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Numerical Improvements and Verification Problems for Hall MHD in the Ares Multiphysics Code[1] CHARLES ELLISON, WILLIAM FARMER, JEFFREY PARKER, Lawrence Livermore Natl Lab — Hall MHD captures important effects occuring in weakly collisional astrophysical and laboratory plasmas. In the laboratory setting, Hall MHD has attracted recent activity for modeling power flow and magnetically driven targets, such as MagLIF liners. In this work, we compare several numerical schemes for Hall MHD in 2D configurations with out-of-plane magnetic fields. We show that numerical instabilities arising in second-order centered differencing schemes can be eliminated using donor cell advection. The methods are tested using a zero-velocity Hall drift wave, a Hall magneto Rayleigh-Taylor instability, and a new verification problem involving the self-consistent evolution of the magnetic field and fluid velocity. The newer verification problem derives the linear response of a perturbed Hall MHD equilibrium; eigenfunctions are numerically determined from a resulting ODE in Cartesian or cylindrical geometry. We show numerical generated by Ares converge to the analytic solution in the linear regime.

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