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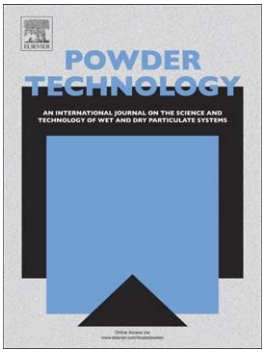

Acceleration of kinetic Monte Carlo simulation of particle breakage process during grinding with controlled accuracy

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Acceleration of Kinetic Monte Carlo Simulation of Particle Breakage Process during Grinding with Controlled Accuracy

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An acceleration algorithm for the kinetic Monte Carlo simulation of breakage process during grinding is introduced. We show that a feedback approach can be used to accelerate simulation as much as possible while control the simulation accuracy under a threshold. This is implemented by introducing a quantitative measurement of simulation accuracy and an estimation method during simulation run-time. The analysis is supported by numerical results showing significant acceleration and accuracy being well controlled below the given threshold.

kinetic Monte Carlo industrial grinding process particle breakage process simulation acceleration simulation accuracy control particle size distribution

1 Introduction

In mineral processing industry, ore grinding is the fine phase in the process of comminution after coarse phase of size reduction such as crushing. In this stage, the sizes of ore particles are further reduced in grinding mills. Grinding operation is expensive as the energy and grinding media (such as steel balls, rods or the ore rock itself) consumptions are extremely high [1] . Optimizing the comminution design and operation requires intensive knowledge of the comminution process, which is traditionally obtained by carrying out experiments on a prototype or real process. Yet, the cost and time of building prototype process and experiments on field turn out to become the most serious obstacle to the development and application of new optimization techniques [2]. This is because conducting experiments on operating processes may cause off-quality product and improperly set experiments may even damage process equipment.

Simulation can provide a cheaper and safer alternative to conducting experiments on field. Quantitative simulation with verified model is useful for many purposes [3]. It can be used to evaluate the design of comminution process and validate operational optimization strategy [4], [5] . For grinding process, *particle size distribution* (PSD) is most of interest. The purpose of the grinding process is to control PSD within an economic optimum particle size range [6], [7], [8]. Simulation can be used to evaluate whether the comminution design can reduce ore to the desired PSD range [3] and the process control strategy can stabilize the product PSD [9], [10], [4]. Since

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