DEM particle characterization by artificial neural networks and macroscopic experiments

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ABSTRACT

The macroscopic simulation results in Discrete Element Method (DEM) simulations are determined by particle-particle contact laws. These usually depend on semi-empirical parameters, difficult to obtain by direct microscopic measurements. Subsequently, macroscopic experiments are performed, and their results need to be linked to the microscopic DEM simulation parameters.
Here, a methodology for the identification of DEM simulation parameters by means of macroscopic experiments and dedicated artificial neural networks is presented. We first trained a feed forward artificial neural network by backward propagation reinforcement through the macroscopic results of a series of DEM simulations, each with a set of particle based simulation parameters. Then, we utilized this artificial neural network to forecast the macroscopic ensemble behaviour in dependence of additional sets of particle based simulation parameters. We finally realized a comprehensive database, to connect particle based simulation parameters with a specific macroscopic ensemble output.
The trained artificial neural network can predict the behaviour of additional sets of input parameters fast and precisely. Further, the numerical macroscopic behaviour obtained with the neural network is compared with the experimental macroscopic behaviour obtained with calibration experiments. We hence determined the DEM simulation parameters of a specific granular material.

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