White Paper

ERDAS IMAGINE® and Military Applications

OCTOBER 1998

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The Geographic Imaging Concept

The quest for national security in a dynamic world demands the accurate processing of intelligence and geographic data into information that can be used to support decisions. While imagery intelligence (IMINT) and text reports are primary sources of data for many users, this information is incomplete unless presented in terms of geospatial relationships. The location, context, and activity of a target are key factors that influence these relationships, as well as terrain and weather considerations.

The concept behind Geographic Imaging is to bring all of these sources together in a unified environment through the use of precise coordinate locations in three dimensions. Advanced commercial-off-the-shelf (COTS) software that enables users to quickly and accurately derive useful information from the data for both tactical and strategic decision making, is now available.

Military Applications Using Image Data

The need for remotely sensed data in military air, land and sea applications has grown exponentially. Weapon systems have become so advanced that they require information extracted from remotely sensed data as input to be operational and/or effective. In the present era of precision munitions and weapon systems, virtual battlefields, and unknown threats in denied terrain, remotely sensed data is essential for the modern information warrior on the digitized battlefield.

From Operation Overlord and Operation Desert Storm, to Operation Provide Promise, remotely sensed imagery has played a key role in used for tactical military operations, humanitarian operations and peacekeeping missions. During World War II, the Korean War, the Vietnam War, the Gulf War, Haiti, Somalia, Bosnia and other military operations, commanders relied on imagery for targeting, terrain analysis, intelligence, mapping, command and control, mission planning, battle damage assessment, feature extraction and threat analysis. Without the “eye-in-the-sky,” these commanders would not have had the relevant common picture of the battlefield and the area of operation.

Image analysts and “targeteers” use imagery to find targets and assess collateral damage. Analysts derive map/grid coordinates from imagery for input into weapon systems, such as ground and naval artillery, and more recently for “smart bombs” and precision munitions. Enemy fighting positions, ammunition depots, and mobile targets (such as SCUD missile launchers) are detected, tracked and reported to field commanders through the use of imagery.

Terrain analysts/cartographers use imagery to create value-added products, such as cross-country mobility maps, situational maps (Sit-Maps), image maps of denied terrain, and other products for inclusion in the Intelligence Preparation of the Battlefield (IPB).

Some of the frequently used imagery-based products and products derived from imagery for military applications include:

- Basic Target Graphics (BTGs)
- Cross Country Mobility Maps (CCMs)
- Battle damage assessment (BDA) graphics

- Non-combatant evacuation operations (NEO) graphics
- Obstacle overlays, combined obstacle overlays
- Gridded Installation Photomaps
- Gridded Airfield Photomaps
- Drop Zone Overlays
- Helicopter Landing Zone Overlays
- Elevations and Contours

A partial list of deployed systems which integrate ERDAS Geographic Imaging capabilities includes:

- Digital Topographic Support System Quick-Response Multicolor Printer (DTSS/QRMP), U.S. Army, fielded to Army Terrain Teams and Topographic Assets
- Digital Topographic Support System Multispectral Image Processor (DTSS-MSIP), U.S. Army, fielded to Army Terrain Teams and Topographic Assets
- Digital Topographic and Mapping Sets (DTAMS), U.S. Marine Corps, fielded to the Terrain Teams at the 1st, 2nd and 3rd Marine Expeditionary Forces (MEFs)
- Remote Replication System, National Imagery and Mapping Agency (NIMA), fielded to the U.S. Major Commands and selected units
- Targeting Materials Workstation System (TMWS), U.S. Air Force, fielded to the Joint Intelligence Centers (JICs), Joint Analysis Centers (JACs) and other Air Force and Joint Commands
- Data Production System (DPS) for the Air Force Mission Support System (AFMSS), U.S. Air Force
- Front-end Processing Environment (FPE), NIMA
- Topographic Imagery Integration Prototype (TIIP), U.S. Army, issued to Army Topographic Assets at Echelons Above Corps (EAC)

Military Mission Areas

The typical objective of Geographic Imaging in military applications is to rapidly process imagery and geographic data into a wide array of digital and hardcopy decision aids. This is accomplished using methods designed for a variety of specific mission areas, including:

- Imagery Intelligence
- Targeting
- Mapping
- Terrain Analysis
- Weather
- Visualization

Each mission area might actually be an assortment of computers and peripherals configured in a client/server environment. While the main server for each mission area supports the activities on the computers within its local network, the server also provides the final data products required by other mission areas within the network. This means that the system is self-supporting and that digital products created by one mission area are easily used by another to synthesize additional products. Furthermore, each Geographic Imaging mission area can consist of just one computer, or any number of computers, depending upon the production load of that particular station. The actual configuration of hardware, software, and peripherals is determined by local needs.

Additional Mission Stations, such as Telecommunications Analysis, can be added depending on the needs of the organization. Visualization techniques, conceptually at the center of the geospatial processing structure, can have rapid access to all the information using web browsing, search and display functionality.

The data that drive these mission areas encompass a broad range of both government and commercial sources, including electro-optical, multispectral, hyperspectral and radar.

