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4D computed tomography of granular force chains

Dr. Wei Li (The New York State University at Stony Brook, USA)

Coupled Thermo-Hydro-Mechanical Modeling of Radioactive Waste Disposal in Rock Salt

Dr. Hafssa Tounsi (Lawrence Berkeley National Laboratory, USA)

26th August 2022 (2:00pm GMT)

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4D computed tomography of granular force chains

Abstract

Granular media constitute the most abundant form of solid matter on the Earth and other astronomical objects. When external forces are applied to granular media, the forces are transmitted in the media through a network of contacts—force chains. Understanding the temporal evolution and spatial structure of these force chains constitute a fundamental goal of granular mechanics. For decades, our understanding of force chains has been derived from 2D experiments, using quasi-2D photoelastic particles of various shapes. Here, we introduce a new experimental technique, which integrates photoporomechanics (Li et al., 2021) into tomography, to observe the temporal evolution of 3D force chains under isotropic compression, triaxial shear and rotary shear. Our experimental study visualizes the allineation and intensification of 3D force chains as the external load changes from isotropic to triaxial shear and rotary shear. We also show that the fluctuation of the continuum-scale shear stresses can be pinpointed to the grain-scale buckling and reestablishing of a few force chains.

Speaker

Dr. Wei Li is an assistant professor at the New York State University at Stony Brook. He obtained his Ph.D. degree in 2019 under the supervision of Professor Herbert H. Einstein in the Department of Civil and Environmental Engineering at MIT. He then worked as a postdoctoral researcher with Professor Ruben Juanes at MIT. He is strongly interested in the geosystems centered on infrastructure and energy. His Ph.D. work focused on developing mathematical and experimental models to understand how the flow and dissolution create cavities, with applications to sinkhole hazard evaluation and enhanced oil production. In his postdoc research, he developed novel experimental techniques, such as photoporomechanics and 3d force chain tomography, to study the mechanics and physics of granular media and porous media.

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Coupled Thermo-Hydro-Mechanical Modeling of Radioactive Waste Disposal in Rock Salt

Abstract

Salt formations have many favorable attributes that make them a promising host rock for permanent geological disposal of heat-generating nuclear waste. They offer a good tolerance to high temperatures, because of their high thermal conductivity and represent an excellent natural barrier due to their low permeability and self-healing properties. The disposal concept we investigate consists of emplacing the waste packages inside horizontal drifts that are backfilled with crushed salt thereafter. Rock salt creep induces the closure of the drift and consequently a gradual reconsolidation of the crushed salt backfill. This presentation reviews consequences of the coupling between Thermal, Hydraulic and Mechanical (THM) processes on the short and long-term evolution of the geological barrier (rock salt) and the geotechnical barrier (crushed salt backfill) through fully coupled THM simulations of a generic salt repository.

Speaker

Dr. Hafssa Tounsi grew up in Morocco where she got her civil engineering degree from Hassania School (Casablanca) followed by a Master of Science on soil and rock mechanics at Ecole des Ponts. After that she did a PhD at the Geosciences and Geoengineering Department of MINES ParisTech. Currently, she is a Postdoctoral Researcher at Lawrence Berkeley Lab. Her scientific interest is in developing and applying coupled thermo-hydro-mechanical and chemical modeling to geoengineering applications such as geological sequestration of CO2, the use of artificial ground freezing for the exploitation of complex mineral deposits or for subsurface ice storage and geological disposal of radioactive waste in Salt formations.