Multiscale stochastic modeling of coupled Stokes-Darcy flows

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We discuss numerical modeling of coupled Stokes-Darcy flows based on the Beavers-Joseph-Saffman interface conditions. The flow domain is decomposed into a series of subdomains (coarse grid) of either Stokes or Darcy type. The subdomains are discretized by appropriate Stokes or Darcy finite elements. The solution is resolved locally (in each coarse element) on a fine grid, allowing for non-matching grids across subdomain interfaces. Coarse scale mortar finite elements are introduced on the interfaces to approximate the normal stress and impose weakly continuity of the velocity. Stability and a priori error analysis is developed for fairly general grid configurations. By eliminating the subdomain unknowns the global fine scale problem is reduced to a coarse scale interface problem, which is solved in parallel using an iterative method and a multiscale flux basis.

If time permits, we will discuss a stochastic framework for uncertainty quantification of the Stokes-Darcy model. The permeability is a stochastic function represented with a Karhunen-Loeve (KL) expansion. The spatial discretization is coupled with stochastic collocation for computing statistical moments of the pressure and the velocity.

The lecture will take place in Thackeray 704 at 3:30pm.
Refreshments will start at 3:00pm.