LARGE-SCALE FINITE ELEMENT SIMULATION OF A CLASS OF INCOMPRESSIBLE NON-NEWTONIAN FLUIDS WITH APPLICATION TO NATURAL CONVECTION FLOWS

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Non-Newtonian fluid models are becoming increasingly important in modeling industrial, scientific, and biological flow problems. Of particular interest here are a class of viscosity models that are useful in characterizing the behavior of certain dilute suspensions. In the present study we develop a finite element formulation and parallel PC cluster implementation for simulation of non-Newtonian fluids of shear-thinning type in three dimensions. Application studies with Powell-Eyring and Extended-Williamson apparent viscosity models are presented together with a description of the algorithm and an analysis of the non-linear solution technique. Related *a priori* error estimates are summarized together with results from supporting numerical convergence studies. Comparisons studies and extensions of the classic natural convection benchmark problem are given as well as the effect on heat transfer rates. Performance and scalability results on dedicated PC clusters are included.