Computational Fluid Dynamics in Cinvestav-Abacus

Jaime Klapp[1,2] and Isidoro Gitler[2]
[1]Instituto Nacional de Investigaciones Nucleares
[2]Departamento de Matemáticas, Cinvestav

During the first half of 2015 a new large supercomputer will start operation in the Centre for Applied Mathematics and High Performance Computing of Cinvestav-Abacus, located in State of México, Mexico. Among our fluid dynamic projects that require large computer resources and the handling of large amounts of data are the following: Astrophysical applications: Galaxy collisions, in particular for explaining the structure of the so-called irregular galaxies; star formation for understanding how stars are formed from molecular interstellar gas clouds; cosmology for understanding various aspects of the cosmic evolution. For the last two astrophysical applications we solve the radiative transfer equation in detail, up to now these effects has mostly been taken into account through an equation of state. Environmental applications: using the Weather Research and Forecasting Model we will study short, mid and long term global warming effects and propose definitive actions to be taken by the government to reduce global warming. Multiphase flow: a large project is underway for studying various multiphase problems, including the simulation of oil fractured reservoirs, and dispersion of contaminants in soil, water and the atmosphere. Complex Fluids: Multi-scale simulations of equilibrium and non-equilibrium properties in multi-component fluids such as solubility parameters, interfacial tension, colloidal stability, competitive adsorption, conformation, viscosity and phase transitions at different thermodynamic conditions. Medicine: Hemodynamic simulations of cerebral arteriovenous malformations for helping the understanding and treatment of cerebral malformations. For the numerical models we use several techniques: Smoothed Particle Hydrodynamics (SPH), Finite Differences (FD), Finite Elements (FE), Dissipative Particle Dynamics (DPD), and Molecular Dynamics (MD). In the project several national (CINVESTAV, ININ, UNAM, IPN, UAM, UNISON, HRAE, INNN) and international (University of Vigo, Spain, Barcelona Supercomputing Center, Spain, IVIC, Venezuela) institutions are involved.