



In Line with GIS: New GIS Mapping Tool for Surveyors **Rj Zimmer, LS**

Imagine mapping a road intersection's curbs, edge of pavement, fire hydrants, telephone pedestals, and striping without leaving the office! New GIS software from Visual Learning Systems of Missoula, Montana, can do just that. Visual Learning Systems' Feature Analyst can be programmed to identify objects in raster images, then perform feature extraction at a fraction of the time required to digitize, and at a fraction of the cost of sending crews into the field. The Feature Analyst, which runs in ESRI's ArcView 3.x and ArcGIS, has the ability to recognize patterns in images and extract those patterns as GIS features. Using this software, the operator can map features incredibly fast, from satellite imagery, aerial photography, or other types of imagery.

The Feature Analyst uses a hierarchical learning algorithm which allows the operator to use an iterative approach to refining the definition of what a feature "looks like" in any sort of imagery. Figure 1 shows the learning setup for the Feature Analyst. Initially, the operator enters information about the imagery and the features that he or she wishes to extract (for example, the number of graphic pixels that represent the shape and color of the feature, and the spatial context of those features). In the example shown, the road striping is described as being a certain number of light pixels wide a certain number of light pixels long, and the feature is surrounded by dark features. The spatial context allows the software to differentiate between a dark manhole and a dark roof. The Feature Analyst can also distinguish between curbs on the left and curbs on the right side of the road. It can also be programmed to extract stream edges, tops of banks, high water marks, and road centerlines.

The Extraction Process

Once the Feature Analyst has "learned" what a feature looks like in an image, it can then go to work on extracting all those features that look alike. The software can also determine which similar-looking features are not part of the set. The extracted features are then saved as ArcView Shapefiles, either as lines or polygons. Point features, such as building or power pole locations, can then be generated from the polygon centroids. Similar feature configurations can be reused in other imagery, and can also be used for change detection, (such as where new buildings have been constructed, roads have been re-aligned, or new vegetation has grown).

Using this tool can be a huge productivity boost for performing site surveys and mapping features for project planning (see Figure 2). For example, a street intersection can be mapped for manholes, poles, hydrants, toe and back of curb, lane striping, buildings, and even fences. Using the Feature Analyst



one computer operator can map an

entire intersection in less time than it takes to send out a crew and set up the instrument. It saves crew time, and mapping is done in a safer environment than a street intersection.

Let's look at an example of extracting the banks of a river from 1-meter resolution black and white photography. Figure 3 shows the photograph and setup information (for example, features) prior to the extraction. Parameters are input that specify the general type of feature to map, the resolution of the imagery, and other information (such as shown in Figure 1). After the parameters are set, then the Feature Analyst performs the extraction. Figure 4 shows the Feature Analyst's interpretation of the riverbanks. It was even able to find the banks around islands in the middle of the river. The resultant feature is a polygon Shapefile of the riverbank, which is saved as a vector file (Figure 5). Attribute data can later be added. According to Stuart Blundell, Chief Operating Officer of Visual Learning Systems, the Feature Analyst's ability to extract features such as riverbanks, is typically a better representation than that created from hand digitizing.

Spatial Accuracy

The spatial accuracy of the Feature Analyst is dependent upon the spatial accuracy of the photo registration, the resolution of the photography, and the clarity of the features being extracted. Typically, the higher the resolution of the imagery, the more clearly defined the features will be. Of course, the spatial registration of the imagery is a factor as well.

Feature Extraction Accuracy

Blundell says that Feature Analyst has proven to be 88%-90% accurate on panchromatic imagery and over 99% accurate on multi-spectral imagery, as well as 8 to 1,000 times faster.

A surveyor can jump-start any project by obtaining aerial photography, then extracting features with the Feature Analyst. On projects where the features are well-defined in the photography, the Feature Analyst alone may suffice to meet the mapping requirements. On other projects, field verification and additional collection may be required. But if the Feature Analyst can extract 88%-90% of the features (or more), then the field crews will have a solid basis to work from, and most of the work will already be done, even before leaving the office. The key of course is the availability of the imagery. If existing imagery, such as Digital Orthorectified Quarter Quads (DOQQ's) from the U.S. Geological Survey (<http://mapping.usgs.gov/www/ndop/>), or local government aerial photography is not recent enough or accurate enough, then new imagery must be flown and controlled. In some cases the cost of the photography may be prohibitive. However, if adequate imagery is available at



a reasonable cost, then the Feature Analyst is a great tool to assist the surveyor in mapping many different kinds of features.

For more information on the Feature Analyst extension to ArcView and ArcGIS see www.featureanalyst.com. The Visual Learning Systems website has a free download of the full software for tutorial purposes (this version only works on the tutorial data sets). Feature Analyst is available in a both a basic version and in a professional version that includes change detection, 3D extraction, and other enhancements.

I can see many uses for the Feature Analyst by surveyors. Generally, it could be used to perform mapping (via feature extraction), project planning (to get an idea of what may be out there before bidding a project or before sending out a crew), and for validation of field mapping (to make sure that the field crews got everything). It can either be the sole source for feature mapping, or a supplemental source, depending on the project requirements for accuracy, time, safety, and cost.

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