Geometry Identification of Fracture Rock for Evaluation of Cavability of Ore Deposits

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ABSTRACT

In an unsupported stope, rock mass caving can happen when the undercut is developed over a sufficient area. Several parameters such as induced stresses, rock mass strength and geometry and strength of rock discontinuity influence rock cavability mechanism. This paper describes a new approach for understanding and estimating geometry of rock blocks created by the planar discontinuities in a rock mass. This algorithm is able to trace and identify all kind of blocks including convex and concave blocks formed by limited or unlimited fractures. Using square matrices with integer elements and performing edge/face regularization step, reduce the size of the necessary matrices due to elimination of unnecessary faces, edges and vertices. Therefore speed and accuracy of block tracing operation will increase. The algorithm was programmed in C#.Net by over 8100 code lines and some cases were modeled by the code as example.

Keywords: Block tracing; DDA; DEM; Cavability; Geometry Identification

INTRODUCTION

Presence of a well extended discontinuity is essential for initiation and development of caving in stopes (Brady and Brown 2004). Dip, Spacing and other parameters of discontinuities are all affecting rock cavability. Combination of a low-dip and another tow steeply dipping sets of discontinuity provide favorable conditions for vertical displacement of rock blocks (Mahtab et al., 1973).

The geological planes, which serve as discontinuities, could be faults, joints, or cracks. Major structural planes such as faults and large joints are the most important discontinuous planes for rock systems. One of the major issues for numerical modeling in rock mechanics and rock engineering is to represent the fracture systems of rock masses as geometrical models. This requires quantitative descriptions of the locations, orientations, sizes, shapes and apertures of all the fractures, their connectivity and the resultant geometry of the rock block assemblage defined by these fractures, using a properly organized data structure for numerical analysis.

Fractures are assumed to be smooth and flat in a limited size which form polygons through a certain or stochastic operation. Fractures are created by their mass center located into a regular form where boundary conditions are taken in the boundaries of this scope. A limited thickness can be attributed to fractures as a similar characteristic to their primary opening in order to analyze physical problems.

Warburton 1983 and Heliot 1984 both introduced the rock blocks detection algorithm for large and unlimited discontinues. These simple algorithms were not able to recognize the concave polyhedral and only the convex polyhedral were formed after recognition and detection. These two algorithms were simple and easy to program. These algorithms are used in 3DEC software (Itasca 1985) as a preliminary processor to generate rock blocks. Assumption of unlimited fracture – where they have limited size in reality – leads to possible formation of more and smaller blocks.

Warburton 1985 introduced a new computer program to calculate the geometry of rock blocks. However no clear algorithm and specific examples was presented. The focus was mainly on method of data inputting and introducing different parts of the program.

Lin et.al 1987 introduced their method, based on the topology and creating a framing to trace rock blocks made from the combination of jointed rock masses. In this method the focus was only on theoretical procedure and no clear algorithm and detail examples were presented.

The concept of topology was used by Shi 1988, Jing and Stephensen 1994 and Jing 2000 in 2D and 3D and a lot of attention was paid on the analytical and theoretical aspects. Concept of simplex and complex were well explained by the researchers, however their application for a computer code would not be an easy task. Moreover these concepts were not