Investigation into 3D Reconstruction: HPC-Driven Gaussian Splat and Neural Radiance Field (NeRF) Modeling

About ERDC-ITL:

The U.S. Army Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi, is the premier research and development laboratory complex for the Corps of Engineers, engaged in creating and applying advanced information technology to support the Warfighter and the nation. ERDC-ITL develop revolutionary products, processes, and methods to address a wide range of engineering and scientific challenges.

The Sensor Integration Branch (SIB) applies sensing modalities to existing and emerging technologies for smart and automated systems solutions. The branch leverages cutting-edge technology research to develop these innovate solutions, which resolve challenges and enhance processes for military and civil works customers.

RESEARCH LOCATION: Vicksburg, MS

PROJECT DESCRIPTION:

ERDC ITL developed multiple robotic platforms to perform unmanned inspections of subterranean infrastructure for the US Army Corps of Engineers and site reconnaissance of unknown environments for the DoD. The robotic platforms were developed using the Robotic Operating System (ROS) and are capable of real-time Simultaneous Localization and Mapping (SLAM) using a fusion of lidars and cameras. This effort will investigate upscaling these maps using Gaussian Splats and Neural Radiance Fields (NeRF) as photo-realistic 3D models.

This effort will investigate the viability of using Gaussian Splats and Neural Radiance Field (NeRF) models on the data products of robotic inspection platforms including existing SLAM maps with exported camera images and poses. These methods are GPU capable but will require the large GPU Memory available in HPC systems like Carpenter. There are many potential open-source libraries on GitHub for generating Gaussian Splats and NeRFs, but they will commonly require python and C++ compilers.

The project will be completed within a 10-week period.

Weeks 1-2: Obtain system access, learn about the team's projects, read the existing literature, learn how to run jobs on HPC.

Weeks 3-4: Intern 1: Identify Gaussian Splat libraries and test against small-scale typical datasets.

Weeks 3-4: Intern 2: Identify NeRF libraries and test against small-scale typical datasets.

Weeks 5-9: Interns 1 & 2 will pair program software to link their libraries with our SLAM map outputs & process full scale datasets on the HPC.

Weeks 9-10: Write documentation and research report, present results at HIP Symposium.

During this internship, the interns will have a workstation in the Edge Computing Lab, a modular workspace tailored to encourage collaboration and team building among the robotics team. This space facilitates hands-on project development on a variety of robotic platforms and allows team members to see the real world impact of their research.

In addition to the proposed research plan, the interns will attend technical meetings, participate in tours of the ERDC campus, and network with experts in a variety of fields. ITL hosts a variety of seminars and workshops focused on advanced computing, machine learning, and other relevant topics, which the interns would be encouraged to attend. The interns will also be invited to join other ERDC interns in social and team building activities through the Student Engagement Program at ERDC Vicksburg. The interns could also be invited to a robotic field deployment if the schedule allows.

ANTICIPATED START DATE:

May 2025 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

QUALIFICATIONS:

A successful candidate should be pursuing a graduate degree in Computer Science, Machine Learning, Robotics, Computer Vision, or a related field. They should have programming experience with Bash, Git, Python, and C++. The ideal candidate would also be familiar with the Robotic Operating System (ROS), Pytorch, CUDA, and/or Docker.

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