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ANALYZING CONVERGENCE ON A CONVECTIVE DOMINANT COUPLED SUPERFICIAL TO SUBSURFACE FLOW

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In solving the nonlinear coupled superficial free water flow into a sub-superficial porous medium flow, we deal with velocity of the superficial flow in a convective dominant behavior. This requires a stabilized iterative finite element approach to overcome spurious numerical oscillations. In this way, the convergence behavior of this coupled flow problem is analyzed. We employ the CAU as velocity field stabilization technique, and FHS one as control procedure over undesirable numerical spurious oscillations in the pressure field.

The convergence criteria employ an iterative process between total pressures – at superficial flow domain – and hydraulic head – at porous medium domain, at each time step, requiring the equilibrium between those physical properties of the coupled flow.

For the superficial and sub-superficial flows we employ respectively: a 3-D Navier-Stokes equations, in primitive velocity-pressure variables, combined with a vertical integrated form of the incompressibility restriction; and the parabolic version of the Darcynian-Richard's equations in the hydraulic head form. Coupling of these two flows is achieved imposing a set of physical consistent relations at the interface surface connecting these two media. Accurate representation of the total pressure on the free superficial water is obtained by adding a dynamic pressure correction to the hydrostatic one.

Numerical experiments using LBB and non-LBB elements were performed checking the efficiency of the proposed iterative procedure. CAU efficiency in compared with the usual SUPG, and the computational performance is highlighted. The acquired convergence rates show a performance near the optimum one.