HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

RESEARCH PROJECT #: HPCMP-HIP-25-013

Quantitative Cloud and Spectral Effects on Directed Energy Systems

About AFIT:

The US Air Force Institute of Technology (AFIT) confers accredited graduate and PhD degrees to military and civilian professionals and yields outstanding technical leaders by providing superior education built on defense- and dual-use civilian-focused research. AFIT's cutting edge, applied education and consulting services support DoD and other US Government Agency needs while molding individuals capable of anticipating and providing solutions to requirements and adapting to any contingency or crisis.

RESEARCH LOCATION: Wright-Patterson AFB, OH

PROJECT DESCRIPTION:

Anchored to the coupling of Air Force Institute of Technology's (AFIT's) Laser Environmental Effects Definition and Reference (LEEDR) code and National Oceanic and Atmospheric Administration's (NOAA) Numerical Weather Prediction (NWP) model data, 4D Weather Cubes provide realistic sky characterizations to capture statistical and quantitative information per cloud types for potentially global analyses. Consecutively, the frequency of occurrence and impact of weather conditions in the operating environment, including climatological visualizations, will also be quantified per designated region of interest (e.g. CENTCOM). The intern will utilize HEC resources to generate 10+ years of 4D Weather Cubes and thus cloud data to quantify cloud distributions per type and altitude, as well as atmospheric extinction and radiance statistics for 30+ wavelengths covering high energy laser (HEL) and EO/IR bands of interest.

CDE's overarching HIP project goals seek to: a) guide the intern to become proficient on use of HEC assets for advanced, worldwide meteorological and cloud data arrays and forecasted DE performance analyses based on real-world weather to support DE technologies advancements; and b) foster HIP intern professional growth by introducing the intern to DoD science, engineering, and technology transition. The scoped HIP effort includes a DE laser and sensor performance assessments based on regional/worldwide 4D Weather Cubes, capturing the impact of realistic atmospheric conditions including clouds/precipitation, on said laser/sensors. The plan includes substantial orientation of the intern on multi-spectral atmospheric propagation, radiative transfer, and performance simulation tools for DE system assessments-- which will be accomplished via journal articles, AFIT student theses, prior HIP intern research papers, and participation in weekly CDE staff and AFRL meetings.

The intern will interact daily with several co-mentors, including three seasoned software engineers (one is a former HIP intern turned full-time AFIT-CDE staff member), each of whom has HEC experience. The intern will also have opportunities to exchange ideas with other AFIT faculty and staff, as well as PhD/MS students, pursuing complementary atmospheric effects and laser research. This interaction will expose the intern to the scientific, collaborative method one applies to pursuits of such broad scale as associated with creating atmospheric and performance assessments based on regional weather including clouds/fog events. Understanding the science behind the HEC code and data processing offers valuable insight into physics/math-based problems and the opportunity to critically assess the results and best methods to display the data to DE professionals.

The intern will attend weekly staff meetings to provide the research staff progress updates and as the summer comes to an end brief the HIP project and results at the AFIT Physics Department Seminar, which is attended by the entire Physics Department's graduate student body and open to all faculty and staff. The intern will tour CDE indoor/outdoor laboratories where experimental atmospheric characterization and effects research, and field tests are conducted to validate DE capability modeling and simulation code. Additionally, effort will be made to arrange a tour of local Wright-Patterson AFB HEC facilities. The intern will have opportunities to network and present their research at various professional forums, including the Directed Energy Professional Society's (DEPS) Annual Symposium.

ANTICIPATED START DATE:

May 2025 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

QUALIFICATIONS:

The intern must be pursuing a major in Computer Sciences, or Atmospheric Sciences with strong programming skills, preferably a Junior or Senior in their studies. Having familiarity with MATLAB and Linux are also preferred to maximize the impacts of the internship for both the intern and mentor-guided project.

ACADEMIC LEVEL:

Degree received within the last 60 months or currently pursuing:

- Bachelor’s
- Master’s

DISCIPLINE NEEDED:

- Computer, Information, and Data Sciences
- Earth and Geosciences