The primary software for each military mission area can be an off-the-shelf or a customized version of ERDAS IMAGINE®. ERDAS IMAGINE is the mapping software for Geographic Imaging solutions, capable of manipulating all types of reconnaissance images for the production of intelligence and geographic information. The unique concept behind customized versions of ERDAS IMAGINE is that the software user interface can be tailored for each specific mission area. This means that while many of the image processing and GIS tools will be common across all the mission areas, these tools will be organized in a software assembly line dedicated to produce the types of products unique to local goals.

The Imagery Intelligence (IMINT) Mission Area

The Imagery Intelligence (IMINT) ensures the accurate and timely reporting of essential elements of information (EEI) through the digital exploitation of multiple sources of imagery. With the IMINT mission area, the computer becomes the photo-lab, exploitation light table, and graphics shop, all in one system. In addition to standard procedures, such as filter sharpening the image, digitally adjusting the contrast and brightness, and mensuration features, the IMINT mission can accomplish other tasks unique to computer image processing. These functions include automatic change detection, feature extraction and the creation of geo-referenced intelligence databases capable of showing the spatial relationships between different intelligence targets.

ERDAS IMAGINE is capable of producing a wide variety of both hardcopy and softcopy IMINT products through the imaging exploitation process, which typically consists of three phases. Phase 1 exploitation is the generation of a simple textual intelligence report highlighting the essential elements of information. Phase 2 expands the report to include a graphic containing an annotated image of the target. Phase 3 exploitation goes into much greater detail and contains a series of images and textual reports. These functions are implemented in a client/server environment, and they play a major role in the IMINT mission area.

Figure 1. A sample Imagery Intelligence Product created with the IMINT Mission Station. This product is typical of a Phase 2 annotated image product.

The server is designed to have an exceptionally powerful CPU in order to quickly perform some of the computationally intensive functions of this station. However, the major time-consuming task of IMINT is the extraction of essential elements of information and the creation of detailed graphical products. These are not computationally intensive functions, so client systems doing this work are less powerful than the server. Given that the IMINT mission is a primary functional area, associated servers and the supporting network must have a greater throughput capacity, as well as greater digital product storage capacity. The IMINT server, as a primary supplier of information to each of the other mission areas, is one of the most heavily used components on the network.

The image processing tools of ERDAS IMAGINE are the primary software tools used to create EEI from raw imagery. The commercial user interface for these tools may be customized for ease of use based upon the production requirements of the IMINT processes. These requirements may include

- digitizing imagery from hardcopy,
- clean and sharpen any source of imagery,
- measure feature information directly from the image,
- extract features of interest for inclusion in geospatial databases,
- produce high quality graphics with detailed annotation,
- and use information derived from this process to create detailed textual reports.

The Targeting Mission Area

Targeting is a very broad subject that encompasses many functional mission areas, such as IMINT, mapping, mission planning and battlefield visualization. All of these disciplines work together within this functional mission area to produce a variety of planning and execution products to support a nation's projection of force. These products can include, but are not limited to:

- Decision aids to help commanders and mission planners visualize objectives, display key relationships and develop courses of action
- Target materials, such as specialized maps/charts and imagery products, used to identify and assess critical elements within a target, assess vulnerabilities, and determine weapons requirements and potential aim points
- Combat mission graphics that the war fighter uses to plan and carry out their specific mission tasking
- Battle damage assessment (BDA) graphics designed to evaluate mission effectiveness and determine if the target requires further attention
- Reconnaissance mission planning

What is a "target" and what is "targeting"? Within the targeting community the word "target" has two meanings:

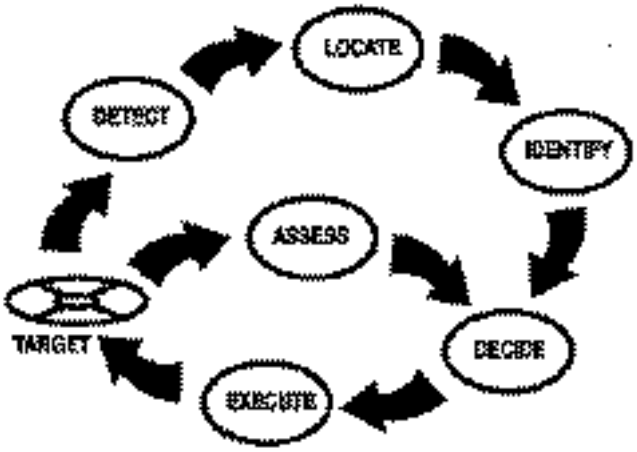
1) A geographic area, complex, or installation planned for capture, neutralization or destruction by military forces, or
2) A country, area, installation, or organization against which intelligence operations are directed. (More specifically, within the Targeting Mission Area this means the detection, location and identification of objectives (potential targets) and post-attack collection for BDA.)

With the above references in mind, the objective of targeting is to affect, change, modify or impede enemy activity through destruction, damage, deception or neutralization. In the preliminary phases of planning, areas of interest are collected and analyzed and are considered objectives. An objective

becomes a target when *military action* is planned or directed against it. (Using our above listed definition, the term "*military action*" includes both offensive action and intelligence collection.)

Targeting and the Mission Cycle

First and foremost, targeting is a process and not a specific act -- *it is a means to an end, rather than the end itself.* Listed below are the steps of the Targeting Mission Cycle.



