A three-dimensional discrete element model for geometrically nonlinear problems considering the properties of a linear elastic medium

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ABSTRACT

In order to model an elastic body using the Discrete Element Method, the microscopic model must be able to represent the macroscopic properties of the body. Two different approaches to determine the parameters of the discrete element model related to the elastic properties of the linear elastic medium are presented. The first one uses a symmetric unit cell from the hexagonal close-pack of spheres to get the stiffness matrix. The second one investigates the stored strain energy in the assemblage of 13 particles described above. The expression is derived with respect to the macroscopic strains and the resulting stress-strain relations can be compared to the constitutive equations of the elastic medium [1],[2]. Both methods yield a model with invariant spring stiffnesses in each contact allowing for equal shear components.

Different bodies under quasi-static and dynamic loading are considered to validate the model. Results and convergence are shown and discussed.

In the presented discrete element model no theoretical limits for rotation exist due to the updated Lagrangian formulation in each time step. As an example of the broad possibilities of the model, elastica problems are presented.

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