Computational Mathematics Seminar Series

Fluid Flow Simulations of Diverse Petroleum Engineering Processes at the Rock Pores-, System Components- and Reservoir Field- Scales

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Abstract:
In this seminar, several examples of fluid flow simulations of interest to petroleum engineering discipline are presented. Fluid flow processes occur at a wide range of length (microns to several kilometers) and time scales (microseconds to several years) in various Petroleum engineering applications. Typical reservoir flow scale spans over several kilometers as compared to the annular dimensions of a well being in the order of centimeters. Further investigation into the flow through porous media reveals that the flow in pore spaces of the formation occurs at micron scales. Lattice Boltzmann Method (LBM) is utilized to simulate inertial flow regimes representative of near well region of a high productivity index well. Macroscopic properties of the flow are then obtained from the computed fluid velocity fields in the pore spaces of a sandstone formation and shown to be in good agreement with the experimental data. An unstructured finite volume method (FVM) based flow solver is utilized to simulate non-Newtonian fluid displacement processes during the primary cementing job. Parametric study is performed to understand the influence of fluid properties, annular geometry and flow conditions on the displacement efficiency. A finite difference method (FDM) based reservoir simulator is utilized to simulate the heat extraction from geothermal resource. Influence of the downhole heat exchanger geometry and location on the natural convection patterns in a confined reservoir is quantified.

Speaker's Bio:
Tyagi obtained his PhD in Mechanical Engineering from Louisiana State University in the area of multiscale turbulent flow modeling. He has a BS in Mechanical Engineering from Indian Institute of Technology, Kanpur. He holds a joint appointment at the Craft & Hawkins department of petroleum engineering and the Center for Computation & Technology (CCT). His broad research interests involve high performance computing applications in reservoir simulation, lattice Boltzmann method (LBM), computational fluid dynamics (CFD) and numerical heat transfer of challenging applications. He is currently involved with pore-scale LBM simulations of inertial flows through porous media, non-Newtonian fluid displacement simulations in drilling processes, innovative methods of heat extraction from geothermal reservoirs and upscaling issues for pore-scale multiphase flow processes.

Refreshments will be served.
This lecture has a reception.

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