1. Detection: The ongoing process of discovering new potential targets and/or changes to existing target sets.
2. Locating: Once detected, this step involves providing accurate positioning and mensuration information on target elements.
3. Identifying: Breaking out a target into individual elements within complex targets; identification of critical elements and relationships to other elements within a target; targeting subsets.
4. Deciding: Identifying the key components within a specific target system and assigning them for strike.
5. Execution: Mission planning and the actual strike mission.
6. Assessment: BDA.
7. Deciding: Based on information from BDA, determination for restrike.
8. Execution: Restrike

How can ERDAS IMAGINE be utilized within this cycle? As with the IMINT Mission Area, ERDAS IMAGINE provides a robust set of tools for the image analyst. During the ***Detection*** phase, collected imagery can be ingested into ERDAS IMAGINE and features in the known EEI can be analyzed for potential targets. Once targets are ***detected***, potential targets can be measured and precise location data can be extracted from the imagery quickly and easily in the ***Locating*** phase. Next, in the ***Identifying*** step, using the Targeting Materials Workstation (TMWS) software, specialized targeting graphics are developed such as the Basic Target Graphic (BTG) (*see Figure 2).* Using ERDAS IMAGINE's Map Composer tools, specialized targeting displays are generated displaying information such as current situation displays, with orders of battle and threat data overlays, target relationships graphics (critical nodal and link analysis), reconnaissance mission routings and photo tracks, target specific maps, and photo products displaying each objective. During the ***Execution*** phase, ERDAS IMAGINE tools can be used to develop combat mission graphics tailored specifically to each war fighter, weapon system and objective. Post strike, during the ***Assessment*** phase, uses imagery analysis again to determine mission effectiveness. Change detection routines within ERDAS IMAGINE can look at both pre- and post-attack images and quickly show the effects of a mission. Again, decision aids are generated and the cycle continues.

Custom-Designed Products

The TMWS and Digital Target Materials (DTM) are customized versions of ERDAS IMAGINE that are in use by the United States Department of Defense and other NATO organizations. The TMWS is a digital production system dedicated to the conversion of raw imagery into the Basic Target Graphic (BTG). A BTG is a multi-page document, similar to a brochure, containing text and detailed graphics of a specific named target. It includes special information extracted from the imagery.

The DTM is a variant of the BTG that resides in a geographic information system format. It consists of both raster imagery and map layers as well as vector annotations with data base attributes. These vector attributes consist of geospatial data that can be searched, queried and selectively displayed over the respective target graphic. This allows the manipulation and display of much more data than is possible in a hardcopy product. Furthermore, the DTM output product is in a digital format so the actual end users can produce their own unique target graphics or even feed the information into a dedicated Mission Planning System. The TMWS produces both the BTG and the DTM, but a special DTM software viewer is provided to fully exploit the information within the product.

