Chemical and Petroleum Engineering

SEMINAR NOTICE

Saman Aryana

Professor of Chemical Engineering and Mathematics
University of Wyoming

Dr. Saman Aryana is an assistant professor in the Department of Chemical Engineering and an adjunct assistant professor in the Department of Mathematics and Statistics at the University of Wyoming (UW). He is also the founder and president of the Northern States Section of the Society of Industrial and Applied Mathematics. Prior to joining UW, Dr. Aryana served as a reservoir engineer as part of an asset management team and also served on a business development team at Occidental Petroleum Inc. Dr. Aryana earned a BS in Civil Engineering in 2003 with Summa Cum Laude honors from the University of Texas at Arlington, where he also completed an MS in Civil Engineering in 2006 with a focus on Structures and Applied Mechanics. He worked as a consulting engineer for several years in Texas where he is registered as a Professional Engineer in two areas of specialization. Dr. Aryana earned a PhD in Energy Resources Engineering at Stanford University in 2012. The main thrust of Dr. Aryana's research is the study of multiscale, multiphysics systems at the nexus of energy, water and the environment with a focus on the fundamentals of subsurface flow processes. His aim is to incorporate the nature of these systems in the simplest form possible without sacrificing adequate representation of all relevant physical mechanisms and verifiable data.

"An Extension of Darcy's Law Incorporating Dynamic Length Scales"

Abstract

Macroscale models of multiphase flow in porous media figure prominently in a wide range of applications, including underground CO_2 storage, groundwater contaminant remediation, and petroleum reservoir engineering. Most models use some form of Darcy's law as the field equation for fluid velocities. Comparisons of experimental data and simulation results suggest that these models often lack predictive capability. In this talk, I will discuss a physics-based, macroscale formulation of multiphase porous-media flows that honors both the validity of Darcy's law in steady or near-steady flows and the multiscale, nonlinear—and hence unsteady—nature of these flows. The new formulation recognizes that parameters characterizing the system operate at different length-scales. In particular, the use of Darcy's law, predicated on the assumption of near-steady flows, requires dynamic length scales, owing to the possibility of rapid fluctuations in rock and fluid properties attributable to heterogeneity and nonlinearity. We accommodate these dynamic length-scales through dynamic spatial averaging. The length and position of the averaging window are driven by the anticipated flow instability characterized by the length of the mixing zone and the direction of propagation of information in the transport process. We validate the proposed formulation by comparing highly accurate, numerical solutions against core-scale displacement experiments. The proposed paradigm is consistent with the classical multiphase Darcy formulation, which represents a limiting case where the size of the dynamic averaging window approaches the static length scales used to define macroscale properties such as porosity.

Tuesday, March 26th

Spahr Auditorium | 1:00 – 1:50pm