Computational fluid dynamics, plasma science and MHD via mathematical modeling and simulation

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In this paper, we solve mathematical equations govern specific computational fluid dynamics, plasma science and MHD problems. Mathematical modeling and solution, applied here, are to be run for industrial applications e.g.; industrial combustion, plasma thrusters and spacecraft propulsion. Computer-based simulations and graphical visualization will be carried out in the scientific investigations. This involves developing algorithms to estimate and determine the values for the parameters that best explain the data. The technology, we use, is based on variational concepts. Broadly speaking, we found that without using such or similar technique or simplifying model problems; solution would be computationally quite expensive or even impossible. Such believe validate once we consider the non-linear case, turbulence and boundary layers (Laminar, Stokes, Blasius or Ekman).

References

[1] A. Yu. Chebotarev and A. S. Savenkova, Variational Inequalities in Magneto-Hydrodynamics, *Mat. Zametki*, **82**, No. 1 (2007), pp. 135–149.

[2] G. A. Glatzmaier, and P. H. Roberts, *A three-dimensional convective dynamo solution with rotating and finitely conducting inner core and mantle*, *Phys. Earth Planet. Inter.*, **91** (1995), pp. 63-75.

[3] C. A. Jones, A. I. Mussa and S. J. Worland, *Magnetoconvection in a Rapidly Rotating Sphere: the weak field case*, *Proc. R. Soc. Lond. A*, **459**, No. 2031 (2003), pp. 773-797.

[4] C. A. Jones, A. M. Soward and A. I. Mussa, *The Onset of Thermal Convection in a Rapidly Rotating Sphere*T, *J. Fluid Mech.,* **405**, (2000), pp. 157-179.