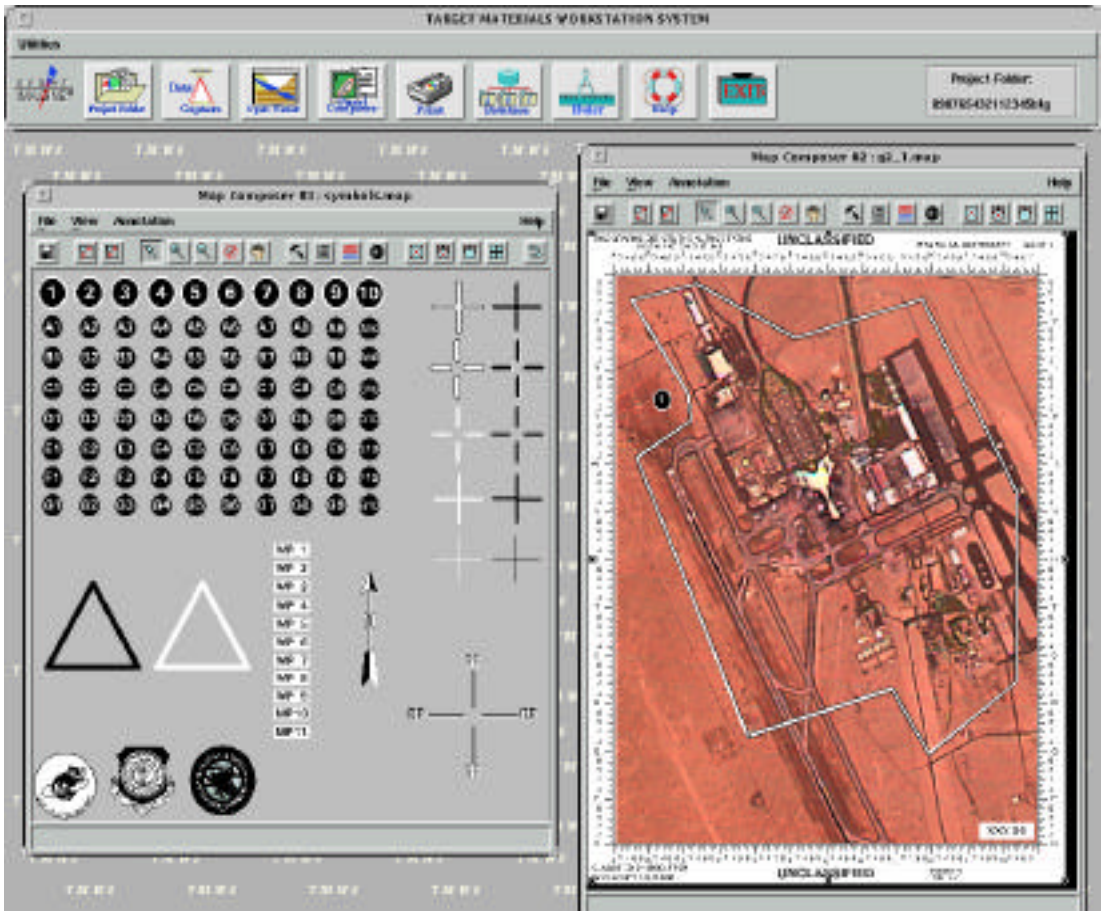


Figure 2. A Basic Target Graphic using the TMWS user interface for ERDAS IMAGINE.

The Targeting Mission Area follows a client/server structure of the other areas with the server being a higher-end processing system, while the clients are focused on final product development such as annotation and attributed vector coverage. The Targeting Mission Area may include databases to track named targets and target information that has been developed. While the Named Target Database is built through the requirement process, the Target Information Database is developed during BTG or DTM production. Both databases could be accessed across the network using a web browser.

The Mapping Mission Area

Mapping uses imagery to provide a variety of different types of geographic information for use by the other Mission Areas. Using the powerful image processing and photogrammetric capabilities of the ERDAS IMAGINE product suite, the mapping mission produces elevation data for terrain models, highly accurate photomaps complete with detailed annotation, and geographic information system (GIS) vector layers for exploitation and display. The following are some of the key capabilities of the Mapping Mission Area.

ERDAS IMAGINE's photogrammetric software processes stereo imagery to extract digital elevation models (DEMs) of the terrain. Once extracted, a DEM can be used to produce highly accurate ortho-rectified image maps.

ERDAS IMAGINE's map composition tools and vector capabilities provide advanced cartographic and GIS functionality. The Map Composer is a "What-You-See-Is-What-You-Get" (WYSIWYG) tool with a number of automatic features that aid in the map production process. Grid lines, scale bars, and legends are all automatic while the addition of thousands of different types of fonts, line styles and symbols is as simple as clicking a mouse. The IMAGINE Vector™ module allows the user to produce detailed topological vectors complete with any amount of attributes. The creation of these vectors is done directly on the screen over the imagery. Once created, the vector attribute database can be sorted and queried using simple screen commands, and the vectors can be displayed using a variety of symbols, line styles, and fill patterns.

The Map Series Tool allows the user to create and store a database of a map series. Once this database is created, the Map Series Tool automatically extracts the data layers for each covered map sheet and populates a specified map template with the pertinent information. The user defines and controls the map template and map series thereby creating a dedicated, highly automated map production system.

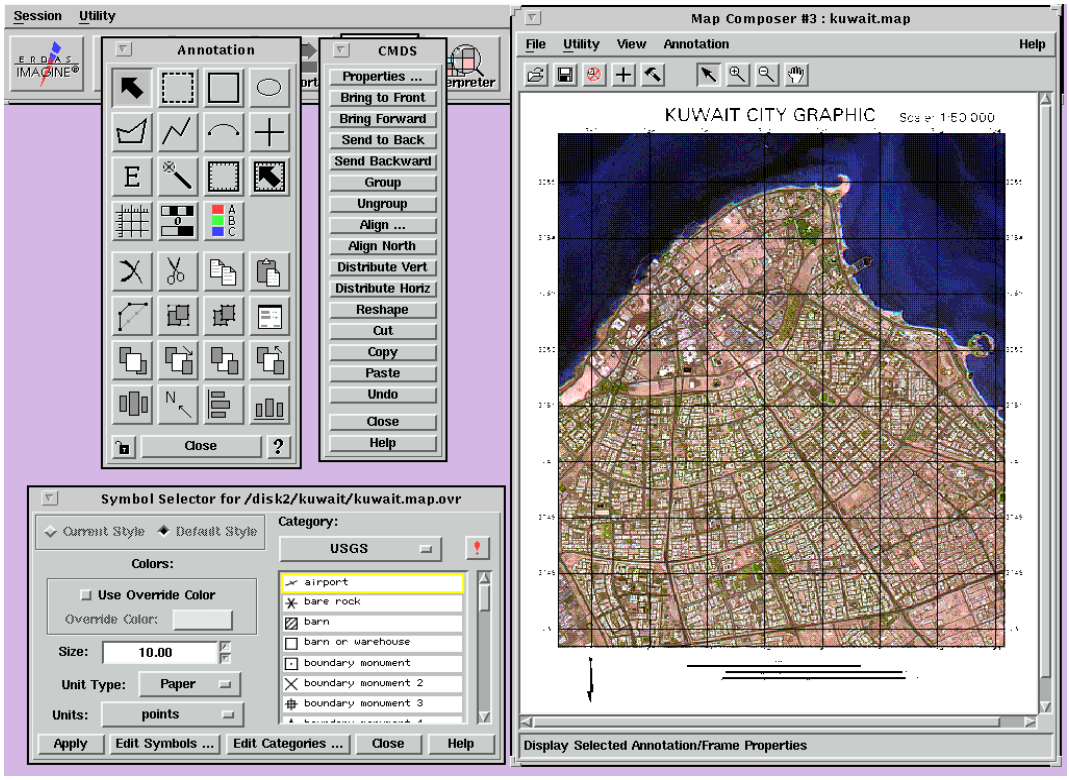


Figure 3. The special map composition tools of ERDAS IMAGINE include automatic scale bars, legends, and grid lines.

