Comparison of different polyhedral DEM models based on the rocking of rigid block

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ABSTRACT

Crushed rock aggregates are often found in architectural structures. One of their most common application is forming a railway ballast. The grains of the aggregate are subjected to dynamic loads from train traffic, which results in sliding and other changes in their mutual positions. Crushing and abrasive wear of the individual grains can happen as well. The individual motion of the particles makes discrete element method (DEM) [1] excellent for modelling them.

In our researches polyhedral elements are applied to model the sharp edges and corners of the crushed rocks. In the first phase of our work only rigid blocks are considered which will be able to fall into pieces if the fracture criteria are satisfied. There are several polyhedral DEM software available and they rely on different mechanical principles. To obtain realistic mechanical behaviour, the model to be applied has to be chosen carefully, then both static and dynamic calibration of the parameters have to be performed during iterations by comparing adequate measurements with their simulation. The time demand of calibration studies is comparable or even extensively more than the computational time of the actual engineering problem.

The aim of our study presented here was twofold: to find and test a fast and simple dynamic calibration method and to compare the mechanical behaviour of different polyhedral DEM models. The rocking motion of rigid blocks was chosen as the basis of comparison, as it was used multiple times in the past for preliminary analysis for masonry mechanics problems [2], [3], and it is simple and computationally fast as it involves only a single moving discrete element and one contact. It has an analytical solution [4] for ideal circumstances for determining preliminary parameters while results of experimental measurements are available in the literature [5] as well.

Open source and commercial software were investigated in our study. Each of them had slightly different behaviour.

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