Computational Mathematics Seminar Series

Insights into Complex Wellbore Construction Processes and Completions Performance using Computation Fluid Dynamics (CFD) Simulations

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Digital Media Center 1034
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Abstract:

Multiphysics CFD simulations on HPC platforms provide a great opportunity to learn about the complex processes during drilling and completions operations of oil & gas wells. Several computational fluid dynamics (CFD) models with different features are presented for cuttings transport, cement placement, and production through completions in this presentation. All simulation cases are both verified and validated against available experimental data for their corresponding physics. In order to get accurate flow predictions while optimizing computational resources requirements, unsteady shear stress transport (SST) k-ω turbulence model is used to model turbulence closure while solving Reynolds-averaged Navier-Stokes (RANS) equations using unstructured finite volume method (FVM) for discretization. Discrete phase is modeled with discrete element method (DEM) by including particle-particle and particle-fluid interactions with two-way coupling in Eulerian-Lagrangian simulations. Volume of Fluid (VOF) model is used to model displacement of different fluid types with non-Newtonian fluid rheology for cement placement applications. Specifically, during the drilling of highly deviated wellbores, the cuttings transport becomes difficult due to the rolling/sliding transport of the cuttings due to settling around the lower side of the annular region between wellbore and drillpipe. Inefficient cuttings transport may lead to several critical problems such as stuck pipe, increased torque and drag, damaged material and poor quality of cementing jobs. Increasing mud flowrates and improving mud properties for a proper wellbore cleaning is usually limited due to the hydraulic and mechanical thresholds for wellbore formation integrity. Further, understanding of cement placement process remains a critical step in achieving zonal isolation between casings and hydrocarbon bearing formations in all types of well construction operation. Lastly, a gravel-packed completion is modeled to showcase the capabilities of CFD simulations by gaining new insights into modeling and representation of high-rate producer wells in reservoir simulators.

Speaker's Bio:

Mayank Tyagi, Ph.D. is the Holder of Chevron #3 Professorship and joint-Associate Professor in the Craft & Hawkins Department of Petroleum Engineering and the Center for Computation & Technology (CCT). He received his PhD in mechanical engineering from LSU and worked at CCT before starting his joint-faculty position in 2007. His current research interests are in high performance computing and simulations across wide range of petroleum and engineering systems for complex phenomena such as pore-scale flows, Wellbore-scale fluid dynamics, geothermal reservoir heat transfer. He collaborates with Prof. Nandakumar (ChE) on "Enabling Process Innovation through Computation (EPIC)" consortium and Prof. Thompson (PETE) on "PoreSim" consortium.

This lecture has a reception @ 03:00 pm

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