Opportunity Title: Computational Fluid Dynamics / Machine Learning: Aerospace Engineering Summer Internship
Opportunity Reference Code: ERDC-ITL-2023-0004

Organization U.S. Department of Defense (DOD)

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How to Apply Click on *Apply* now to start your application.

Description

The HPCMP CREATE TM -AV is tasked to develop, deploy, and support a set of multi-disciplinary, physics-based simulation software products for the engineering workforces supporting air vehicle acquisition programs of the services. The products are designed to exploit the capacity of next generation computer resources and enable increased capacity of the engineering workforce, reduced workloads through streamlined and more efficient engineering workflows, and minimized need for rework through early detection of aircraft design faults and performance anomalies.

Computational Fluid Dynamics simulations are typically run in parallel. Each simulation is different based on the size and density of the computational domain and the features selected for execution. These differences drive the scope of the distributed resources needed to execute the simulation. However, sound guidance on the optimum selection does not currently exist. The existing helps in the software only solve part of the problem. The proposed effort will work towards development of a machine learning based estimator that, using the simulation inputs, will predict the optimum processor count to set for the simulation based on the simulation inputs and a given cluster memory available per core.

HPCMP CREATE TM -AV Helios is a multi-physics simulation tools focused on rotary wing applications in regular use by a wide variety of organizations to support the DoD mission. In general, improvements to this tool will improve the experience of the entire user community. This specific effort addresses a long standing issue with regards to how to decide what processor count to set on the DSRCs. Most users will learn what works and doesn't work through experience, but this takes time, doesn't guarantee that the final result is optimal, and often must be revisited when moving to a different clusters. In addition, there are situations where a poor selection will produce an error that is sometimes mistaken for a software problem and not tied to how the case was setup, delaying user progress while they work to resolve a problem that doesn't exist. The current effort will work towards developing a machine learning based predictor to help guide the user in the appropriate processor count to select for a simulation. This product will have multiple benefits, the user will experience less trial and error when executing simulations, the recommended processor count will be more optimal, saving both the user's time and making better use of the DSRC resources. Given the ever increasing popularity of Helios these gains will add up.

The development of the machine learning predictor requires multiple stages. The most critical of these is gathering a database of information with which to train the model. This data gathering is aimed at creating a predictor based on a more optimal selection rather than user experience so a wide variety of simulations will be needed to extract this information. These simulations will not only varying the problem size, but also will include a variety of different software features, vary the processor count, and use multiple clusters. In addition, while gathering data, intermediate data analysis is needed to ensure that the plan is producing results that may be used effectively in the final product by training and evaluating the machine learning framework. Note that an initial investigation into this effort has already been pursued to assess the feasibility of the concept with positive results.

What will I be doing?

Under the guidance of a mentor, you will learn how to use Helios and how to interact with Helios on the DSRCs through the portal, attending weekly virtual meetings with the mentors to present

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intermediate results and discuss progress, writing the final required paper, and putting together a final presentation. Additional research include setting up and executing a wide variety of Helios simulations, and processing and presenting the data as it is generated. You will also be involved with initial investigations into the training, execution, and evaluation of the machine learning framework. In general, you will gain practical experience using Helios, working with the DSRCs, and learning how machine learning may be used to support the aerospace community.

Why should I apply? This fellowship provides the opportunity to independently utilize your skills and engage with experts in innovative ideas to move the proposed research forward.

Where will I be located? Remote

What is the anticipated start date? June 2023 - Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

What is the appointment length? This appointment is a summer research appointment. Appointments may be extended depending on funding availability, project assignment, program rules, and availability of the participant.

What are the benefits? You will receive a stipend to be determined by the sponsor. Stipends are typically based on a participant's academic standing, discipline, experience, and research facility location. Other benefits may include the following:

- Health Insurance Supplement (*Participants are eligible to purchase health insurance through ORISE)*
- Relocation Allowance
- Training and Travel Allowance

About ORISE

This program, administered by Oak Ridge Associated Universities (ORAU) through its contract with the U.S. Department of Energy (DOE) to manage the Oak Ridge Institute for Science and Education (ORISE), was established through an interagency agreement between DOE and DoD. Participants do not enter into an employee/employer relationship with ORISE, ORAU, DoD or any other office or agency. Instead, you will be affiliated with ORISE for the administration of the appointment through the ORISE appointment letter and Terms of Appointment. Proof of health insurance is required for participation in this program. Health insurance can be obtained through ORISE. For more information, visit the ORISE Research Participation Program at the U.S. Department of Defense.

Qualifications

This internship opportunity is most relevant to students in, or planning to pursue a future career in the field of aerospace engineering. While the core research is focused on machine learning efforts, these efforts support the aerospace engineering community and will provide you with practical experience in setting up, executing, and evaluating computational fluid dynamics simulations. Having some background in computational fluid dynamics is a plus, but not a requirement. Having some background in rotary wing aerodynamics is a plus, but not a requirement.

Security Investigation: Applicants should be able to pass a National Agency Check and Inquiries (NACI) security investigation should they be selected and accept the internship offer.

Application Requirements

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A complete application consists of:

- Zintellect Profile
- Educational and Employment History
- Essay Questions (goals, experiences, and skills relevant to the opportunity)
- Resume (PDF)
- Transcripts/Academic Records - For this opportunity, an official transcript or copy of the student academic records printed by the applicant or by academic advisors from internal institution systems may be submitted. Click here for detailed information about acceptable transcripts.
- One recommendation. Your application will be considered incomplete and will not be reviewed until one recommendation is submitted. We encourage you to contact your recommender(s) as soon as you start your application to ensure they are able to complete the recommendation form and to let them know to expect a message from Zintellect. Recommenders will be asked to rate your scientific capabilities, personal characteristics, and describe how they know you. You can always log back in to your Zintellect account and check the status of your application.

Submitted documents must have all social security numbers, student identification numbers, and/or dates of birth removed (blanked out, blackened out, made illegible, etc.) prior to uploading into the application system. All documents must be in English or include an official English translation. If you have questions, send an email to USACE@orise.orau.gov. Please list the reference code of this opportunity in the subject line of the email. Please understand that ORISE does not review applications or select applicants; selections are made by the sponsoring agency identified on this opportunity. All application materials should be submitted via the “Apply” button at the bottom of this opportunity listing. Please do not send application materials to the email address above.

Connect with ORISE...on the GO! Download the new ORISE GO mobile app in the Apple App Store or Google Play Store to help you stay engaged, connected, and informed during your ORISE experience and beyond!

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Associate's Degree, Bachelor's Degree, Master's Degree, or Doctoral Degree received within the last 60 months or currently pursuing.
- **Overall GPA:** 3.00
- **Discipline(s):**
  - **Computer, Information, and Data Sciences** (17)
  - **Engineering** (27)
  - **Mathematics and Statistics** (11)
  - **Physics** (16)
- **Age:** Must be 18 years of age
- **Veteran Status:** Veterans Preference, degree received within the last 120 month(s).