Identification of discrete element model parameters of brittle material by an inverse approach

†Rui Chen[1,2], Yong Wang[1,2], Ruitao Peng[1,2], Congfang Hu[1,2] and Shengqiang Jiang[1,2]

[1]College of Mechanical Engineering, University of Xiangtan, China.
[2]Engineering Research Center of Complex Tracks Processing Technology and Equipment of Ministry of Education, China
†Corresponding author: chenrui85@xtu.edu.cn

Abstract

The discrete element method (DEM) is widely used to simulate the mechanical behavior of brittle materials, such as rock, glass, concrete. In DEM simulations, particle-particle contact laws determine the macroscopic computational results. The contact laws usually rely on microscopic parameters, which are very difficult to obtain by direct measurements. In this study, an effective inverse approach is presented to determine the discrete element model parameters of brittle material, by minimizing differences in the macroscopic responses of uniaxial compression test between experimental and simulation results. In this approach, the bonded particle model (BPM) is adopted to describe the behavior of brittle material. A response surface method is used as a forward solver to calculate the macroscopic responses for given material model parameters varying continuously in a certain range. An intergeneration projection genetic algorithm (IP-GA) is then employed as the inverse operator on the response surface to determine the unknown key constants. The selected BMP parameters, e, k and s, are varied iteratively using the proposed inverse approach until the stopping criterion is satisfied. The identification results for two cases demonstrate the effectiveness of the present inverse approach. It is found that this approach is a potentially useful tool to effectively help determine the discrete element model parameters of brittle materials.

Keywords: Inverse problem; Parameter identification; Discrete element model; IP-GA