THE UNIVERSITY OF HONG KONG

DEPARTMENT OF CIVIL ENGINEERING

SEMINAR

MULTISCALE MODELING OF STRONG AND WEAK DISCONTINUITIES IN POROUS MEDIA

by
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Date: January 12, 2015 (Monday)
Time: 12:00 p.m. - 1:00 p.m.
Venue: Room 6-12B, Haking Wong Building
The University of Hong Kong

ABSTRACT

The mechanical behaviour of a fluid-infiltrating porous solid is significantly influenced by the presence of the pore fluid in the voids. This hydro-mechanical coupling effect can be observed in a wide range of materials, including rocks, soils, concretes, bones and soft tissues. Nevertheless, due to the high computational demand, explicitly simulating the pore scale solid-fluid interactions of every single grain in the solid skeleton remains impractical for engineering problems commonly encountered in the field and basin scales. The objective of this talk is to present grain- and continuum models that predict and replicate onset of strain localization and fractures in fluid infiltrating porous media. We will first discuss the state-of-the-art mathematical theory and numerical implementation techniques used to model strain localization and fracture of brittle rocks and granular materials undergoing large deformation at the field scale. To improve the understanding of the hydro-mechanical coupling effects in the grain-scale, discrete element model is used and subsequently coupled with continuum models to analyze the onsets and propagations of shear bands and fractures from the microstructural origin. By using a nonlocal homogenization scheme, the discrete-continuum model retains the simplicity and efficiency of the continuum-based finite element model, while possessing the original length scale of the granular system.

ABOUT THE SPEAKER

Professor Sun obtained his B.S. from UC Davis; M.S. in civil engineering (geomechanics) from Stanford; M.A. degree from Princeton; and Ph.D. in theoretical and applied mechanics from Northwestern. Prior to joining Columbia, he was a senior member of technical staff at Sandia National Laboratories. Professor Sun works in the fields of theoretical and computational solid mechanics, poromechanics and multiscale modeling of fully coupled multi-physical systems. His research includes the development of solution techniques for coupled deformation-diffusion in non-isothermal saturated and unsaturated porous media, formulations of stabilized mixed-field finite element model for large deformation multiphysics problems, modeling and homogenization of mechanical and hydraulic properties of porous media from CT images, applications of mathematical tools, such as graph theory, Lie algebra, and combined deterministic-stochastic method, for modern engineering problems. He is the recipient of the 2013 Caterpillar Best Paper Prize from Acta Geotechnica.

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