Lagrange-Remap scheme for 3D ideal magnetohydrodynamic equations in a Cartesian AMR hydrocode

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Abstract

We present the high-order numerical scheme implemented in the cartesian AMR hydrocode HERA developed at CEA for ideal 3D MHD equations. The discretized model [1] contains two magnetic field instances: a centered one, denoted **B**, which contributes to the magnetic energy, and a staggered one, denoted **C**, which preserves the divergence. Its resolution is splitted into two steps:

1. We first solve the modified ideal MHD system in which some instances of the magnetic field are frozen to **C** on faces using a dimensional splitting and a Lagrange-remap approach. At first-order, the 1D Lagrangian scheme is a generalization to MHD of the two states Godunov acoustic solver [2] and is entropic under CFL condition. The high-order extension is a generalization of the GAIA scheme proposed in [3] for hydrodynamics. The 1D remap step is based on polynomial reconstructions [4].

2. We then update the face-valued **C** of the magnetic field using a constrained transport type method. During this step $\nabla \cdot \mathbf{C}$ is preserved at machine precision.

We will also discuss the coarsening and refinement AMR steps and conclude by presenting numerical results on standard test-cases in 2 and 3 dimensions.

References

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