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Direct Numerical Simulation of turbulent flow in a porous, face centered cubic cell[1] XIAOLIANG HE, SOURABH APTE, BRIAN WOOD, Oregon State University — DNS of flow through a 3D, periodic, face centered cubic (FCC) unit cell geometry at Re = 300, 550, and 950 based on diameter is performed. This low porosity arrangement of spheres is characterized by rapid flow expansions and contractions, and thus features an early onset to turbulence. The simulations are performed using a fictitious domain approach [Apte et al, J. Comp. Physics 2009], which uses non-body conforming Cartesian grids, with resolution up to $D/\Delta = 250$ (354^3 cells total). The results are used to investigate the structure of turbulence in the Eulerian and Lagrangian frames, the distribution and budget of turbulent kinetic energy, and the characteristics of the energy spectrum in complex packed beds and porous media. The porescale flow physics, which are important to properties such as bulk mixing performance and permeability, are investigated. Specifically, the data generated is being used to understand the important turbulence characteristics in low porosity packed beds of relevance for heat tranfer applications in chemical/nuclear reactors.

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