

IMAGINE OBJECTIVE

The Future of Feature Extraction, Update, & Change Mapping







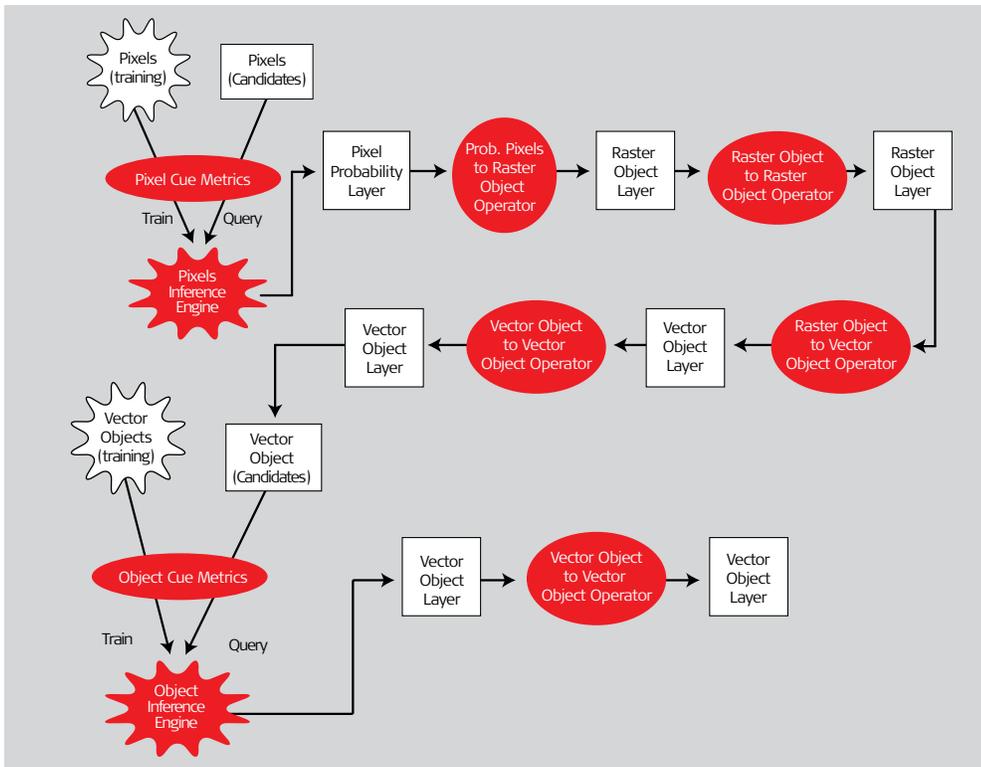
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ADDRESSING BUSINESS PROBLEMS

Globally, GIS departments and mapping institutions invest considerable revenue into creating and, perhaps more importantly, maintaining their geospatial databases. As the Earth is constantly changing, even the most precise base mapping must be updated or replaced regularly. Traditionally, the capture and update of geospatial information has been done through labor and cost intensive manual digitization (for example from aerial photographs) and post-production surveying. More accurate and complete information increases the value and ease of analysis. Remotely sensed imagery, whether airborne or satellite based, provides a rich source of timely information if it can be easily exploited into usable information. This transformation of data into tailored, relevant information provides benefits to a number of industries:

- **Insurance companies** can determine the presence or absence of swimming pools within land ownership parcels to correct liability insurance policies.
- **Utility companies** can identify and map the location of assets, such as man-hole covers, across a city-wide sewerage network. With assets installed over a long period of time, possibly by other companies, many utility companies have inaccurate or incomplete historical records.
- **Local government** institutions mapping urban growth (such as roads and buildings) can maintain a usable geospatial database for use by First Responders, tax departments, planners, etc. When disasters strike, the ability to rapidly identify the location of damaged houses or other infrastructure is critical to minimise the loss of life and aid in the recovery efforts
- **Forest management** companies can more accurately estimate species mix, yield potentials, and environmental impacts.
- **Tax assessors** can better map impervious surfaces and cross reference ownership parcels, increasing the accuracy of tax billing, and promoting better planning.
- **State agencies** can better manage water rights by mapping agricultural field boundaries and crop types.

IMAGINE Objective is offered within the PRODUCER SUITE of the Power Portfolio. The Producer Suite empowers you to collect, process, analyze and understand raw geospatial data, and ultimately deliver usable information. This includes Hexagon Geospatial's desktop-based GIS, remote sensing, and photogrammetry offerings.



