PROGRAM PLAN FOR RIPS 2002

Project title: Application of level set algorithms on 3-D object visualization

Program description:
The remote sensing system used in the JIGSAW program uses lidar to sample surfaces of 3-D objects obscured by foliage. The sensed 3-D object is represented by a collection of data points (data cloud). This project will explore and apply appropriate level set algorithms on selected data sets to segregate the 3-D object data from obscuration clutter data and then construct surfaces to represent the object. The final step uses existing Areté LADAR analysis software to visualize the 3-D object to aim in human recognition and identification.

Objectives

- Explore and apply appropriate level set algorithms on selected 3-D lidar data to enhance the visualization of a 3-D target under obscuration

Approach

- Get familiar with the data, the sensor system and the Areté software (3DID) that display and manipulate the data.
- Get familiar with level set concepts and techniques
- Apply selected level set algorithms to the data to visualize the 3D objects
- Optimize the algorithm coding and incorporate the algorithm as part of the software.

Tasks

1 Understanding the data, the data collection system and the data display software
   - Understand the JIGSAW program system and how it collects data
   - Read in and understand the JIGSAW data sets – Get familiar with Areté's software (3DID) to view the 3-D data

2 Investigate techniques for generating surfaces from data cloud
   - Understand the concept and techniques of level set based algorithms
   - Determine and select candidate algorithms for 3-D object construction from dta cloud

3 Implement and test the most promising algorithms and use Areté's software to display the 3-D objects
   - Implement algorithms as libraries and add to existing Areté data display code

4 Optimize the algorithm (code) efficiency
   - Apply algorithm to increasingly complex data sets
   - Identify area where efficiency can be improved (in algorithmic and/or computational procedure)

5 Evaluate the performance of the algorithm in data sets with increasing degree of obscuration

Outputs

- Algorithm description document
- Software performance document and demonstration
- Integrate and optimized visualization software (3DID)

Program Conduction Plan

Kick-off meeting: Areté staff to give details of the problem statement, introduction of the data and sensor system and expected program outputs. More meetings will be scheduled to go over research details (transferring Areté's understanding of the problem to the students and bring them up to speed)

Weekly meetings: One or more Areté staff will meet with the student team to answer questions, provide research guidance and review progress status. Students are expected to give verbal presentation of work progress, discuss issues at these meetings.

Midterm written report: Student team will write a brief report of their research work and status. This report will serve as the draft and outline of the project final report.

Final report and presentation: The students will write a final report with supporting or appending documents (if necessary) such as software description. Areté staff will assist in the report development (not writing) and proofreading. Students will also make a verbal presentation of the final result. Areté staff will provide assist and guidance for the presentation.

Areté staff support: Designated Areté staff will be available most of the time for consultation via email, telephone or pre-arranged visits.

UCLA faculty support: The students are expected to do the research with some support of designated UCLA faculties. The students are expected to engage with these faculties when their expertise are called for.

Program Deliverables

1. Mid-term briefing about the selected algorithms and approach (with rough outline of final report and rough draft of the algorithm descriptions.)
2. Final report with full description of the analyses, algorithms, results and demonstration.
3. Demonstration of algorithms within Areté 3DID software.