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Computer Based Optimization of Underground Mining Area

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ABSTRACT

Few algorithms are available for economic optimization of underground mining area. This is mainly because there are a variety of underground mining methods with various restrictions and conditions and the underground mining parameters are more complex. Therefore, it does not allow the development of general optimization tools, especially, software tools or computer programs. Based on the Global Optimization for Underground Mining Area (GOUMA) algorithm, a computer program, GOUMA-CP, was developed to implement the mentioned algorithm. GOUMA enjoys a new system of modelling named "Variable Value Economic Model" (VVEM) and benefits from the mathematical proof and provide the true optimal solution according to the conditions and environment it is applied. This paper includes a description of the GOUMA-CP program in details and the corresponding algorithm briefly. This computer program has successfully been applied to optimize underground mining area of a gold mine in Australia.

KEYWORDS:

Modeling, Optimization Algorithm, Computer Software, Underground Mining, GOUMA-CP

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1- Introduction

Optimization in underground mine design has received less attention than that in open pit mines. This is mostly due to the diversity of underground mining methods and complexity of underground mining parameters, which do not allow the development of general optimization tools, especially, software tools or computer programs. However, few algorithms are available for optimization of ultimate stope boundaries, which are either tailored for a specific mining method (i.e. rigorous algorithms) or lack rigorous mathematical proof and fail to guarantee the true optimum (i.e. heuristic algorithms). Fewer software tools are available based on these algorithms [1].

The first computer program in this field has been developed by Riddle in 1977. It was written in FORTRAN [2]. Based on floating stope heuristic algorithm, Datamine software was presented by a company with the same name [3]. Ataee-pour has developed a non-commercial program, named SLO, based on the maximum value neighbourhood (MVN) algorithm [4]. Based on OLIPS algorithm, a program, called SBO, has been designed by Jalali et al. in 2005 [1]. In addition to OLIPS algorithm, Jalali presented GOUMA comprehensive algorithm. GOUMA algorithm runs on a specific model, called variable value economic model (VVEM). For easy use of GOUMA algorithm and its use in solving large scale models, a computer program was designed, named GOUMA-CP. It was written in C++ language. A step by step description of the program is explained in this paper.

2- Methodology

The GOUMA-CP computer program has been developed based on GOUMA algorithm. GOUMA algorithm has two important characteristics, which make it very useful. First, it is executed on the variable value economic model (VVEM). Second, constraints and technical limitations of all conventional underground mining methods used for tabular deposits are applied in this algorithm. Therefore the main difference between this computer program and other programs and software tools is the kind of algorithm used. After it is started, the program receives a set of technical, geometric and economic data including: input and output files information, model specifications, geometric specifications of stopes and levels, and the block mining costs. After entering all the data, the GOUMA-CP program is run on the variable value economic model, VVEM, then two output files (main and secondary) are created. The suffixes of the main file and the secondary file are DAT and REP, respectively. The main file consists of the address and economic value of blocks, which are located in the optimum underground layout. Also a report of the input information and probable levels information are recorded in the secondary file. To introduce GOUMA-CP features, this program has been implemented on real data of a gold deposit in Australia. After running the program, a mining limit was determined. The optimum mine layout consists two levels with the height of 51 meters. The optimum layout scores a total value of $ 10,284,000.

3- Conclusions

The shortage of appropriate and comprehensive algorithms to optimize underground mining layout has caused the lack of computer programs in this area. After developing GOUMA algorithm, a computer program called GOUMA-CP, which aims to be executed on the real economic and large-scale models, was developed and implemented using C++ language. This program has been executed based on technical and economic data of a vein gold deposit in Australia. The optimum mining layout and its corresponding value is determined by the program.

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