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Application of Metaheuristic Algorithms to Optimal Clustering of Sawing Machine Vibration

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Abstract

The sawing machine vibration is a major factor to evaluate and predict the sawing performance. A few increases in sawing machine vibration cause a significant increase in the maintenance cost, which is important, because it determines the production cost. Hence, the purpose of this study is to investigate the sawing machine vibration based on rock characteristics using stochastic techniques, namely genetic algorithm (GA) and differential evolution (DE). Additionally, 12 types of rocks, including Granite, Marble and Travertine were collected and studied and laboratory tests were conducted based on physical and mechanical properties for evaluating sawing machine vibration from Iranian quarries. The results showed that the applied metaheuristic algorithms such as stochastic approaches can be very suitable to classify the ornamental stone into 2 and 3 separate categories based on vibration level by only some important physical and mechanical properties including uniaxial compressive strength, Schmiarezek F-abrasivity, Mohs hardness, and Young's modulus. Although, it has been found that there is no significant difference between the two algorithms, genetic algorithm modeling is more reliable than differential evolution based on the cost function. Finally, such studies can be used by engineers to optimize the ornamental stone sawing process.

Keywords: Rock properties, Sawing machine vibration, Genetic algorithm, Differential evolution, Stochastic techniques.

1. Introduction

System vibration is a very significant measure of the sawing performance, because it indicates the amount of sawing energy consumption and maintenance cost. The maintenance cost of the system is directly dependent on system vibration. The system vibration can be significantly dependent on tangential and normal forces per diamond grain. These forces are changed by changing the physical and mechanical properties of rock and operational parameters. So, it is important to study the relationship between sawing

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