HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM
RESEARCH PROJECT #: HPCMP-HIP-26-004

AI/ML Reinforcement Learning in HPCMP Aircraft Design Tools

About AFRL:

Air Force Research Laboratory (AFRL) is a scientific research organization operated by the United States Air Force Materiel Command. AFRL is dedicated to leading the discovery, development, and integration of aerospace warfighting technologies, planning, and executing the Air Force science and technology program, and providing warfighting capabilities to United States air, space, and cyberspace forces.

This project will be carried out in the Aerospace Systems Directorate's Aerodynamic Technology branch which focuses on advancing a variety of aerospace technologies, including unmanned vehicles, hypersonic vehicles, and collision avoidance systems. The branch is involved in cutting-edge research and development, including scramjet engines and alternative fuels.

RESEARCH LOCATION: Wright-Patterson AFB, OH

PROJECT DESCRIPTION:

Many groups across the DoD use CREATE-AV's ADAPT software to conduct aircraft design studies and analyze aircraft performance. These studies help quantify the impacts of new technology and form the basis for the requirements of new aircraft programs. The speed and quality of these design studies could be improved by the use of AI/ML Reinforcement Learning techniques, driving ADAPT analysis on DoD HPC machines. This project will get Reinforcement Learning working on HPC, with each point evaluation completed by ADAPT.

Under the guidance of mentors, the intern will be given a sample aircraft design problem already set up in the ADAPT environment. The intern will spend the first two weeks learning how to use ADAPT and HPC resources by exploring the design space using existing techniques on HPC, like full factorial exploration and non-gradient based optimization. Weeks three through ten, the intern will gain knowledge and experience in:

- Getting ADAPT running by using Flux on the HPC machines. Flux, from Lawrence Livermore National Laboratory, is a next-generation resource and job management framework. It provides an ability to run many short jobs quickly, without waiting in the overall job queue, which is crucial to the success of Reinforcement Learning (RL) techniques driving ADAPT on HPC. Flux is already installed on the HPC machine the intern will be using
- Use python RL techniques driving ADAPT on HPC through Flux. This project will use the same RL libraries recently used by the CREATE SHIPS team
- Explore the sample aircraft design problem using the new techniques and compare the final design to the designs found using the old techniques

The intern will have an opportunity to:

- Learn how to run the ADAPT aircraft design software using HPC resources
- Use the ADAPT aircraft design software to explore an aircraft's design space using design of experiments, non-gradient optimization, and AI/ML Reinforcement Learning techniques
- Gain familiarity with design space exploration using HPC resources
- Meet and work with aircraft design research experts, both at the AFRL, and within the DoD wide ADAPT community, providing excellent networking opportunities in the aircraft design field
- Tour of AFRL facilities, including wind tunnels, etc., and a guided tour of the world class National Museum of the US Air Force

This internship will provide an appropriate challenge for a ten week internship, while the intern collaborates with the mentors and the ADAPT development team. The project will allow the intern to build valuable skills in AI/ML, HPC utilization, and aircraft design processes that will serve them well in future career endeavors.

ANTICIPATED START DATE:

May/June 2026 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

QUALIFICATIONS:

The ideal candidate will be currently pursuing or received a bachelor's degree in Aeronautics/Aviation/Aerospace Science or related field. Factors that would be considered favorable:

- Completion of an aircraft design course
- Some experience using the Python programming language
- Some experience or course work using design optimization techniques
- Some experience or course work using Reinforcement Learning (RL) techniques

ACADEMIC LEVEL:

Degree received within the last 60 months or currently pursuing:

- Bachelor's
- Master's
- Doctoral

DISCIPLINE NEEDED:

- Computer, Information, and Data Sciences
- Engineering
- Science & Engineering-related