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Review

A comprehensive review of the use of computational intelligence methods in mineral exploration

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Introduction

Mineral exploration is a process by which it is decided whether or not continuing explorations at the end of each stage t will be cost-effective or not. This decision is dependent upon many factors including technical factors, economic, social and other related factors. All new methods used in mineral exploration are meant to make this decision making more simplified. In recent years, advanced computational intelligence methods for modeling along with many other disciplines of science, including the science of mineral exploration have been used. Although the results of the application of these methods show a good performance, it is essential to determine the mineral potential in terms of geology, mineralogy, petrology and other factors for a final decision. The purpose of this paper is to provide a comprehensive set of mineral exploration research and different applications of computational intelligence techniques in this respect during the last decades.

Materials and methods

Artificial neural network and its application in mineral exploration

Artificial neural network (ANN) is a series of communications between the units or nodes that try to function like neurons of the human brain (Jorjani et al., 2008). The network processing capability of communication between the units and the weights connection originates or comes from learning or are predetermined (Monjezi and Dehghani, 2008). The ANN method has been applied in different branches of mining exploration in the last decades (Brown et al., 2000; Leite and de Souza Filho, 2009; Porwal et al., 2003).

Support vector machines (SVM) and its application in mineral exploration

SVM uses a set of examples with known class of information to build a linear hyperplane separating samples of different classes. This initial dataset is known as a training set and every sample within it is characterized by features upon which the classification is based (Smirnoff et al., 2008). The SVM classifier is a new method that has been applied in mining exploration in recent years, for example for separating alterations in initial stages of mining exploration (Abbaszadeh et al., 2013).

Neuro-fuzzy methods and its application in mineral exploration

The base of fuzzy logic is to make flexible borders between different samples. By applying this method with other methods, we can improve their performance. The adaptive neuro-fuzzy inference system (ANFIS) is one of the useful approaches in this branch of intelligent methods in

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mining exploration. For example, we can note the use of this approach in mineral mapping (Porwal et al., 2004).

Hybrid computational intelligence methods and its application in mineral exploration

In order to improve the performance of intelligence methods, often a hybrid form of these methods and optimization algorithms is a fit option. For example, Genetic Algorithm (GA), Ant Colony Optimization and Particle Swarm Optimization (PSO) have been applied with ANN and SVM in research studies. For example, (Chatterjee et al., 2008) applied a genetic algorithm-based ANN for ore grade estimation.

Conclusions

Earth sciences in general and more specifically mineral explorations have always been a part of science that encompasses all the factors involved due to their complexity and the factors that influence them thereby making the solution very difficult or almost impossible to solve. Because of the difficulty of accurate measurement parameters and boundaries, in recent years, researchers have been trying to use modeling in order to simplify natural disasters for better evaluation. One of the models that has received a lot of attention in recent years is modeling with of computational intelligent methods. The appropriate results show the usefulness of these methods.

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