The Terrain Analysis Mission Area

The Terrain Analysis Mission Area is a culmination of geospatial analysis. Using a number of feature extraction capabilities within ERDAS IMAGINE, terrain analysts build and manipulate different thematic layers that represent various geospatial information covering an area of interest. Once collected, these thematic layers can than be synthesized into other products using the spatial modeling ability of ERDAS IMAGINE. For example, in order to understand the positioning of mobile missile launchers, the thematic layers of slope, soil, lines of communication, and electronic intelligence information could be synthesized into a map product showing the probability of where a mobile launcher may be located.

Thematic layers are produced from imagery, reports from analysts, and geographic data. These layers describe the characteristics of the land cover in a particular geographic area, such as vegetation, urban features, roads, slopes and water. Additional IMINT layers such as military disposition, electronic intelligence information (ELINT), signals intelligence (SIGINT) and lines of communication can be added. Special feature classification tools in ERDAS IMAGINE, such as multispectral and hyperspectral analysis tools, automatically extract ground cover and other environmental features. The Spectral Seed Generation tools can be used to automatically extract a feature of interest based upon its spectral signature. When combined with DEMs, all the standard factor overlays needed to synthesize complex terrain products can be developed. Once collected, thematic layers can than be synthesized into final intelligence products using the spatial modeling ability of ERDAS IMAGINE.

The Spatial Modeler consists of a digital flow charting structure built graphically on the screen by an analyst. With simple points and clicks, complex models are rapidly built to generate all types of products. Included in the Spatial Modeler are hundreds of functions to perform calculations to buffering distance around features, or the intersection/overlap of two features; provide decision rules with multiple variables, and analyze elevation values for slope and aspect. Models can be built and saved in a model library. With the ERDAS Macro Language (EML), a graphical user interface can be added to any model, and the end user can easily add the appropriate files names and initiate the modeling process with the touch of a button.

