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. The 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 tasks.

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. The project includes leveraging open-source libraries such as Eigen for matrix operations and OpenCV for image processing to ensure robust metadata parsing and transformations. The 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: Involve core development, including metadata parsing, transformation computation, and integration with HPC resources.

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

Weeks 9-10: Dedicated to testing, optimization, and final delivery.

The faculty member will be actively involved in all stages of the software development lifecycle, from prototyping to deployment. Under the guidance of a mentor, the faculty member will collaborate with team members to integrate metadata processing functions for use in 3D reconstruction algorithms running on edge devices and HPC machines. Additionally, the faculty member will research the computational complexity of the algorithm for further improvement. The faculty member will also have the opportunity 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:

The faculty member should hold a Ph.D. degree in computer science, with a research emphasis in computer vision and a strong understanding of computational geometry. Proficiency in programming skills, particularly in languages such as C++ and python, is essential. In addition, experience with imaging devices and a solid background in geospatial analysis are considered crucial. Adjunct or visiting faculty are ineligible.

ACADEMIC LEVEL:

- Doctoral

DISCIPLINE NEEDED:

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