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Implementation Of An Efficient Parallel 3-D Finite Element Solver For The Equations of Viscous, Resistive Magnetohydrodynamics Using A Velocity-Current Formulation. KEITH BRAUSS, Lamar Univ, AMNON MEIR, Southern Methodist University — We describe the implementation of a parallel finite element method for the viscous, resistive magnetohydrodynamics (MHD) equations using a velocity-current formulation [proposed by A.J. Meir and Paul G. Schmidt]. The velocity-current formulation of the viscous, resistive MHD equations can be used for modeling phenomena occurring in plasma fusion reactors, liquid metal casting of aluminum, and the Czochralski crystal growth of silicon for the semiconductor industry. The velocity-current formulation is a system of nonlinear integro-differential equations whose solution is approximated through a Picard linearization, discretized using the finite element method, and solved iteratively with the Krylov subspace method GMRES. Effective preconditioning strategies are required to numerically solve the equations. A simple preconditioner is constructed and successfully tested with the Krylov method GMRES. The parallel solver for the equations utilizes open-source, freely-available, academic and government funded supercomputing software libraries.

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