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A Mesh-Free Method for the Simulation of Magnetic Diffusion
JEFFREY JOHNSON, UC Davis / Lawrence Livermore National Lab, MICHAEL OWEN, Lawrence Livermore National Lab — Magnetohydrodynamics (MHD) plays an important role in various physical systems at large and small scales. Recently, mesh-free methods such as Smoothed Particle Magnetohydrodynamics [1] (SPMHD) have been developed to study these systems by simulating magnetic fields in the presence of conducting media. However, these methods currently do not incorporate realistic models for electrical resistivity, which can significantly affect the dynamics of the system by introducing magnetic diffusion, thereby altering the field's topology. We describe a Meshless Local Petrov Galerkin (MLPG) method that solves such magnetic diffusion problems using local weak forms composed of mesh-free shape functions. This MLPG method accommodates inhomogeneous and anisotropic electrical resistivity models and allows the magnetic field to be evolved implicitly in time. We have assembled several test problems of interest in order to verify the method. Ultimately, we aim to combine this MLPG method with a form of SPMHD in order to treat realistic resistive magnetohydrodynamic systems. This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.
[1] D. J. Price, J. J. Monaghan, Mon. Not. Roy. Astr. Soc. Volume 348 Issue 1 pp. 123-138 (2004)

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