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Fast parallel algorithms for flow in porous media ROMIR MOZA, GEORGE BIROS, Univ of Texas, Austin — In porous media flows, the variation in permeability over a large range of length scales gives rise to fluctuations in velocity which in turn lead to phenomena of interest, such as anomalous diffusion. However, due to the complex 3D structure of the medium, numerical simulation of flows in porous media remains a challenge and there is a need to develop efficient parallel algorithms for fast computation. We model porous media with a set of arbitrary shapes that are homeomorphic to a sphere. The stokes equations are often valid for these flows, which we solve using the boundary integral method. This reduces the dimensionality and number of unknowns for the problem. We evaluate far-field kernel summations using a parallel fast multipole method. Since the separation between spheres can be arbitrarily small, it is a challenge to resolve the flow near the surface. We use special singular and near singular quadratures to tackle this challenge and achieve high accuracy close to the spheres. We study hydrodynamic properties of the flow, such as dispersion, using the correlated continuous time random walk model. Our solver is highly scalable, solving for velocity fields in arbitrary geometries of several thousand spheres in a few minutes.

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