

HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

RESEARCH PROJECT #: HPCMP-HIP-24-005

Rotor Aerodynamics and Structural Loads for a Coaxial Rotor Test Stand

About DEVCOM ARL:

The DEVCOM Army Research Laboratory conducts basic and applied research for the Army. Its mission is to operationalize science for transformational overmatch. The basic research conducted at the laboratory leads to capabilities for soldiers to fight and win on the battlefield. The Vehicle Applied Research Branch specifically conducts experimental and computational research in rotary-wing and other vertical lift technologies at both the manned and unmanned scales.

RESEARCH LOCATION: Aberdeen Proving Ground, MD

PROJECT DESCRIPTION:

Coaxial rotor aircraft have been proposed for future vertical lift applications. Both lift-offset coaxial rotors and more conventional coaxial rotors have potential for high maneuverability and high-speed for future aircraft, but there are currently no operational coaxial rotor helicopters in service in the United States. There are several technology risks and uncertainties related to coaxial rotor aerodynamics, vibration, and loads, especially at high speed. The DEVCOM Army Research Laboratory is in the process of designing a coaxial rotor test bed for wind-tunnel testing. The intern project would be to conduct CFD and coupled CFD/CSD analysis of the wind tunnel model design using RCAS and Helios and predict its performance, loads, and vibration.

The intern will be given the opportunity to impact an Army-relevant program using state-of-the-art computational tools Helios and the Army's Rotorcraft Comprehensive Analysis System (RCAS), and Capstone. Normally the CREATE program offers a training class on Helios and Capstone at the beginning of summer that summer students from several DoD laboratories attend. The mentors will train the student to use RCAS, to create CFD/CSD coupled models in Helios, and to develop custom scripts to post-process the Helios results. A preliminary design of the MSCRAT will be available including blade sections and planform, hub geometry, and structural properties. Ideally the student would create both the Helios and RCAS models while the mentors create a CAMRAD II model in parallel. Normally the student requires significant training with RCAS models, and this provides an opportunity for the student to learn a widely used DoD analysis tool.

In past years, because of their internships, students have learned to use several government-owned computational tools which they would not have access to at school, which makes them more interested in and marketable to the DoD and defense contractors. Many have co-authored papers and even gone on to be hired into DEVCOM ARL, hired elsewhere within the DoD or by defense industry contractors and many have returned to ARL or interned at other Army research facilities.

Exact research will depend on the student's prior experience and interest. An approximate 10-week schedule is as follows:

Weeks 1-3: Training on software and development of CFD meshes, and RCAS models.

Weeks 4-7: Conduct most of computational runs and process results.

Weeks 8-10: Complete computational runs, prepare HIP deliverables, and participate in summer student symposium.

ANTICIPATED START DATE:

May 2024 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

QUALIFICATIONS:

The ideal candidate would be master's or doctoral student in aerospace engineering with education or experience in vertical lift/rotorcraft aerodynamics and dynamics.

Favorable knowledge and experience include:

- Aerodynamics and computational fluid dynamics
- Rotorcraft dynamics
- Structural dynamics and vibration
- Scientific programming in languages such as Matlab or Python

ACADEMIC LEVEL:

Degree received within the last 60 months or currently pursuing:

- Bachelor's
- Master's
- Doctoral

DISCIPLINE NEEDED:

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