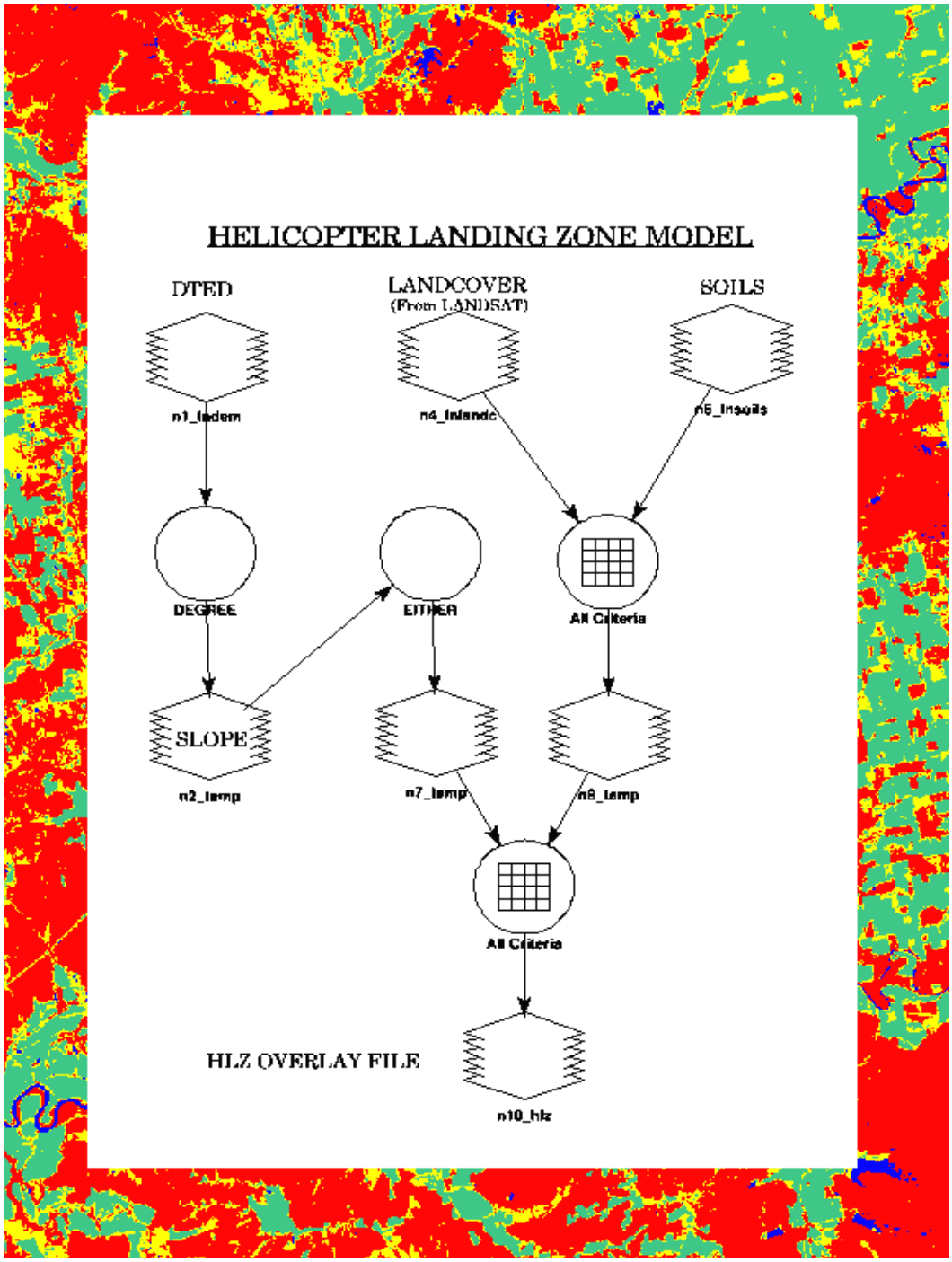


Figure 4. A spatial model designed to combine an elevation thematic layer and a land cover thematic layer in a "criteria selection" process to create a helicopter landing zone overlay.

The Weather Mission Area

Combat operations need access to real-time weather data to construct current and forecast weather products supporting a variety of environmental assessments. A number of weather satellites provide data to support such timely weather products. ERDAS IMAGINE's customized weather module,

Weather Front™, places this information in the correct format and structure to also be used in intelligence analysis. The advantage of this approach is to provide high-quality weather imagery along with digital information to terrain analysts, mission planners, and intelligence personnel. Weather satellites have several qualities that make them ideal for determining broad-scale ground conditions not observable by higher resolution systems. An excellent example is the wide spread effect of sandstorms in the desert. High-resolution systems cannot determine the size, speed or density of the storm and therefore are incapable of determining the military impact of broader scale events. A high-resolution weather receiver/processor collecting high-resolution weather several times a day, more effectively supports dissemination of broad area information (graphics, text and/or images) to various units in the path of the storm. This mission station also serves to alert imagery collection managers and military leaders to the declining probability that certain imaging missions will be successful.

In addition to the standard hardware configuration, there are a number of remote sensors that can be used to collect relevant weather information. These sensors can be placed throughout a given region to collect data and then the Weather Front software can be used to analyze the resulting "meso-net" information. Sensor types include barometric pressure, temperature, humidity, soil moisture, etc… In time, a detailed weather picture generated from satellite imagery and remote sensors, can be used to create a detailed information base of the climatic conditions of a chosen region.

The Visualization Mission Area

Visualization is the focal point for a complete terrain analysis and intelligence understanding. It consists of a workstation and special large screen projection display placed in a centralized location for the decision makers who need to see and understand the *"Common Relevant Picture."* The objective is to provide real time access to the intelligence and geographic information produced by the other mission areas in a highly visual setting, so that the key information is rapidly conveyed and readily understood. Visualization relies on special enabling technologies that emphasize system communications, visualization, and information management. Enabling technologies allow any finished product to be easily queried, accessed, and displayed directly through visualization, with minimal system knowledge or technical expertise.

Using the previously mentioned capabilities within IMINT, mapping, and terrain analysis, ERDAS IMAGINE is capable of producing complex, realistic databases of terrain, mapping, and intelligence information for interactive visual displays. IMAGINE VirtualGIS™ provides dynamic, real-time terrain "fly throughs," so that Order of Battle and threat information can be displayed and queried in a 3D environment. Pre-set flight lines that can be used to model various approaches to a given target can be rapidly created and saved. Using the complete set of ERDAS IMAGINE tools, users have the unprecedented ability to build and model the battlefield so war fighters can rehearse and battle planners can determine the proper course of action.

ERDAS Military Activities and Key Projects

ERDAS has the technical resources and appropriate personnel to provide product and application support to military and intelligence-oriented organizations around the world. Personnel within several ERDAS offices have direct experience using ERDAS software in military applications, providing them keen insight into the multitude of uses for ERDAS IMAGINE within a military and intelligence environment.

Recent or completed military application projects include:

(1) U.S. Army Maneuver Control System (Phoenix). This Battle Command Battle Lab project demonstrated the utility of providing digital imagery from space systems on a Command and Control platform. The project resulted in a prototype integration of ERDAS IMAGINE with Maneuver Control System/Phoenix **(**MCS/Phoenix), capable

of receiving many varieties of data formats and writing out MCS/Phoenix files for use by other MCS/Phoenix systems. The success of this effort led directly to integration of ERDAS IMAGINE with other MCS software and has great potential of leading to an MCS-NT integration with ERDAS IMAGINE as well.

(2) U.S. Army Maneuver Control System (Baseline). This project was a joint effort between the Training and Doctrine Command (TRADOC) System Manager for MCS, the Communications-Electronics Command (CECOM) Program Manager for MCS, the Battle Command Battle Lab and the United States Army Engineer School. The project demonstrated the power and flexibility gained in using a commercial-off-the-shelf (COTS) mapping and image processing system (ERDAS IMAGINE) to provide digital imagery from space systems on a Command and Control platform. The Army Topographic Engineering and Command and Control communities evaluated the resulting prototype during Prairie Warrior '97. This "MCS / ERDAS IMAGINE" prototype retrieves information from the MCS database and places unit icons and control features (phase lines, unit boundaries and coordination points) at the proper geographic position on imagery, mapping or GIS products.