IMAGINE Objective provides object based multi-scale image classification and feature extraction capabilities to reliably build and maintain accurate geospatial content. With IMAGINE Objective, imagery and geospatial data of all kinds can be analyzed to produce GIS-ready mapping.

AUTOMATING WORKFLOWS

Originally, workflows were done manually. Since then, various attempts have been made to help automate workflows analyzing remotely sensed imagery. These attempts have often resulted in limited success, especially as the resolution of imagery and the intended mapping scale increases. With recent innovations in geospatial technology, we are now at a place where workflows can be successfully automated.

When Landsat was launched more than 30 years ago, it was heralded as a new age for automating mapping of the Earth. However, the imagery, and therefore the geospatial data derived from it, was of relatively coarse resolution, and thereby became limited to smaller scale mapping applications. However, its analysis was restricted to “remote sensing experts.” Equally, the traditional supervised and unsupervised classification techniques developed to extract information from these types of imagery were limited to coarser resolutions.

Today’s sources for higher resolution imagery (primarily meaning 1m or smaller pixel sizes, such as that produced by the IKONOS, QuickBird, and WorldView satellites or

by airborne sensors) do not suffer from the “mixed pixel” phenomenon seen with lower resolution imagery, and, therefore the statistical assumptions which must be met for the traditional supervised and unsupervised classification techniques do not hold. Thus, more advanced techniques are required to analyze the high resolution imagery required to create and maintain large scale mapping and geospatial databases. The best techniques for addressing this problem analyze the imagery on an object, as opposed to pixel, basis.

INTUITIVE FEATURE EXTRACTION AND CLASSIFICATION TOOLS

IMAGINE Objective includes an innovative set of tools for feature extraction, update and change detection, enabling geospatial data layers to be created and maintained through the use of remotely sensed imagery. This technology crosses the boundary of traditional image processing with computer vision through the use of pixel level and true object processing, ultimately emulating the human visual system of image interpretation. Catering to both experts and novices alike, IMAGINE



The IMAGINE Objective user interface showing a feature model designed to extract the locations of building footprints in a GIS-ready form to minimize manual post-processing and editing.

Objective contains a wide variety of powerful tools. For remote sensing and domain experts, IMAGINE Objective includes a desktop authoring system for building and executing feature-specific (buildings, roads, etc) and/or land cover (e.g., vegetation type) processing methodologies. In addition, more entry-level users may apply existing examples of such methodologies to their own data. The user interface enables the expert to set up feature models required to extract specific feature types from specific types of imagery. For example, road centerlines from 60cm Color-Infrared (CIR) satellite imagery require a specific feature model based around different image-based cues. Building footprints from six inch true color aerial photography and LIDAR surface models require a different feature model. For those familiar with existing ERDAS IMAGINE® capabilities, an analogy can be drawn with Model Maker, with its ability to enable experienced users to graphically build their own spatial models using the primitive building blocks provided in the interface.

The less experienced user can simply use built-in example Feature Models or those built by experts, applying them as-is or modifying through the user interface. While similar to the IMAGINE Expert Classifier™ approach, the construction and use of feature models within IMAGINE Objective is simpler and more powerful. Constructing a feature model is more linear and intuitive to the expert building the model. In addition, the support for supervised training and evidential learning of the classifier itself means that the feature models are more transportable to other images once built.

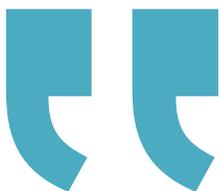
Hexagon Geospatial patent pending approach uses a unique combination of artificial intelligence, computer vision, and traditional image processing and remote sensing technologies. As a result, the algorithms perform not only raster contouring (stair-stepped results), but also incorporate object and vector level processing to yield a spatially matched, precise shape for each feature.

Consequently, the output generated from the product will be GIS-ready, such as smooth roads and squared-up buildings. Therefore, the output can be directly merged into a GIS with minimal post-processing, and will accurately reflect the image content. Outputs include clean vector outlines and auto-attribution of polygons with probability measures enabling querying of dubious results for quality control purposes.

