The Feature Analyst® Extension for ERDAS IMAGINE®

Automated Feature Extraction Software for GIS Database Maintenance

*We put the information in GIS℠*

*A Visual Learning Systems, Inc. White Paper*

*September 2005*
Contents

Introduction .................................................................................................................................. 1
Product Design .......................................................................................................................... 1
Product Positioning .................................................................................................................. 2
Functional Description ........................................................................................................... 4
Target Markets ........................................................................................................................ 5
Examples: ................................................................................................................................. 6
Platforms .................................................................................................................................. 7
Feature Analyst

Introduction

Keeping geospatial features current and up-to-date, however, is estimated to be 60-80% of the cost of implementing a GIS and represents a major bottleneck in the exploitation of high-resolution earth imagery. The Feature Analyst extension for ERDAS IMAGINE provides users with a powerful automated feature extraction (AFE) toolset for extracting object-specific geospatial features from earth imagery including panchromatic, multispectral, radar, and hyperspectral imagery. The result is a tremendous cost savings in labor and a new workflow process for maintaining the temporal currency of geospatial feature data.

Product Design

The Feature Analyst extension provides Geospatial and Image Analysts with a comprehensive automated feature extraction (AFE) toolset for collecting 2D and 3D geospatial features from earth imagery and scanned maps. Features such as roads, buildings, water bodies, vegetation, pervious-impervious surfaces, multi-class image classification, and land cover are easily extracted using simple One-Button workflows. Feature Analyst uses multiple spatial attributes (size, shape, texture, pattern, spatial association, and shadow) with spectral information to collect geospatial features from monoscopic and stereo imagery as vector Shapefiles. Benefits include significantly lower database maintenance costs, increased accuracy in feature collection, and a simpler approach to geospatial data production.

There are multiple bottlenecks in the collection of geospatial feature data from earth imaging sensors. Feature Analyst provides Analysts with tools for extraction, vector cleanup, and feature attribution.
Key design elements in the Feature Analyst extension for IMAGINE software include:

- **A suite of machine learning algorithms that “learn” how to classify the object-specific geospatial features specified by the user.** Machine learning algorithms such as Nearest Neighbor, Neural Networks, Decision Trees, Genetic Ensemble Feature Selection (patent pending) and others are used to efficiently extract user-defined features. Our software makes these powerful algorithms available through a simple, user-friendly interface.

- **Automated clutter removal methods that iteratively improve classification.** Feature Analyst works with the analyst by listening to feedback and adapting. This innovative method is essential for removing clutter in complex scenes such as urban landscapes.

- **The ability to use spatial context when extracting features.** Feature Analyst uses spatial attributes and advanced techniques such as Foveal Vision (patent pending) that allows the learning algorithms to take into account the spatial context of a target feature. For instance, to recognize roads and not parking lots, one must be able to see the sides of the road.

- **An adaptive user interface that hides the complexity of the underlying machine learning system from the Geospatial and Image Analyst.** Our software is designed for Geospatial and Image Analysts that may not be familiar with machine learning approaches to image classification. The adaptive interface hides the complexity of the extraction process, which makes the software fun and easy to use.

- **The ability to read in recipes for feature extraction from a Learning Model Library.** Each extraction is saved in a learning model and each learning model can be stored in a repository built over time. Specific features such as roads, buildings, vegetation, etc. can each have a model, and this repository allows users to exchange learning models, simplifying the process of GIS database maintenance.

**Product Positioning**

Feature Analyst for IMAGINE is tightly integrated with Leica Geosystems’ ERDAS IMAGINE software suite. Analysts can utilize the image handling and processing functionality already existing in IMAGINE and then extract features with the most advanced AFE technology in the GIS industry.

- The shelf life or temporal currency of geographic features varies as a function of ground sample distance (GSD) commonly referred to as image resolution. As image resolution increases from 5 meters to 1 meter and smaller, the refresh rate requirements for a GIS database will increase as well.
Feature Analyst uses multiple spatial attributes such as size, shape, texture, pattern and spatial association to extract features from imagery. The top image shows airplanes on a runway with an inset picture of the Feature Analyst input representation window. At the bottom all of the airplanes are extracted as Shapefiles (red airplanes).

- Organizations that rely on GIS analyses must now address the labor and cost issues of maintaining feature databases using high-resolution imagery. The Feature Analyst extension for IMAGINE provides a solution for this business problem.
- GIS users can leverage current capabilities of their COTS GIS and Image Processing packages and augment them significantly by adding true feature extraction to their systems.
Shown below is a Cost-Benefit Analysis of a feature extraction project using 0.5 meter multispectral imagery collected over the Presidio area of San Francisco indicates that Feature Analyst can improve the feature extraction process by orders of magnitude compared to hand digitizing methods.

### Functional Description

The marriage of the world’s best AFE technology with ERDAS IMAGINE provides a complete solution for extracting geospatial features from panchromatic, 3-band color, multispectral, radar, and hyperspectral imagery. One-Button feature extraction workflows are well integrated within the ERDAS IMAGINE geoprocessing environment. In addition, Feature Analyst provides new feature editing, smoothing and conversion tools as well as tools for committing features to a Geodatabase. The end result is a comprehensive geospatial data production solution for earth imagery.

Feature Analyst Professional includes:

- **Powerful Feature Extraction** in the IMAGINE environment.
- **Learning Explorer** for object-specific feature extraction using state-of-the-art machine learning algorithms including neural networks and ensembles.
- **Hierarchical Learning** for adaptive feature extraction to identify objects in complex and cluttered scenes.
- **Software Agent** technology including the ability to extract small features (cars, planes) or large features (land cover, tree canopy)
- **Clutter Removal** allows users to clean up their results even beyond hierarchical learning.
- **Change Detection** for objects. Our novel machine learning techniques allow users to assess object-specific changes for multi-temporal images.
- **Image/Data Fusion** for imagery. Allows users the ability to fuse raster data to perform more accurate extractions. Also makes it possible for users to combine existing vector files into a single vector layer.

- **3D Feature Extraction Capability** makes feature extraction leveraging LIDAR data, and DEMs possible, taking into consideration 3-dimensional information.

- **Unsupervised Classifier** for feature extraction using unsupervised methods.

- **Improved Batch Classification** so users may queue up images in a batch and let Feature Analyst run on each of them thus coming even closer to truly automating the process of feature extraction.

---

**Feature Analyst** provides users with both advanced feature extraction and image classification technology in the IMAGINE environment.

**Target Markets**

Feature Analyst technology represents a paradigm shift in GIS database maintenance by integrating feature extraction into the geospatial image chain workflow process. Hence, any vertical market that uses GIS will benefit if high-resolution imagery represents the *fresh source* of geographic information for their geospatial database.
Examples:

Feature Analyst extracts user-specified objects for building a GIS.

Final results of buildings extracted from a cluttered urban scene.
Platforms

- Windows XP, Windows NT, Windows 2000, Windows 98, & Windows 95