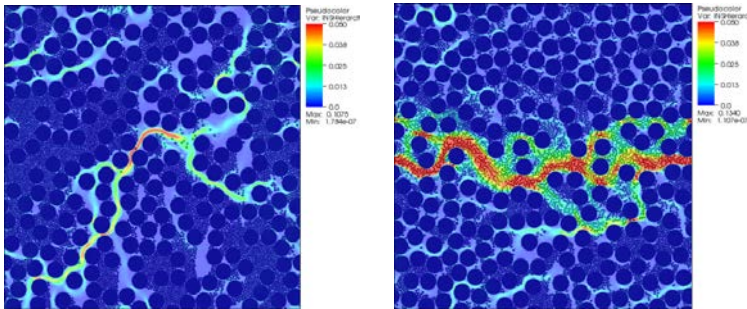


Mesoscale Priority Research Direction

Meso-scale Investigation of Particle Transport in Porous Media

Opportunity

Current approximations of erosion rates, particle and fluid dispersion, particle deposition rates, porosity, and permeability changes during the migration of suspensions through porous media in field-scale models lack the phenomenology required for predictive modeling.



Approach

The mathematical research issues include resolution and gridding of porous media geometry at the pore scale, coupling of an appropriate particulate representation model to the fluid dynamics, numerical accuracy and stability of the particle method, micromechanical interaction between solids, resolving interfaces for multiple fluid system (e.g., oil, gas and water) and adaptive algorithms for multiscale coupling. Using X-ray computed tomography methods enable representation of natural materials at the grain scale. The ability to compare the numerical results directly to the experimental results will provide validation of new capabilities.

New state-of-the-art modeling approach will provide critical insight into the connection between microstructure and mechanical and transport properties of porous media required for predictive modeling.

Meso Challenge

How do mesoscale factors such as grain structure and fluid pressure distribution in the pores affect the transport and mechanical properties of soils, sediments and sedimentary rocks ?

What aspects of mesoscale transport must be captured to enable predictive reservoir-scale models?

Impact

The proposed approach will improve mesoscale and field scale modeling activities in engineering and design studies in a wide range of applications, including: drilling and fluid injection and extraction applications, evolution of sedimentary basins, oil recovery, carbon sequestration and borehole cleanup, and proppant placement in fractures.

References: Y. Kanarska, I. Lomov, T. Antoun. Mesoscale simulations of particulate flows with parallel distributed Lagrange multiplier technique. *Comp. & Fluids*, 48(1), 16-29, 2011