[SPGNA MEETING-2017]

NODAL DISCONTINUOUS GALERKIN METHOD FOR THE BROAD-BAND BIOT'S EQUATION

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Abstract

We present a generic system of hyperbolic partial differential equations describing the Biot's proroelastic wave equation for quasi-static Poisseulli's and potential flow of the fluids. To incorporate the micro-heterogeneities of pores, we have used the Johnson-Koplik-Dashen (JKD) model of dynamic permeability to account for viscous dissipation caused by the pore fluids. Coupling the JKD model with equation of motion recasts the dissipation forces in terms of a fractional derivative operator of order 1/2. The Presence of dissipative forces in the system results in a *stiff* system of PDEs. We follow the Strang's splitting approach to circumvent the effect of stiffness, by solving the *stiff* and *non-stiff* parts of the system separately. Solution of the *stiff* part of the system is obtained analytically whereas the *non-stiff* part of the system is solved using a high order discontinuous Galerkin (DG) method in a 2D/3D domain, discretized with unstructured meshes. Natural boundary conditions are imposed implicitly via a penalized central numerical flux, which also recovers a similar convergence rate as any upwind flux. The computational experiments are performed on various realistic models. We also incorporated a heterogeneous computing platform in order to utilize the significant fine grain parallelism present in the DG method.