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A high resolution wave propagation scheme for ideal two-fluid plasma equations. (English)

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Summary: Algorithms for the solution of the five-moment ideal two-fluid equations are presented. The ideal two-fluid model is more general than the often used magnetohydrodynamic (MHD) model. The model takes into account electron inertia effects, charge separation and the full electromagnetic field equations and allows for separate electron and ion motion. The algorithm presented is the high resolution wave propagation method. The wave propagation method is based on solutions to the Riemann problem at cell interfaces. Operator splitting is used to incorporate the Lorentz and electromagnetic source terms. To preserve the divergence constraints on the electric and magnetic fields two different approaches are used. In the first approach Maxwell equations are rewritten in their mixed-potential form. In the second approach the so-called perfectly hyperbolic form of Maxwell equations are used which explicitly incorporate the divergence equations into the time stepping scheme. The algorithm is applied to a one-dimensional Riemann problem, ion-acoustic soliton propagation and magnetic reconnection. In each case two-fluid physics described by the ideal two-fluid model is highlighted.

MSC:

76W05	Magnetohydrodynamics and electrohydrodynamics
76M20	Finite difference methods applied to problems in fluid mechanics
76X05	Ionized gas flow in electromagnetic fields; plasmic flow
82D10	Statistical mechanics of plasmas

Keywords:

plasma physics; two-fluid; high resolution; Godunov method; magnetic reconnection; solitons; Maxwell equations

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