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# 脆性岩石破坏的演化细胞自动机(ECA)研究

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**摘要** 演化细胞自动机模型是以细胞自动机方法的基本理论为基础, 结合岩石力学的基本原理提出的。演化细胞自动机模型认为脆性岩石的应力 - 应变关系在细观上符合理想线弹脆性本构关系, 在宏观上则认为脆性岩石材料是一种非均质的材料, 并假定脆性岩石材料的非均质性符合Weibull分布。演化细胞自动机模型突破以往细胞自动机只有一类细胞的限制, 采用包含节点细胞和三角形细胞在内的两类细胞的邻居模型。该方法以位移、力、应力和应变等矢量和张量作为系统的基本变量, 将张量和纯量定义在三角形细胞中, 而将矢量定义在节点细胞上, 两类细胞共同形成细胞空间。在演化细胞自动机系统中, 两类细胞互为邻居, 依据模型所建立的局部作用规则进行演化, 并且按照以修正的莫尔 - 库仑准则为依据建立的破坏演化规则进行破坏演化, 分别考虑了由拉伸和剪切两种原因所引起的破坏情况, 进而实现对脆性岩石材料加载及破坏过程的模拟。

**关键词** [岩石力学; 脆性岩石; 演化细胞自动机; 邻居模型; 莫尔 - 库仑准则](#)

分类号

## STUDY ON EVOLVING CELLULAR AUTOMATA (ECA) TO MODEL CRACK OF BRITTLE ROCK

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### Abstract

Based on the theory of cellular automata, evolving cellular automata (ECA) model is set up considering the fundamental of rock mechanics. In the ECA model, the strain-stress relations of the brittle rock are considered to agree with the perfect elastic constitutive law in meso-cosmic view, but in the macroscopically view, the brittle rock is a kind of nonhomogeneous material and its nonhomogeneous distribution is assumed as Weibull distribution. Breaking out the limit that the CA model only consists of one kind of cell, a neighborhood model with two kinds of cells is brought forward in the ECA model. There in, one is the node cell and the other is triangular cell. Displacement, force, stress and strain are taken as basic variables of the system. The tensor and scalar are defined at the triangular cell and the vector at the node cell. In the ECA system, the triangular cell and the node cell are taken as neighborhoods with each other and evolved according to the local international rules. The tensile failure and shear fracture are taken into account by the triangular cell's evolving followed the failure rules which are on the basis of the modified Mohr-Coulomb criteria. According to the above-mentioned method, the simulation of the loading and failure process are carried into execution.

**Key words** [rock mechanics; brittle rock; evolving cellular](#)

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