

NASA Spring 2020 Internship Position

Title:

Improving the Efficiency and Parallel Scalability of a Scientific Code

Type:

Internship

Session:

Spring 2020

Center:

Glenn Research Center

Description:

The development and flight of Electric Propulsion (EP) thrusters require high-fidelity physics-based numerical simulations. At NASA GRC, we use a multi-scale hybrid particle-fluid framework to perform large domain simulations, such as single/multiple thrusters in a ground vacuum facility and in a full-size spacecraft on orbit. The hybrid particle-fluid code used in this project is written in object-oriented C++ and has a parallel simulation capability using MPI. The student's main goal is to improve simulation speed/efficiency of the code by optimizing both various algorithms in the code and the MPI network and thus parallel scalability (i.e., increasing number of processors resulting in faster computation time). In particular, the student will look at the current MPI parallelization, particle-merging and splitting algorithms, fluid model, and mixed DSMC (Direct Simulation Monte Carlo) and ray tracing algorithms to improve the computation speed for both in-space and vacuum chamber simulations. This project supports the core competency of In-Space Propulsion at NASA GRC.

Keywords: parallel computing; MPI optimization; Object-oriented C++; Improve computation / simulation speed

Computer/Software Skills:

Student must have a solid foundation for writing efficient, safe C++ code. Student must be proficient with programming and computer science concepts (e.g. variable, control flow, functions, data structures, algorithms). The student should have knowledge of MPI (or OpenMP) and parallel computing.

Other Skills:

Understanding of basic engineering and physics concepts is necessary. Prior scientific computing experience is desired. Prior knowledge of electric propulsion, plasma, and DSMC are NOT required but could be helpful.

Good communication and teamwork skills are required. The student should have the ability to learn new materials quickly.

Academic Level(s):

College Junior; College Senior; Master's; Doctorate

Major(s):

Computer and Information Sciences - Computer Programming; Computer and Information Sciences - Computer Science; Computer and Information Sciences - Computer Systems Networking and Telecommunications; Engineering - Aerospace / Aeronautical and Astronautical Engineering; Engineering - Computer; Engineering - Electrical / Electronics / Communications Engineering; Engineering - Mechanical; Engineering - Nuclear; Engineering - Physics; Mathematics - Applied; Mathematics - Mathematics and Statistics; Multi-disciplinary - Computational Science; Physical Science - Astronomy and Astrophysics; Physical Science - Atmospheric Sciences and Meteorology; Physical Science - Physics

Mission directorate(s):

Human Exploration and Operations Mission Directorate

Deadline for application:

November 5, 2019

Apply at:

<https://nasa.force.com>