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Taylor-Galerkin Residual Distribution Schemes with Applications to Astrophysical Flows JAMES ROSSMANITH, University of Wisconsin — Residual distribution (RD) schemes are multidimensional extensions of the upwind method for solving hyperbolic PDEs. These schemes are most often implemented on unstructured triangular (tetrahedral) grids in 2D (3D). For steady-state flows, these methods have been shown to produce accurate and efficient results for several hyperbolic systems including the compressible Euler equations of gas dynamics and the ideal MHD equations of plasma physics. In particular, RD schemes have the capability to accurately approximate shock waves and contact discontinuities. In the last few years, research has focused on developing high-order versions of these methods for fully time-dependent flows. In this work we present some preliminary results on a Taylor-Galerkin residual distribution scheme for time-dependent flows. The work we present on RD schemes is part of a larger effort to develop more accurate and efficient computational methods for simulating astrophysical flows. Examples of phenomena where such tools are required are the accretion of matter onto black holes and the dynamics of pulsar wind nebulae. Under the assumption that the space-time metric remains fixed on the time scales of fluid motion, these flows are governed by the equations of relativistic hydrodynamics. In this work, in addition to a discussion of our work on Taylor- Galerkin residual distribution schemes in general, we will present some numerical examples from astrophysical fluid dynamics.

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