

# APGD IFD

## Monthly Report #1

### SRI Contract #1515

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The following tasks from our Statement of Work summarize the work being carried out by SRI International and its subcontractors GDE Systems and Vexcel Corp. on the DARPA Automatic Population of Geospatial Databases Integrated Feasibility Demonstration contract. A description of our activities in the latest reporting period in support of each task follows the task description. The monthly reports from GDE and Vexcel are included as appendices.

This report is also available through the URL <http://www.ai.sri.com/~apgd/reports>.

## 1 Technology Development

### 1.1 Refine the BOS architecture

*Review the current BOS architecture, enhance it, and distribute a description of it to the APGD community.*

Review is currently underway.

### 1.2 Develop CBACS

*Extend and enhance existing RADIUS HUB architecture to meet the requirements of the CBACS to serve as the control structure for invoking feature extracting algorithms.*

Initial enhancements are in the design stage.

### **1.3 Develop feature extraction managers**

*Design and develop feature extraction managers for terrain, linear, area, compact 3-D features, and dynamic objects.*

We have begun the design of the feature extraction manager for linear features.

### **1.4 Survey automated model extraction techniques**

*Identify potential algorithms for improving the performance of planned or installed BOS testbed capabilities and extending the operating domain of existing algorithms.*

Vexcel has furnished a bibliography on SAR and IFSAR processing and feature extraction algorithms.

### **1.5 Develop feature extraction and consistency enforcement algorithms**

*Adapt, integrate, and enhance IU algorithms for extracting terrain, linear features, area features, 3-D compact objects, and dynamic objects. Develop new techniques that capitalize on the complementary aspects of radar data and E-O and multi-spectral data. Adapt the Model-Based Optimization (MBO), deformable mesh, and consistency enforcement technology to work with extracted features and their attributes.*

Work is proceeding on development and testing of linear feature extraction algorithms. Initial experiments have been done on using low-resolution SAR data to seed high-resolution extraction from panchromatic images.

### **1.6 Develop techniques for multi-sensor registration**

*Extend the Model-Supported Positioning technology to include radar imagery and multi-spectral imagery. These will co-register images from different modalities in a common coordinate system. Extend the sensor model API in the RCDE to provide a homogeneous interface to the full range of data, including the transformations to map back and forth between image coordinates and 3D coordinates. Implement photogrammetrically rigorous error analysis and propagation facilities in the RCDE.*

We have completed an initial implementation of the Generic Sensor Model API. A document describing this is attached to this report. Current work is focusing on error models.

### **1.7 Refine the design of, and implement, the persistent store**

*Specify the data format (syntax and semantics) and API for the spatio-temporal database component of the BOS, based on the requirements derived from the selected SE and MSE applications. Implement the dynamic database component of the BOS.*

We in the process of reviewing the requirements, and specifying data formats. An initial implementation for linear features has been completed.

## **2 APGD Community Development and Technology Transfer**

### **2.1 Produce, maintain, and distribute calibrated datasets to FRE and IUBA contractors**

*Collect, calibrate, and document classified and unclassified sets to be distributed to the community for experimental and evaluation purposes.*

The rectified SAR magnitude and IFSAR-derived DEM coverage of Ft. Hood has been added to the dataset. Appropriate transforms have been added to allow this data to be georeferenced and coregistered with existing panchromatic coverage of Ft. Hood. Work is currently being carried out to rectify and mosaic the “raw” SAR coverage of Ft. Hood, to provide a registered correlation image, as well as possibly improved magnitude and DEM data.

### **2.2 Construct and distribute ground-truth models**

*Interactively construct attributed, detailed 3D models of three sites (e.g. Ft. Hood, Ft. Irwin, and Ft. Benning) to be used for benchmarking and evaluation.*

RCDE “ground data” models for approximately one-third of the structures and linear features in the motor pool area of Ft. Hood have been constructed. Working is proceeding on deriving an annotated pixel classification image of the fhn717-719 area of Ft. Hood. This labels pixels as roads, proto-roads, etc., as well as indicating the surface material. This will be used to evaluate automatic extraction algorithms.

### **2.3 Develop evaluation metrics and procedures and perform evaluations**

*Design an evaluation process that can be used to identify significant advances in feature extraction or attribution. Enhance metering facilities currently available in the RCDE. Periodically run evaluations to document the current competence of the evolving system. These results will be posted on the network for comment and comparison.*

We have completed the first draft of evaluation metrics and procedures for linear features and buildings.

### **2.4 Establish and maintain the APGD virtual lab**

*Provide continuous access to data, ground-truth models, and results on a WWW site. In this way, any group can compare its results with the current best results.*

The initial page for the Virtual Lab has been created. The URL is <http://www.ai.sri.com/~apgd/vl>. It currently provides a summary of data sets currently available from SRI for use by the APGD contractors.

## **2.5 Interface to FRE contractors**

*For each FRE, select one of the three partners to be the primary interface for that FRE.*

For the first year, GDE has been selected as the primary interface for FREs working on building extraction (UMass, USC). Vexcel has been working with MIT on photogrammetry and image registration issues, and has provided a free license for their Foto-G system to MIT. SRI has supplied data to Utah, and will be providing access to our current MBO technology for their use.

## **2.6 Develop and perform demonstration scenarios**

*Identify realistic processing scenarios and demonstrate prototype systems for them. Include scenarios and demonstrations for systems working with classified data.*

A scenario for linear feature extraction is begin developed.

## **2.7 Transfer technology**

*Develop and carry out pilot insertions of the developed technology into existing systems, such as GDE's SOCET SET and Vexcel's mapping system.*

We have formulated a design to provide a data path between SOCET SET and RCDE, to help in carrying out pilot insertions and evaluation.

## **3 Meetings and Reports**

We hosted the APGD Kickoff meeting at SRI in Menlo Park on 21 February and the First APGD Symposium in New Orleans on 15 May.

## **A GDE Monthly Report**

## **B Vexcel Monthly Report**

## **C Generic Sensor API Draft Report**