2023 ARMA Future Leader Webinar Series

Every Two Weeks on Fridays 9-10 AM MT

14th lecture: September 22, 2023

Please reach out to shahrzad.roshankhah@utah.edu to get the Zoom meeting information.

Speaker: Yao Huang

Stress Measurement and Modelling in Underground Rock

In-situ stresses have wide applications in Petroleum Engineering, Mineral Engineering, Earth Sciences, and Geo-Engineering. Well-established tests can be used to estimate minimum horizontal stress; however, quantifying the magnitude of the maximum horizontal stress (σ_{Hmax}) is substantially more difficult. For example, sleeve fracturing is a promising but underused in-situ stress evaluation technique that operates in the subsurface. Similarly, the burst experiment is a laboratory technique for the estimation of fracture toughness of rock under confined conditions that has been sparingly used for several decades by the petroleum industry. The techniques both involve pressurizing an uncased borehole until one or more fractures emanate from the borehole. However, ambiguity in their interpretation has led to inconsistencies and has been the primary barrier to wider adoption and full realization of the potential of these promising techniques. To answer these challenges, we first introduced numerical simulation techniques to solve the forward problem by analyzing crack initiation and propagation behavior under sleeve fracturing conditions in both laboratory experiments and at the field scale. Then, a rapidly deployable inversion algorithm is developed to estimate the maximum and minimum horizontal stress based on the field data. The results show that, combining this inversion algorithm with data that is available from recent developments in field measurements using Fiber Optic sensors, the full potential of sleeve fracturing to predict both minimum and maximum horizontal in-situ stress can be realized. Finally, turning attention to the laboratory burst experiments, the results show that choosing a 3-parameter traction-separation law for the cohesive zone model is able to capture the impact of confining stress and specimen geometry. Furthermore, the results show that running burst experiments with different specimen geometries can provide a promising path to the challenging goal of experimental characterizing a traction separation for a given rock (or other quasi-brittle) material.

Biography:

Dr. Yao (Catherine) Huang is currently a post-doc research associate working at Los Alamos National Laboratory (LANL). Before joining LANL, she did a post-doc at the University of Pittsburgh. She is the winner of the 2022 Dr. N.G.W. Cook Ph.D. Dissertation Award of American Rock Mechanics Association (ARMA). She also serves as a future leader for ARMA. She received her B.S. in Theoretical and applied mechanics from the University of Science and Technology of China and her M.S. in mechanics from China University of Petroleum, Beijing. She obtained her Ph.D. in Geotechnical Engineering from the University of Pittsburgh in 2022. Her research interests include but are not limited to Thermal-Hydro-Mechanical-Chemical coupling, computational geomechanics and rock mechanics and stress analysis in underground rock.