HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM RESEARCH PROJECT #: HPCMP-HIP-25-018

Streamlined Image Metadata Transformations for 3D Reconstruction

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. The ERDC DSRC operates a variety of large HPC systems to serve the HPC needs of engineers and scientists throughout the DoD.

RESEARCH LOCATION: Vicksburg, MS

PROJECT DESCRIPTION:

The ITL Supercomputing Research Center at ERDC has a unique opportunity to create 3D models from ground and aerial imagery, using edge computing and HPC. Despite the vast amount of data at ERDC's disposal, the potential for 3D reconstruction remains largely untapped. Currently, some groups at ERDC utilize MetaShape, a closed-source tool developed by AgiSoft, a Russian company. Our proposed project aims to initiate the development of a government off-the-shelf software pipeline to process ERDC data to create 3D models, with a focus on finding appropriate transforms from the diverse sensor platforms for use in reconstruction research.

The project aims to harness both edge computing and HPC resources for transforming camera metadata for 3D reconstruction. The GUI will be developed using C++, Qt, and OpenGL. We will leverage open-source libraries such as Eigen for matrix operations and OpenCV for image processing to ensure robust metadata parsing and transformations. Our objective is to create a tool that can process metadata in various formats, visually show how a specified transformation affects the cameras, and iterate until a proper transformation is found. Once the correct transformation is identified, the tool can process all associated metadata or provide a command that can be used on any folder without the GUI.

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

Weeks 1-2: Focus on gathering requirements and prototyping.

Weeks 3-5: Will involve core development, including metadata parsing, transformation computation, and integration with HPC resources.

Weeks 6-8: Will flesh out the user interface using Qt and OpenGL.

Weeks 9-10: Will be dedicated to testing, optimization, and final delivery.

During this internship, the student will actively participate in all stages of the software development lifecycle, from prototyping to deployment. The student will gain hands-on experience using Qt for GUI development and will collaborate with team members to integrate metadata processing functions for use in 3D reconstruction algorithms running in edge and HPC environments. Specific outcomes include developing key modules for metadata parsing, transformation computation, and marshalling GUI output into other algorithms. Professional development activities will include networking with experts in computer vision, geospatial analysis, edge devices, and HPC environments. The student will have opportunities to attend technical briefings, training sessions on HPC tools and advanced algorithms, and tour ERDC's supercomputing resources.

ANTICIPATED START DATE:

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

QUALIFICATIONS:

This project provides challenging research in multiple disciplines. Therefore, candidates with specialized knowledge in computer science, computer vision, and mathematics, with an emphasis in linear algebra, are required. The ideal candidate will have the ability to learn and handle complex data, understand the intricacies of creating camera poses from metadata, develop a GUI application with Qt and OpenGL, and program with C++. These activities will significantly enhance their knowledge and abilities, preparing them for advanced technical roles and improving their career opportunities in fields such as 3D reconstruction, photogrammetry, and remote sensing.

ACADEMIC LEVEL:

Degree received within the last 60 months or currently pursuing:

- Bachelor's
- Master's
- Doctoral

DISCIPLINE NEEDED:

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