



Research article

The effect of explosion parameters on the amount of Powder factor and its optimization using the bat algorithm and the crow search algorithm with a view on Zarand Sadat Siriz iron ore mine

Roghayeh Heydari ^{1*}, Seyed Mehdi Mousavi Nasab¹

1- Dept .of Mining Engineering, Zarand Higher Education Complex, Kerman, Iran

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Keywords

**Powder factor
bat algorithm
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English Extended Abstract

Summary

Choosing the right drilling and blasting methods is very important to improve mine productivity and increase profits while increasing the safety of workers and the environment. One of the main goals of Blasting is to estimate the optimal amount of specific cost, which is described as the specific cost required for optimizing rock crushing, air blast, ground shaking, and rock throwing. In this paper, to further improve the effect of blasting and increase the efficiency of mine production, we optimized the plan by considering the implementation of the blasting plan concerning the drilling intervals, and a numerical simulation model was created to provide technical guidance for the optimization plan. In this paper, data collection and analysis were done by the software and it was determined that with $R^2=0.969$, $VAF=9.825$, the lowest error is $RMSE=0.031$, and $MAPE=0.323$ with unit m^3/kg . The polynomial function model with incorrect coefficients has a more satisfactory performance and this function model was subjected to sensitivity analysis using the cosine field method. The evaluation and analysis also showed that the selected function model has a more accurate calculation of the specific cost. This proposed function was called in the bat algorithm and the crow search algorithm in MATLAB software, and the optimization operation was performed by the algorithms.

General guidelines

In this paper, the number of 11 data from 31 blasting series that were carried out in the Sadat iron ore mine of Zarand series was collected. The special cost of this mine was modeled with 6 functions by SPSS software, and among them, the polynomial function model with incorrect coefficients was chosen to predict the special cost. The special cost optimization operation was performed by two bat algorithms and the crow search algorithm, and the special cost optimized by the algorithms was compared. By sensitivity analysis, the sensitive and effective parameters taken in this mine were identified for special spending. This analysis showed that all the input parameters used in this modeling have a strong sensitivity to the specific cost, and among them, the ratio of the height of the step to the thickness of the burden has the highest sensitivity and the total consumption cost has the lowest sensitivity.

Introduction

Blasting is one of the main operations in open pit mining. Blasting operations are affected by various factors that can be classified into three categories. Rock mass characteristics, blasting design parameters, blasting properties, the distance between drillings, drilling slope, hole diameter, and length, the drilling pattern,

*Corresponding author: E-mail: kohdasht3@gmail.com



direction, and sequence are blasting design parameters that can be controlled. The parameters of explosives include the type of explosives, density, strength, resistance to moisture, heat, etc., all of which can be controlled. The third group includes parameters related to the nature of the rock mass. These uncontrollable parameters are among the most important influencing variables in explosion results [1], [2], [3], [4], [5], [6].

Methodology and Approaches

In general, 60 series of explosions were carried out in the Sadat iron ore mine and their data were collected. These collected parameters include hole diameter (D), hole length (L), burden (B), spacing (S), the ratio of step height to burden (K/B), flowering to burden ratio (ST/B), total consumption expenditure (Q), number of holes (NOH) and Powder factor (PF).

Results and Conclusions

Mathematical modeling, sensitivity analysis of parameters, calculation of statistical indices, modeled functions, bat algorithm optimization, and crow search algorithm optimization were performed in this Paper. The comparison of two optimization algorithms, bat and crow search, shows that the crow search optimization algorithm has a higher speed of convergence and solving because it reached the solution and converged with the population number of 100. However, the bat algorithm reached the final and optimal solution with 200 population numbers.

Figures, Tables, and Images

The convergence curve related to the bat algorithm is shown in Fig. 1.

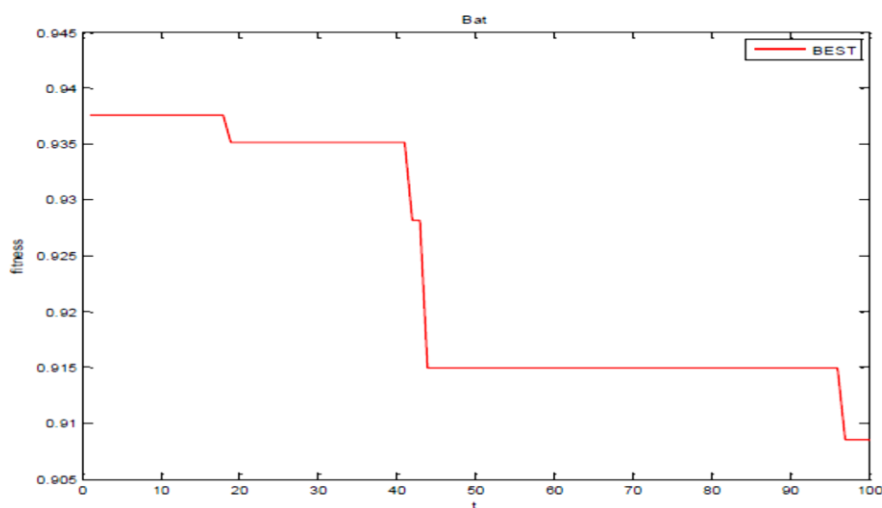


Fig. 1. Convergence curve related to bat algorithm

Sensitivity analysis of normalized parameters by the cosine field method is expressed in Table 1.

Table 1. Sensitivity analysis of normalized parameters by cosine field method

Q	NOH	$\frac{ST}{B}$	$\frac{K}{B}$	S	B	L	D	Pramete
0.877	0.913	0.982	0.985	0.923	0.917	0.941	0.952	R _{ij}

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