利用地质统计学方法模拟岩石裂隙网络的三维空间分布——以云南个旧高松矿田为例

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中文摘要:裂隙在地学的诸多领域中均具有重要意义，其空间分布可以使用地质统计学方法进行模拟，同时考虑裂隙的方向(走向和倾角)。利用序贯高斯模拟方法可以估计裂隙密度的分布，并根据裂隙密度数值随机产生裂隙位置的空间分布。裂隙方向被划分成若干(非)均等的方向组，将裂隙方向归属到其所属方向组，表示为由若干二值变量组成的指示形式，0和1代表该裂隙方向不属于和属于该组。为了便于计算，减少方向指示变量的成分数目，使用主成分分析法求出方向指示变量的主成分，用普通克里格法估计各主成分的空间分布。把估计果反演为原始的指示形式，并找出其中数值最大的方向组且将其赋值为1。按照对应方向组内裂隙方向的累积密度函数，随机产生裂隙的方向。根据估计结果，将符合一定距离和角度的裂隙元连接为一个裂隙面，从而形成裂隙网络。根据在云南个旧锡矿高松矿田白云岩中进行裂隙网络模拟的应用，可见该方法由于组合了序贯高斯模拟法、普通克里格法和主成分法，可以较好地对岩石裂隙位置和方向进行合理的模拟。

中文关键词:裂隙网络 三维空间分布 地质统计学 个旧锡矿

Three-dimensional Simulation of Rock Fractures by Geostatistical Method: A Case Study of Gaosong Field in Yunnan Province

Abstract:The simulation of fracture distribution is an important problem in various fields of geosciences. To simulate the spatial distribution of fracture networks, this paper proposes a geostatistical method in consideration of their di-rections (strikes and dips). Fracture locations are generated randomly, following fracture density values assigne sequential Gaussian simulation method. Fracture direction is divided into n equal (or unequal) groups, and sample fracture directions are assigned to its corresponding gro Then sample fracture directions are transformed into indicators consisting of n binary variables, where 1 and 0 represents belonging to and not belonging to this group. For calculation convenience, the indicator number is reduced by using the principal component analysis. Then ordinary kriging is employed to estimate the distributions of these principal components. The results are inversed to the original indicator form, and the biggest one is assigned as 1 while the others are assigned as 0. Fracture directions a generated randomly by using the cumulative distribution function of the biggest group. Based on these simulated results, fracture elements can be determined with location direction. At last, fracture elements within the angle and distance tolerances are connected to be one fracture. The case study of the fracture data in Gejiu dolomite of southe Yunnan Province shows that the combination of sequential Gaussian simulation, ordinary kriging and principal component analysis can provide a reasonable simulation res for locations and directions of fractures.