MH4D: an MHD Algorithm on an Unstructured Tetrahedral Grid

R. Lionello, D.D. Schnack
Science Applications International Corporation
San Diego, CA 92121

Abstract

MH4D (Magnetohydrodynamics on a TETRAhedral Domain) is a massively-parallel, device-independent numerical code for the solution of the resistive and viscous MHD equations on an unstructured grid of tetrahedra. The unstructured grid allows the computanional domain to be of arbitrary shape and the resolution to be increased in the regions of physical interest. Consequently, plasma confinement devices of complex shape (e.g. stellerators) can be modeled and problems with a wide range of spatial scales can be studied. A variational formulation of the differential operators ensures accuracy and the preservation of the analytical properties of the operators ($\nabla \cdot \mathbf{B}=0$), and self-adjointness of the resistive and viscous operators. The combined semi-implicit treatment of the waves and implicit formulation of the diffusive operators can accommodate the wide range of time scales present in the solar corona. The capability of mesh refinement and coarsening is also included. MH4D is capable of solving the resistive diffusion equation and the equations of hydrodynamics. We are currently implementing the MHD operators and will present preliminary results..