(3) U.S. Army Battle Command Battle Lab (BCBL) Topographic Data Support. The ongoing effort provides ERDAS topographic support for use by the Battle Command Battle Lab at Ft. Leavenworth, Kansas. This project is being used to support a number of BCBL and Command and General Staff College (CGSC) experiments, demonstrations and exercises.

(4) Feature Counting Tool. ERDAS is currently under subcontract to build and deliver a customized version of ERDAS IMAGINE software for a US government agency. This contract includes development of custom software and will also provide limited training support.

(5) Battlespace Awareness System Prototype. This project consisted of the modification of ERDAS IMAGINE for use as a mission planning system. Events and military vehicles were tracked in real time using an Air Force capability, and ERDAS IMAGINE was used to view movement of military icons "fed" to the system using secure tactical radios. The software development work was completed as a firm, fixed-price purchase order.

(6) US Army Space Command Space Technology, Exploitation and Planning Support Contract. This contract is an indefinite quantity, indefinite delivery contract designed to provide topographic, imagery and intelligence support to a variety of United States military organizations. The current task is with the Battle Command Battle Lab at Ft. Leavenworth, Kansas, and deals with

- database development and visualization of six historic military engagements;
- advanced communication of very large databases (using Defense Advanced Research Projects Agency (DARPA) Next Generation Internet experiments, the SPRINT Model Cities project, and the SPRINT Gigabit network);
- technical consulting for command and control visualization and advanced topographic applications;
- next generation terrain visualization for United States Army training, simulations and war-games; and,
- the United States Army Space Technology Advancement Panel.

(7) National Imagery and Mapping Agency (NIMA) IMAGIZER Project. This project is providing a minimal viewer and view-mastering capability to be distributed with NIMA (formerly the Defense Mapping Agency) products. NIMA will acquire several mastering packages, allowing them to bundle prototypical data with the ERDAS

IMAGIZER program.

(8) Global Geographic Information System Support, April 1996. The former Defense Mapping Agency contracted with ERDAS to support the Global Geographic Information System (GGIS) Program. This program is designed to provide real-time mapping support to the major commands of the United States Department of Defense and other key NATO organizations. In addition to numerous ERDAS IMAGINE license sales, ERDAS is providing initial support to the National Military Command Center at the Pentagon in Washington, DC. ERDAS employees are using ERDAS IMAGINE to produce a wide range of special map products for the Joint Chiefs, the Secretary of Defense and the White House. The eventual goal of this effort is to make each GGIS site self sufficient in the production of special map products for the key Commanders and Staffs throughout NATO.

(9) Bosnia Peace Talks, November 1995. ERDAS personnel were on-site at Wright-Patterson Air Force Base in support of the Defense Mapping Agency. Both DMA and the Topographic Engineering Center (TEC) relied on ERDAS systems to produce a variety of products for the Peace Talk efforts. This support was provided with short notice at the request of DMA, and it involved having an ERDAS Applications Specialist on site for over ten days. During the course of the Peace Talks, ERDAS systems were responsible for rapidly editing hundreds of different maps with daily boundary changes, with a final production output exceeding 3000 map sheets printed. Working intensive, long hours, and facing challenging technical requirements, ERDAS systems and personnel successfully responded to the task and played an integral part in the entire Peace Talk effort.

(10) Combat Terrain Information System (CTIS), October 1995. The CTIS is a development effort on the part of the United States Army Topographic Engineering Center, to provide a digital terrain analysis system to tactical Army organizations in a field environment using COTS technology. The Digital Topographic Support System Multispectral Image Processor (DTSS-MSIP) was the first system successfully fielded by this program, and it is being followed by the Digital Topographic Support System Quick-Response Multicolor Printer (DTSS/QRMP). Both of these systems include ERDAS IMAGINE software. In support of this effort, ERDAS provided programming resources to the prime contractor, to perform customization work on many key components of the system. This support greatly facilitated the development effort, and having ERDAS technical resources on the team greatly reduced the overall cost of the program. This ongoing project has thus far resulted in 78 systems being fielded to United States Army organizations around the world.

(11) UK Military Survey Contract. UK Military Survey uses ERDAS IMAGINE to simulate real-time 3D fly-throughs for operational areas. The systems with ERDAS IMAGINE software have already been deployed to waiting units in Bosnia who uses them to become familiar with unknown territory as well as aid the decision makers in mission planning. ERDAS IMAGINE tools are also utilized to spatially reference graphics and input geographic data into the command control and communications system.

(12) UK Battle Group Training. The Battle Group Training Unit (BGTU) is responsible for exercising units in war fighting within the British Army. BGTU uses ERDAS IMAGINE with IMAGINE VirtualGIS software to provide realistic 2D and 3D views of the battlefield exercise area. The ERDAS IMAGINE software also provides a more effective means of presenting After Action Review material through its capability to be re-played as a simulation and aiding discussion on ‘what-if’ scenarios.

