



Point-based methods and their applications in geomechanics

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Existing geotechnical designs mostly rely on traditional analytical and computational approaches, such as the mesh-based finite element methods (FEM), which are limited to small deformation problems. While these methods of analysis provide important guidance and have been used for the safe design of many geotechnical structures, they are unable to provide information beyond the onset of failure of such structures under extreme weather or operational conditions or the risk associated with these failure modes. To foresee and assess risks associated with geotechnical failures, there has been an increasing research trend in the area of computational geomechanics to develop or adopt mesh-free (or particle-based) methods to deal with problems involving large deformation, discontinuous deformation and post-failure of geomaterials. Example of these approaches includes continuum-based particle methods such as Smooth Particle Hydrodynamics (SPH), Material Point Method (MPM), Particle Finite Element Method (PFEM), smoothed particle finite element method (SPFEM) and discontinuum-based particle methods such as discrete element method (DEM). The successful development of advanced computational methods suitable for modelling field-scale failure of geomaterials will provide effective tools for effective risk management and mitigation planning, and thus ensuring environmental and public safety.

To assess the potential of particle-based methods for solving general geomechanics problems and look into future development trends, an international symposium on

particle-based continuum methods and their applications in geomechanics” was held in September 2019 at the Institute of Geotechnical Engineering, BOKU, Vienna, Austria. The workshop brings together active scientists, software developers and engineers working in this research area to take stock of the state of the art of particle-based methods and look into future development trends. After the workshop, the organising committee decided to publish a special issue of Acta Geotechnica on particle-based method and their applications in geomechanics. This special issue not only consists of selected papers presented at the workshop, but also welcomes relevant research papers tackling the same problems. All papers published in this special issue went through a rigorous reviewing process set by the standard of the journal and provide a broad range of ideas to tackle emerging geomechanics problems, ranging from micromechanics investigation of granular materials to the field-scale predictions of granular failures. We hoped that this special issue will provide readers with general ideas on the capability of particle-based methods and their potential applications in solving challenging problems in geomechanics and related fields.

Finally, the Guest Editors would like to thank all the authors for their contributions to this special issue and the reviewers for their valuable time providing feedback on the scientific merits of all manuscripts submitted to this special issue.

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