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Delineation of Orientation Data Randomly Distributed in Rock Mass and Its Fractal Dimension

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In order to understand the engineering geological properties of a rock mass, quite a large number of orientation data have been collected from outcrops or adits. Orientation data is composed of dip direction and dip angle, which are also called bivariate parameters. It is hard to deal with bivariate parameters by conventional mathematical analytical solutions. Many methods have been put forward to deal with orientation data by research group of Jilin University in the past few years; some of the results are introduced as follows:

1) Delineation of predominant set of discontinuities

The fundamental method is based on the stereo-projections of discontinuity poles, and then combined with the method of graphic contour lines, probability and statistics or other modern mathematical algorithms, such as fuzzy C-Means, K-Means algorithm based on particle swarm optimization, mutative scale chaos optimization algorithm etc., respectively, to delineate the predominant set of discontinuities. Each of the methods provides a good result; the best methods are recommended.

2) Presentation of orientation data by pole and strike

Presentation of bivariate parameter data is generally by contour map, graphic pole or strike rose, each of which has its own deficiency. The right hand rule of discontinuity strike is accepted, and then the pole and strike rose in the range of 360° is presented in one plot that makes it easier to be understood.

3) Fractal dimension of orientation data

Orientation data is randomly distributed in the rock mass, and its poles are also randomly distributed in the plot of stereo-projection, which is very difficult to be described further, but the density of poles in the plot is indicating a characteristic of the geometric pattern of the discontinuities which influences the mechanical and hydraulic properties of rock mass. However the density of discontinuities set cannot be modelled due to its non-linearity. Compared to a Cantor set, the poles of discontinuities set has the features of self-similarity; the box counting method recommended by Benoit B. Mandelbrot has been applied to calculate the fractal dimension of the discontinuity set; finally the rationality of the fractal dimension and the properties of the fractal dimension value are discussed.