An experimental investigation and numerical simulation on the damage process of rock specimen

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The experimental specimen is a Fangshan (Beijing) marble plate ($2mm \times 6mm \times 12mm$) with a oblique pre-existed crack in one edge under biaxial compression. A fresh crack initiates from the tip of the original crack along a curved path which inaugurates on the direction inclined to the pre-existed crack with fracture angle and eventually tends to the direction of maximum compression load (X.C.Yin, 1987[5]). Using the S-570 Scanning Electron Microscope, the whole meso-scopic damage process including the nucleation, growth, coalition of microcracks and the unstable fracture has been observed and photographed in LNM (Lab of Nonlinear Mechanics, Institute of Mechanics, CAS). Especially the closure or healing phenomenon of some other cracks has been discovered as soon as the mail crack to be formed.

Meanwhile the numerical simulation of damage process for a specimen with the same configuration has been conducted using our discrete element model (Y.C. Wang et al., 1998[4]) based on Mora's lattice model (Peter Mora, 1994[2]). In our model, the material consists of many particles which arranged into triangular lattice and three kinds of interaction between neighboring particles–radial force, tangential force and moment are considered which can be calculated according to the relative radial, tangential and the angular displacements.

The results of both experiment and numerical simulation are coincide to each other quantitatively. It verified the availability of our discrete model to simulate the process of damage and failure of rock which is one of the underlying mechanism of earthquake and other disasters such as landslide, rockburst etc. The experimental results will also help us to improve our numerical model and get more insight into the damage and failure process of brittle solids.

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