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Numerical simulation of partially ionized gas flows under the influence of electromagnetic fields KONSTANTINOS PANOURGIAS, University of Patras, JOHN EKATERINARIS, Embry-Riddle Aeronautical University — Partially ionized gases under the influence of electromagnetic fields are described through the coupled system of the compressible Navier-Stokes equations augmented by the equations of species in the mixture (electrons, ions, atoms) and the Maxwell equations. The coupled system is completed with an energy equation for electrons. Stiff source terms encompass the interactions of fluid flow with electromagnetic fields and resulting system of equations is solved numerically. The discontinuous Galerkin finite element method is used for the numerical solution of the above system.For the Maxwell equations, DG method is performed using a divergence free vector basis for the magnetic field in order to preserve zero divergence in the element and retain the global implicit constraint of a divergence free magnetic field vector down to very low levels. In order to avoid severe time step limitations for the Maxwell system, implicit time marching is used with high order implicit Rugne-Kutta methods. The coupled system of the Navier-Stokes and the Maxwell equations is advanced in time simultaneously to avoid wrong wave shapes and propagation speeds that are obtained when the coupling source terms are lagged in time.The method is applied for supersonic plasma flows in strong electromagnetic fields.

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