Physics-guided Semi-Supervised Learning to Characterize Subsurface Volumes

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Speaker:

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Abstract:

The exponential growth of collected data from seismic surveys makes it impossible for interpreters to manually inspect, analyze and annotate all collected data. Deep learning has proved to be a potential mechanism to overcome big data problems for various computer vision tasks. However, the applications of deep learning are limited in the field of subsurface characterization due to the limited availability of consistently annotated seismic datasets. Obtaining annotations for seismic data is a labor-intensive process that requires field knowledge. Moreover, in addition to seismic data, interpreters rely on the few high-resolution measurements of the subsurface from well-logs and core data to confirm their interpretations. Different interpreters might arrive at different valid interpretations, all of which agree with well-logs. This seminar introduces a learning-based physics-guided subsurface volume characterization framework that learns from limited inconsistently annotated data. The framework integrates seismic data and the limited well-log data to characterize the subsurface at a higher-than-seismic resolution. It also considers the physics that governs seismic data to overcome noise and artifacts that are often present in the data. Integrating a physical model in deep-learning frameworks improves their generalization ability beyond the training data. Furthermore, the physical model enables deep networks to learn from unlabeled data, in addition to a few annotated examples, in a semi-supervised learning scheme.

Bio:

Dr. Motaz Alfarraj is an assistant professor in the Electrical Engineering Department at King Fahd University of Petroleum and Minerals (KFUPM). Dr. Alfarraj is a currently serving as the IEEE Signal Processing Society – Saudi Arabia Chapter Chair. He received his B.Sc. degree with first honors in Electrical Engineering in 2013 from King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia. He received his M.S. and Ph.D. degrees in Electrical and Computer Engineering with a minor in Math from Georgia Institute of Technology, Atlanta, GA in 2015 and 2019, respectively. His research interests include machine learning, deep learning, computer vision, and image processing. His research focuses on the integration of physics in data-driven systems to enable effective learning from noisy or unannotated data for seismic interpretation. Dr. Alfarraj worked previously in Anadarko Petroleum Corporation (APC) in Houston, TX as a geoscience intern in the Advanced Analytics and Emerging Technology (AAET) group. He was the recipient of the outstanding research award from the Center for Signal and Information Processing (CSIP) at Georgia Institute of Technology in Spring 2019. Dr. Alfarraj is a member of the IEEE Signal Processing Society (SPS), Society of Exploration Geophysicists (SEG), and Society of Petroleum Engineers (SPE).