https://dspace.org/

Open-pit mine production scheduling using the genetic algorithm

Muke, Pathy Musema

2021
https://hdl.handle.net/10539/31861

Downloaded from a DSpace repository. https://dspace.org/

ABSTRACT

The determination of an optimum open-pit mine production scheduling (OMPS) plan is an important part of the planning of any open-pit mine. The related optimisation problem for OMPS is an intractable problem. This is because it involves large datasets and, multiple hard and soft constraints, which make it a large combinatorial optimisation problem. Therefore, the use of deterministic techniques has demonstrated their limitation towards solving the OMPS problem. This impracticability has led to the use of metaheuristic techniques suitable to handle problems of such a nature. In order to solve the OMPS long-term problem, this research study applied the genetic algorithm (GA), which is regarded as an evolutionary technique to address difficult and complex problems in a much-reduced amount of time. The concern of the OMPS problem is to find the best extraction layout that generates the maximum net present value (NPV) of the project, out of thousands of feasible options.

A proposed GA model was developed and coded in Python programming environment to solve the OMPS optimisation problem. Python is an interpreted, interactive and object-oriented programming language and is one of the most used in data mining and machine learning. The research demonstrated that the GA run in Python, can be effectively used to find a near-optimal mine production schedule for small- and large-scale block models in three-dimensional (3D) space. The GA algorithm was applied on two mining case studies, namely: Newman1 and Zuck Small, which were downloaded from MineLib datasets that are freely available in the public domain for research purposes. The production plans obtained using the GA algorithm defined the appropriate time at which each block should be extracted from the mine on a long-term horizon. In order to validate the proposed GA model, a numerical result comparison was done against the best-known solutions provided in MineLib.

The two OMPS long-term plans generated for the two case studies yielded NPVs, which were by about 7.0% and 8.3%, respectively compared to the best-known optimal feasible solutions obtained using the TopoSort approach. Although the proposed GA algorithm demonstrated its efficiency to deal with the OMPS long-term problem,

further research such as applying the proposed GA on a real-world active open-pit mine needs to be conducted in order to improve and generalise the GA to other optimisation problems in mining.