Numerical Simulation of Liquid Patch Formation and Retention in Porous Media

Mingrui Dong[1], Yanyao Bao[1], Yixiang Gan[1 *]

[1] School of Civil Engineering, The University of Sydney, Sydney, Australia
* yixiang.gan@sydney.edu.au

Abstract

Liquid retention and patch formation during drainage processes in porous media are important phenomena in energy geotechnics. These behaviours are governed by drainage conditions, properties of different constituents, and topological structure of pore space. In this study, gravity-driven drainage processes in porous media are simulated using a modified Smoothed Particle Hydrodynamics (SPH) method. An inter-particle inter-action force is applied to the liquid-liquid and liquid-solid SPH particles for simulating surface tension and wettability. The influence of Bond num-ber, characterising gravity and surface tension, and surface wettability, represented by the contact angle, on liquid patch formation and retention are investigated. Under a given combination of Bond number and contact angle, the corresponding residual saturation and morphological feature of liquid patches are recorded. During drainage, the formation and evolution of liquid patches and bridges can be observed within the pore space. The van Genuchten equation and stretched exponential function are used to capture the dependencies on the Bond number and contact angle, respec-tively. The combination of these two theoretical models can lead to quanti-tative predictions of liquid retention and its relative change under any giv-en Bond number and contact angle.