

Formulation of a Well-Posed Stokes-Brinkman Problem with a Permeability Tensor

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Abstract—

We consider a slow flow with incompressible viscous fluid flowing through two different domains: a porous medium and adjacent free-fluid region. With the slow flow problem the Stokes equation is employed in this study. To match the shear stress at free-fluid/porous-medium interface and to have a flexibility to make choice of boundary conditions at the interface, we apply Brinkman equations in the porous medium domain. A mixed finite element method is used to discretize the model to obtain a weak Stokes-Brinkman formulation. We establish the continuity of the bilinear form and then provide the well-posedness of the discrete problem of the Stokes-Brinkman equation when permeability coefficient is considered to be an n -dimensional tensor. This result can also be applied to a free boundary problem as long as the boundary conditions at the interface is in the Sobolev space $H^{1/2}(\partial\Omega)$.

Keywords— Well-posedness; Stokes-Brinkman; Permeability tensor; Moving solid phases; Finite element; Porous media