Reinforcement Learning Based Control Agent for Rotorcraft Trim Applications

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 manned and unmanned scales.

RESEARCH LOCATION: Aberdeen Proving Ground, MD

PROJECT DESCRIPTION:

Reinforcement learning based control agents will be developed to provide an automated trim capability for rotorcraft simulations within the CREATE-AV Helios software. Several aspects of developing the reinforcement learning control agent will be explored including state estimation, pre-training, and reward policy design. Different reinforcement learning (RL) control algorithms will be evaluated to provide understanding and insight into their effectiveness, robustness, and reliability. RL trim agents will be developed for the CREATE-AV Helios software that can test RL policies using CFD.

Under the guidance of mentors, the intern will learn how to perform Helios simulations using a variety of HPC tools including Helios (CREATE-AV) and Capstone (CREATE-FT). The intern will attend Capstone and Helios trainings if offered by the CREATE program. The intern will learn how to write plugins for Helios, how to track and process aerodynamic loads, how to control rotor states to achieve the desired response, how to train RL models, and how to use RL models for control.

In the first two weeks of the internship, the mentor will train the intern on software, methods, concepts related to the research (Helios, Capstone, RL modeling for control). The intern will learn how to perform Helios simulations on the HPC systems and introductory RL control.

Throughout the 10-week period, a daily informal meeting will be scheduled to assess the intern progress and fill in any knowledge gaps. The intern and mentors will be co-located in the same building which allows for convenient formal and informal daily interactions. At the conclusion of the project, the intern will present their findings to researchers in the mentor organization.

Tentative program schedule (10-weeks):

Weeks 1-2: Training on software, CFD model setup, Helios plugin architecture, TensorFlow, proportional control, RL control agent.

Weeks 3-5: Run basic Helios control plugin (proportional controller for rotor thrust control) and existing HELIOS RL control agent. Develop low-order aerodynamic model for pre-training. Investigate the effect of state information on low-order model.

Weeks 6-8: Integrate and demonstrate state-informed RL control agent (pre-trained and cold-start) into HELIOS plugin.

Weeks 9-10: Assess the performance.

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 would be a master's or doctoral student in aerospace engineering or computer engineering sciences education or experience in:

- CFD
- Surrogate modeling
- Control experience
- Python

ACADEMIC LEVEL:

Degree received within the last 60 months or currently pursuing:

- Master's
- Doctoral

DISCIPLINE NEEDED:

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