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(57) Abstract:

The present invention relates to a computational system for simulating magnetohydrodynamic (MHD) and relativistic fluid behavior in high-energy environments. The system integrates a computational processing engine, adaptive meshing framework, magnetohydrodynamic solver, relativistic fluid dynamics module, thermal transport engine, turbulence analysis subsystem, and electromagnetic field computation module to accurately model interactions between electrically conducting fluids and magnetic fields under extreme conditions. The invention further incorporates intelligent optimization algorithms, machine learning techniques, and high-performance parallel computing architectures to improve computational efficiency, numerical stability, and prediction accuracy. The system is capable of simulating plasma confinement, fusion reactor dynamics, astrophysical phenomena, space weather interactions, high-speed aerospace environments, and industrial electromagnetic fluid systems. Advanced visualization and data assimilation capabilities enable real-time monitoring, validation, and predictive analysis of complex physical processes. The invention provides a unified, scalable, and efficient computational platform for scientific research, engineering design, and high-energy system analysis.