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A New AMR Code for Relativistic Magnetohydrodynamics in Dynamical Spacetimes: Numerical Method and Code Validation YUK TUNG LIU, ZACHARIAH ETIENNE, STUART SHAPIRO, University of Illinois at Urbana Champaign — The Illinois relativity group has written and tested a new GRMHD code, which is compatible with adaptive-mesh refinement (AMR) provided by the widely-used Cactus/Carpet infrastructure. Our code solves the Einstein-Maxwell-MHD system of coupled equations in full 3+1 dimensions, evolving the metric via the BSSN formalism and the MHD and magnetic induction equations via a conservative, high-resolution shock-capturing scheme. The induction equations are recast as an evolution equation for the magnetic vector potential. The divergenceless constraint div(B)=0 is enforced by the curl of the vector potential. In simulations with uniform grid spacing, our MHD scheme is numerically equivalent to a commonly used, staggered-mesh constrained-transport scheme. We will present numerical method and code validation tests for both Minkowski and curved spacetimes. The tests include magnetized shocks, nonlinear Alfven waves, cylindrical explosions, cylindrical rotating disks, magnetized Bondi tests, and the collapse of a magnetized rotating star. Some of the more stringent tests involve black holes. We find good agreement between analytic and numerical solutions in these tests, and achieve convergence at the expected order.

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