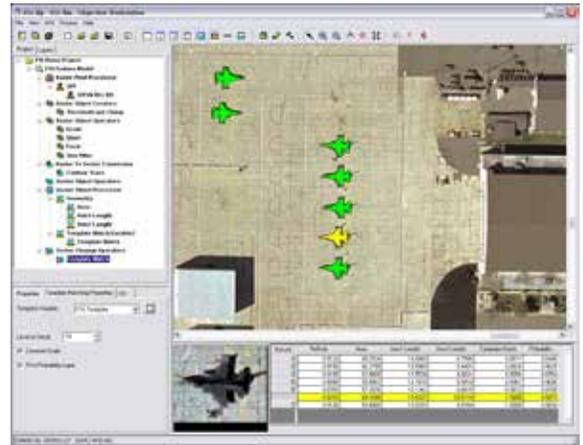
Initially targeted feature types for built-in sample feature models to be distributed with the first release include:

- Vegetation delineation
- Road extraction
- Building footprint extraction
- Building footprint change identification
- Military targets (airplane types, ship types, etc.)

Users may also build their own Feature Models.



When Landsat was launched more than 30 years ago, it was heralded as a new age for automating mapping of the Earth.



The IMAGINE Objective user interface showing a feature model designed to identify the locations of a particular aircraft type.

IMAGINE OBJECTIVE METHODOLOGY

- Offers open, modifiable, and extensible feature models. This flexibility means that the classifier can be fine-tuned to the specific circumstances of the imagery being analyzed if initial results are not adequate.
- True object-oriented approach means that in addition to spectral properties being utilized, the spatial components are also measurable and available to the processing engine.
- Caters to discrete feature extraction (e.g. where are the buildings) and multi-class extractions (wall to wall classification), providing a flexible tool for a variety of problem scenarios.
- Provides discrete feature extraction, where clean-up operators can be included in the feature model to produce output suitable for merging into a GIS with

minimal post-processing (squared-up buildings, smooth gap-less roads, aircraft outlines, etc).

- Integrates with ERDAS IMAGINE, providing a full suite of vector editing tools for further clean-up and editing. This integration provides an end-to-end feature extraction process within one integrated package. Other workflows often require steps to be performed in different software packages, with the inherent capability for losing information and efficiency.
- Utilizes ancillary layers (data fusion) – e.g. slope, aspect, LIDAR, texture, etc. – along with the capability inherent with an object based approach to employ shape metrics, proximity, association, thereby leading to increased feature extraction accuracy.
- Leverages holdings of all remotely sensed imagery, including panchromatic, multispectral, hyperspectral, SAR, LIDAR, etc.
- Extracts features and classes which are attributed based on the measures used to identify them, including a final probability of being that class, enabling quicker validation of final results and analysis of problem areas.
- Provides the ability to prototype and test a new feature model on user-selected view windows (even if the training evidence lies outside the area to be processed) for rapid fine-tuning and applying the finished feature model to the whole data set (or to different data sets).
- Deploys floating licenses as standard, ensuring that maximum usage of the software can be made across an institution's network.

| POWER PORTFOLIO | PRODUCT & INTERACTION |
|-----------------|---|
| PRODUCER SUITE | Link your results to a GeoMedia environment from the ERDAS IMAGINE interface to synchronize navigation and Area of Interest. |
| | Enhance Imagery in ERDAS IMAGINE before bringing it into IMAGINE Objective. |
| | Utilize any raster imagery using the ultra-fast ECW compression format may be directly consumed in ERDAS IMAGINE . |
| | Output vector or raster's from your IMAGINE Objective results into any GIS ready platform like GeoMedia |
| | Create value added products in ERDAS IMAGINE before publishing to GeoMedia WebMap. |
| PROVIDER SUITE | Publish your results from IMAGINE Objective to ERDAS APOLLO and deliver over the Internet as server-side geoprocesses (WPS). |
| | Raster backdrops can be streamed, using the ultra-fast ECWP streaming protocol, by ERDAS APOLLO . |



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Hexagon Geospatial helps you make sense of the dynamically changing world. Known globally as a maker of leading-edge technology, we enable our customers to easily transform their data into actionable information, shortening the lifecycle from the moment of change to action. Hexagon Geospatial provides the software products and platforms to a large variety of customers through direct sales, channel partners, and Hexagon businesses, including the underlying geospatial technology to drive Intergraph® Security, Government & Infrastructure (SG&I) industry solutions. Hexagon Geospatial is a division of Intergraph® Corporation. For

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