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基于粒子群算法的岩体结构面产状模糊C均值聚类分析

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PARTICLE SWARM OPTIMIZATION ALGORITHM BASED FUZZY C-MEANS CLUSTER ANALYSIS FOR DISCONTINUITIES OCCURRENCE IN ROCK MASS

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摘要 结构面产状分析是进行岩体力学分析及稳定性评价的基础,玫瑰花图、等密度图等传统的图形分析方法较为粗糙,无法对产状数据进行准确分析,采用模糊聚类方法则可以得到较为准确的优势产状,但需要事先指定分组数及初始聚心,且模糊聚类算法为局部寻优算法,初始划分对最终的数据分析结果影响较大。为了得到较为客观的分组结果及优势产状,同时能够针对大量结构面产状数据进行聚类分析,提出了基于粒子群算法的岩体结构面产状模糊C均值聚类算法。采用粒子群算法进行模糊C均值聚类算法初始聚心的求解,在计算过程中可同时确定最佳分组数,避免了人为指定的主观性,克服了模糊C均值聚类算法易陷入局部极小值和对初始划分敏感的不足。最后,通过工程实例中不同方法的聚类效果对比分析该算法的有效性,并将该方法应用于实测结构面产状数据的分析,得到较为符合实际的优势结构面分组。

关键词: 岩体   结构面   模糊C均值聚类   粒子群算法

Abstract： The analysis of occurrence of discontinuities is a basic work for further study on mechanical analysis and stability of rock mass. Traditional analysis of the plot method is insufficient and inadequate. And they are unable to analyze occurrence data of discontinuities accurately. Although the fuzzy cluster method can achieve accurate dominant occurrences, the initial cluster centroids must be given in advance. And the method uses a local optimized algorithm. Different choices of initial guesses of cluster centroids can lead to different partitions of the same data. In order to obtain objective results of classification and the dominant occurrence, a fuzzy c-means cluster analysis method based on the Particle Swarm Optimization(PSO)algorithm is proposed. This hybrid method uses the PSO algorithm to solve the problem. So it can avoid the subjectivity of the initial cluster centroids specified manually, overcome the defects of the fuzzy c-means algorithm such as the local optima and sensitivity to initialization, and analyse the occurrence data efficiently, even if there are a large number of discontinuities. Meanwhile, the optimal cluster number can be determined automatically during the operational process of the algorithm. On the basis of the field measured data from the real rock mass, the proposed approach has been testified to be reliable and reasonable. And the classification and dominant occurrences are more realistic.

Key words： Rock mass   Discontinuity   Fuzzy C-means cluster algorithm   PSO algorithm

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