Machine Learning Applications for Safe and Sustainable Energy Transition

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Abstract

Increasing emissions of greenhouse gases (GHGs) have resulted in pressing concerns about climate change and increased investments in decarbonization. Therefore, it is imperative that the currently prevalent petroleum resources must make way for several alternate (and hopefully sustainable) energy solutions for society. However, the challenges for the safer and sustainable energy transition will require addressing not only the technological issues but also the socio-political concerns. Progress in artificial intelligence (AI) and machine learning (ML) has provided a strong economic motivation to many industrial sectors such as healthcare, retail etc. Applications of machine learning to petroleum engineering during the energy transition provide a unique opportunity to help train the workforce on translational skillsets and yet achieve the goal for safer and sustainable energy transition. In this talk, several examples of machine learning applications will be discussed to highlight Smart decision-making, Safety of operations, and Sustainability of subsurface energy resources that will be relevant to the energy transition. Rig state identification to reduce the invisible lost time (ILT) on offshore drilling platforms will be presented as ML example of smart decision making. Early kick detection (EKD) using ML based multi-class alarm system for an offshore drilling platform is shown as an example of operational safety. Lastly, the physics-informed neural networks (PiNNs) for the production datasets of an offshore reservoir field will be shown as an example for reduced-order models (ROMs) for waterflooding operations. Future directions of ML applications to geothermal reservoir engineering will be presented as an example of sustainable energy transition.

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Prof. Mayank Tyagi is Chevron #3 professor at the Craft & Hawkins department of petroleum engineering, Louisiana State University (LSU). He also holds a joint faculty appointment at the Center for Computation & Technology (CCT), LSU since 2007. He obtained his Ph.D. in mechanical engineering from LSU and undergraduate in mechanical engineering from Indian Institute of Technology (IIT), Kanpur. His current research interests span data analytics, machine learning, and physics-based modeling of interdisciplinary petroleum engineering applications using high performance computing, image-based pore-scale modeling with lattice Boltzmann method, multiscale multiphase computational fluid dynamics, geothermal reservoir engineering, and unconventional reservoir simulations. He has also worked on the issues in the quantitative risk assessment of offshore petroleum engineering operations, spills, and their impacts on regional economy. He has given numerous invited talks in India, China, and several US universities. He has published over eighty (80+) peer-reviewed technical publications. He is co-founder of 3LiXIR, a lithium extraction innovation research company that is focusing on direct lithium extraction from geothermal brines. Also, he served as Data Science and Petroleum Engineering Fellow to a startup company, Enovate Upstream, Inc.