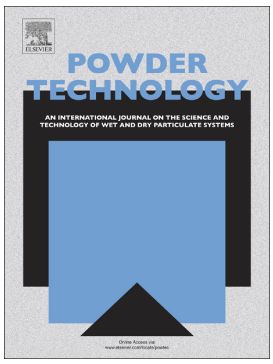

Study of the critical angles of granular material in rotary drums aimed for fast DEM model calibration

Zhou Hu, Xiaoyan Liu, Weining Wu

PII: S0032-5910(18)30791-5
DOI: doi:10.1016/j.powtec.2018.09.065
Reference: PTEC 13739

To appear in: *Powder Technology*

Received date: 20 April 2018
Revised date: 14 August 2018
Accepted date: 22 September 2018

Please cite this article as: Zhou Hu, Xiaoyan Liu, Weining Wu , Study of the critical angles of granular material in rotary drums aimed for fast DEM model calibration. Ptec (2018), doi:10.1016/j.powtec.2018.09.065

Study of the critical angles of granular material in rotary drums aimed for fast DEM model calibration

Zhou Hu[1], Xiaoyan Liu[1,2,*], Weining Wu[1]

[1]College of Electrical and Information Engineering, Hunan University, 410082 Changsha, China

[2]Hunan Key Laboratory of Intelligent Robot Technology in Electronic Manufacturing, Changsha 410082, China

* Corresponding author: xiaoyan.liu@hnu.edu.cn, 0086-731-88822224

Abstract: Discrete Element Method (DEM) is a powerful tool for simulating granular flow in rotary drums. To obtain reliable simulation results, the DEM model parameters should be calibrated, usually by matching simulated bulk properties (mostly the dynamic repose angle) with experimental value. However, DEM simulation of the dynamic repose angle costs much computing time because it is available after multiple avalanches of the granular bed at steady state. In the present work, the *first* avalanche of granular bed was investigated, with the aim to find a bulk property for faster calibration of DEM models. First, image processing algorithms were proposed to calculate the upper and lower critical angles in the first avalanche of the granular bed. Sensitivity analysis was performed to find the key material properties affecting simulation results. 60 sets of DEM simulations were then performed to study the upper and lower critical angles, with particle-particle friction coefficient, rotation speed and filling ratio of the drum as varying variables. Finally, a DEM calibration method was proposed, which employees the feature angle (the average of the upper and lower critical angles) of the first avalanche as bulk property for calibration of the particle-particle friction coefficient. Calibration tests demonstrated that, the proposed method has the same accuracy as the traditional calibration method using dynamic repose angle, but is more advantageous in calibration efficiency (the computing time was greatly reduced by 84% in the examples) because only the first avalanche needs to be simulated to obtain the feature angle. The prediction accuracy of the calibrated DEM model was verified quantitatively by experiments under different configurations.

Keywords: Rotary drum; DEM; Granular material; Critical angle; Dynamic repose angle; Model calibration