

# HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

## RESEARCH PROJECT #: HPCMP-HIP-24-030

### Data Management and Learning for Autonomous System

#### About DEVCOM ARL:

The Army Research Laboratory (ARL) is the Army's foundational research laboratory focused on cutting-edge scientific discovery and technological innovation. This internship is with ARL's Science of Intelligent Systems Division where research and experimentation are conducted to drive the future of ground autonomy systems. Research topics includes robotics mobility and computer vision.

**RESEARCH LOCATION:** White Marsh, MD

#### PROJECT DESCRIPTION:

High speed robots, such as the DARPA Robotic Autonomy in Complex Environments with Resiliency (RACER) Robotic Fleet Vehicle, require immensely higher resolution and higher frame rate sensors to collect data at greater distances which means the data collected by robotic platforms increases in veracity and volume requiring the high-performance computing resources for analysis and machine learning. At any given DARPA RACER test, upwards of 45 TB are collected and must be uploaded on an HPC for post processing. The ARL autonomy stack is a collection of continuously evolving perception, planning, control, and state-estimation algorithms that enable autonomous maneuver. These tools are created in collaboration with other efforts such as the ARL Scalable, Adaptive, and Resilient Autonomy (SARA) Collaborative Research Alliance and DARPA RACER, allowing researchers to process and inspect sensor logs at the terabyte scale and create smaller extractions from these logs for closer analysis and in-turn improving the autonomy stack. Under the guidance of mentors, the intern(s) will upload data to HPC for processing and labeling and learn how to train models using these datasets.

The interns will be an integral part of the Science of Intelligent Systems Division efforts providing data management and analysis for robotic experiments. The focus for the interns will be large datasets collected by ground platforms navigating in unstructured environments. The interns will be introduced to the Robot Operating System, the Phoenix ground autonomy stack and how it is used in on SCOUT and Jean. The interns will learn how to work with large datasets, and the process to create analysis products relevant to ongoing research.

Weeks 1-2: Obtain access to HPC systems, meet with AIMM scientists, understand system architecture, and understand the data analysis workflow. Introduction to HPC, getting setup with relevant access. Introduction to the ARL Ground Autonomy Stack, Robot Operating System (ROS) and ROSbag data format.

Weeks 3-5: Learn to use RACER data store system on HPC, upload data for processing, accessing, and labeling. Learn how to train models using datasets.

Weeks 5-7: Use python interface in data store to find key points (i.e., manual interventions, emergency stops), create extractions relevant to those points, and document process and issues.

Weeks 8-9: Use existing tools or expand upon existing tools to create analysis products and models from datasets. This includes videos, charts, and spreadsheets of various collected data streams.

Week: 10: Finalize presentation, poster, and report.

**ANTICIPATED START DATE:**

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

**QUALIFICATIONS:**

- Background experience in a Linux environment and using Python3. Comfortable using the Command Line.
- Desired Experience: Robot Operating System, Containerization (Singularity/Docker)

**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