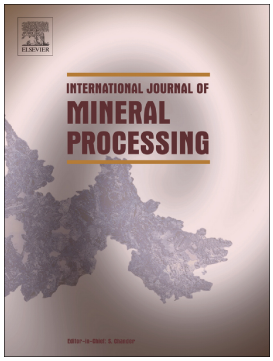

Development of a machine vision system for real-time monitoring and control of batch flotation process

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Development of a machine vision system for real-time monitoring and control of batch flotation process

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Abstract

Substantial progresses have been made over the past decade in using machine vision for automatic control of the froth flotation process. A machine vision system is able to extract the visual features from the captured froth images and present the results to process control systems. The current research work is concerned with the development and implementation of a machine vision system for real time monitoring and control of a batch flotation system. The proposed model-based control system comprises two in-series models connecting the process variables to the froth features and the metallurgical parameters along with a stabilizing fuzzy controller. The results indicate the developed machine vision based control system is able to accurately predict the metallurgical parameters of the existing batch flotation system from the extracted froth features and efficiently maintain them at their set-points despite step disturbances in the process variables. Furthermore, the proposed control system leads to higher target values for the metallurgical parameters than the previously developed system ($R_{Cu} = 91.1\%; G_{Cu} = 11.2\%$ vs. $R_{Cu} = 87.6\%; G_{Cu} = 8.1\%$).

Key words: Froth flotation, Machine vision, Froth model, Fuzzy controller

1. Introduction

Froth flotation is a complicated physico-chemical process for selectively separating the hydrophobic valuable from hydrophilic gangue minerals (Wills and Finch, 2011). Real time monitoring and control of the flotation process is not straightforward because of a large number of variables involved (Bergh and Yianatos, 2011; Jovanović and Miljanović, 2015; Jovanović et al., 2015; Saravani et al., 2014; Shean and Cilliers, 2011).

In recent years, on-stream X-ray analyzers have been used in the flotation plants for continuous measurement of the grade of key streams and estimation of the process performance. However, these instruments suffer from the severe disadvantage of high capital and maintenance costs (Holtham and Nguyen, 2002).

It is a well-established fact in literature and in practice that the froth surface visual features are closely related to the state of the process, so by monitoring and analyzing the froth characteristics, much valuable information regarding the process conditions and performance can be obtained.

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