (the first stages of the crack propagation path), and away from the crack tip, CFC-II and SW-II almost have the same path. For bi-axial loading, crack propagation paths predicted by SW-II deviate away from the original crack as friction coefficient is increased. The stress ratio ($K_o$) and friction coefficient have opposite effects on the crack propagation path. Crack trajectory deviates away from the original crack under the effect of friction coefficient and moves toward the original crack under the effect of the stress ratio. The present study indicated that the results predicted using TDCPC are in good agreement with the experimental and numerical results of other studies.

**Keywords:** Closed crack situation, classical fracture criteria, Swedlow criterion, crack propagation path, friction coefficient, stress ratio.

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