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ADVANCES IN PARTICLE METHODS FOR GEOMECHANICS

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ABSTRACT

The past decades have witnessed a rapid development of particle methods for geomechanical problems. According to their natures, the particle methods can be approximately divided into the continuum and discrete categories. Developed based on the continuum mechanics, the primary aim of the continuum particle approaches such as the Particle Finite Element Method [1], the Smoothed Particle Hydrodynamics [2], and the Material Point Method [3] is to tackle issues relevant to extreme material deformation where conventional continuum methods suffer from severe mesh distortion, for example free-surface flow and cone penetration. In contrast, the application of the discrete particle method such as the Discrete Element Method (DEM) is motivated by the discrete feature of soils. Regarded as an assembly of granules with air and/or fluids filling the pore space, micromechanical analysis of soils can be performed using the DEM coupled with proper Computational Fluid Dynamics (CFD) techniques [4]. To combine strengths of both continuum and discrete approaches, some multiscale schemes have been developed as well [5,6]. Despite recent advances in the particle approaches, unmet challenges still exist in the application of particle approaches to geomechanical problems particularly when multiphase and multiphysics processes are involved such as debris flows, submarine landslides, cone penetration into wet soils, etc.

This mini-symposium is intended to provide a forum for researchers to present contributions in the broad field of particle methods relevant to geomechanical problems. Topics within the scope of interest include, but are not limited to:

(1) Modelling of granular flow and geohazard problems such as subaerial/submarine landslides, debris flow, avalanches, etc;
(2) Simulation of insertion or intrusion of solid bodies into dry/wet granular soils, and pile installation problems;
(3) Micromechanical analysis of dry/wet granular soils;
(4) Discrete-continuum multiscale modelling of geomechanical problems.

REFERENCES

[1] X. Zhang, E Oñate, S. A. G. Torres, J. Bleyer and K Krabbenhoft, "A unified Lagrangian formulation for solid and fluid dynamics and its possibility for modelling submarine landslides and their consequences". *Computer Methods in Applied Mechanics and Engineering*, **Vol**. **343**, pp. 314-338, (2019).

[2] H.H. Bui, R. Fukagawa, K. Sak, and S. Ohno, "Lagrangian meshfree particles method (SPH) for large deformation and failure flows of geomaterial using elastic–plastic soil constitutive model". *International Journal for Numerical and Analytical Methods in Geomechanics*, **Vol**. **32**(12), pp. 1537-1570 (2008).

[3] K. Soga, E. Alonso, A. Yerro, K. Kumar, and S. Bandara, "Trends in large-deformation analysis of landslide mass movements with particular emphasis on the material point method". *Géotechnique*, **Vol**. **66**(3), pp. 248-273 (2016).

[4] S.A. Galindo-Torres, "A coupled Discrete Element Lattice Boltzmann Method for the simulation of fluid–solid interaction with particles of general shapes". *Computer Methods in Applied Mechanics and Engineering*, **Vol**. **265**, pp. 107-119 (2013).

[5] N. Guo and J. Zhao, "A coupled FEM/DEM approach for hierarchical multiscale modelling of granular media". International Journal for Numerical Methods in Engineering, **Vol**. **99**(11), pp. 789-818 (2014).

[6] C. Wellmann and P. Wriggers, "A two-scale model of granular materials". Computer Methods in Applied Mechanics and Engineering, **Vol. 205-208**, pp. 46-58 (2012).