Pore-scale Modelling of Instability in Partially Saturated Granular Soils

Yixiang Gan

School of Civil Engineering, The University of Sydney, Sydney, Australia.
Email: yixiang.gan@sydney.edu.au

Abstract

Landslides can be related to the dynamics of individual soil particles within the weakened layers, and are governed by a variety of pore-scale processes, including the additional inter-granular forces, changes of pore pressure, and water flow between neighbouring pores. In this study, grain-scale models, namely, Discrete Element Method (DEM) and Pore Network Method (PNM) are proposed for studying instability in unsaturated soils. Previous investigations of landslide releases using DEM have mainly focused on "*dry*" or "*fully saturated*" granular media. The microscopic mechanisms, such as, wettability of soil grains, the role of liquid menisci between grains and pore network evolution, are considered in this study. We first reproduce the soil water retention curves using DEM and PNM to demonstrate the pore-scale origins of the hydromechanical responses. The proposed DEM method incorporates rate-dependent inter-granular capillary forces, which can be measured through micro-tensile tests of liquid bridges at different rates. Moreover, the DEM method has been employed to investigate the triggering mechanisms of landslides at the scale of the weakened soil layer. We will further motivate the idea that the balance between these grain-scale weakening mechanisms is a dominating factor controlling the instability at various initial saturation levels.