Other key military and intelligence clients include:

- United States Army Battle Command Battle Lab
- Defense Intelligence Agency, USA
- National Imagery and Mapping Agency, USA
- Defense Mapping School, USA
- United States Army Space Command
- United States Pacific Command
- United States Strategic Command
- United States Central Command
- United States Atlantic Command
- Air Intelligence Agency, USA
- Intelligence Threat Analysis Center, USA
- Department of Defense, Australia
- Western European Union, Spain
- Ministry of Internal Affairs, Russia
- High Command, Norway
- Joint Air Reconnaissance Intelligence Command, South Africa
- Military Survey Department, Saudi Arabia
- G3 GEO, Northern Ireland
- Defense Research Establishment, Denmark
- Army (ETCA), France
- Department of National Defense, Canada
- Alteck Defense, South Africa
- Royal Air Force, UK
- Border Service, Russia
- National Institute of Military Cartography, Mexico
- Military Survey, UK
- Joint Air Reconnaissance Intelligence Command, UK

Appendix ERDAS IMAGINE® Solutions for Military Applications

Function	Military Application Area	Description	ERDAS IMAGINE Module
Adjust Contrast	Imagery Intelligence	Control the quality of an image by adjusting brightness and contrast. Permits complete control over the image histogram.	IMAGINE Essentials™
Adjust Contrast Within An Area of Interest	Imagery Intelligence	Adjust the contrast and brightness of a selected portion of an image (i.e., lighten up shadow areas).	IMAGINE Essentials
Contrast Librarian	Imagery Intelligence	Store standardized histograms that can be applied to an image.	IMAGINE Essentials
Image Filtering	Imagery Intelligence	Use convolution filters to enhance the quality of an image.	IMAGINE Essentials
Data Scaling	Imagery Intelligence	Control the display range of an image that exceeds 8 bits.	IMAGINE Essentials
Spectral Profile	Imagery Intelligence	Compare pixel signatures with stored spectral libraries for feature detection. Can be used with hyperspectral data.	IMAGINE Essentials
Blend/Fade	Imagery Intelligence	Compare multiple images in a single viewer by slowly merging data values of one image in and out of another. Useful for change detection and sensor comparison.	IMAGINE Essentials
Swipe	Imagery Intelligence	Compare multiple images in a single viewer by splitting the viewer into sides with a different image on each side. The transition line can then be "swiped" back and forth or up and down. Useful for comparing imagery with maps, change detection, etc.	IMAGINE Essentials
Flicker	Imagery Intelligence	Compare multiple images in a single viewer by rapidly exchanging one image for another. Useful for change detection.	IMAGINE Essentials
Mensuration (measuring)	Imagery Intelligence	Measure lengths and areas within an image. Control measurement units. Print out mensuration reports.	IMAGINE Essentials
3D Mensuration	Imagery Intelligence	Measure areas, lengths, and heights.	IMAGINE Ortho*MAX*
Rotate an Image	Imagery Intelligence	Rotate imagery so that the look angle is in the proper position. User can manually select the rotation using a mouse or enter the precise rotation angle.	IMAGINE Essentials
Haze Reduction	Imagery Intelligence	Use simple tools to reduce the amount of haze blurring an image.	IMAGINE Essentials

Function	Military Application Area	Description	ERDAS IMAGINE Module
Graphical Output	Imagery Intelligence	Build detailed intelligence graphics to show a variety of information using image insets, multiple comparison images, and annotation. Offer a variety of line styles and fonts, and graphics colors. Offer image friskets and other annotation outside the image area. Store common formats in user defined templates.	IMAGINE Essentials
Radar Imagery Enhancement	Imagery Intelligence	Provide special tools to enhance the quality of radar imagery.	IMAGINE Radar Interpreter™
Hyperspectral Image Processing	Imagery Intelligence	Provide special tools to process hyperspectral imagery to include displaying and modeling numerous data bands, building and comparing hyperspectral signature libraries, processing sensor values into pure spectral value.	IMAGINE Advantage™
NITF	Imagery Intelligence	Provide certified import and export capability for NITF 2.0 levels 1-6. Include support for TACO2 transmission software.	IMAGINE NITF™
Simple Imagery Rectification	Mapping	Perform rectification of imagery using sensor modeling, polynomial warping, or rubber sheeting.	IMAGINE Essentials
Complex Imagery Rectification	Mapping	Perform orthorectification correcting for relief displacement using a digital elevation file.	IMAGINE Advantage
Extract Elevation	Mapping	Extract digital terrain elevation data from optical or radar stereo imagery, as well as IFSAR radar sources.	IMAGINE Ortho*MAX*
Use GPS Ground Control	Mapping	Input ground control values from GPS systems for the rectification process	IMAGINE Ortho*MAX* IMAGINE Essentials
Digital Cartography	Mapping	Produce quality map products containing multiple grid projections, scale bars, legends, declination diagrams, symbols, fonts, line styles, etc.	IMAGINE Essentials
Map Templates	Mapping	Store map templates for rapid production. Include a database of map sheet series that can be used to rapidly produce maps over a specified area	IMAGINE Essentials
Symbology	Mapping	Create and store multiple symbol libraries.	IMAGINE Essentials

Function	Military Application Area	Description	ERDAS IMAGINE Module
Attribute Information	Mapping	Store data attributes for all annotation. Allow users to select annotation in a query process.	IMAGINE Essentials
Digitize Features	Mapping	Digitize and store attributes of features, to include points, lines, and polygons, in topological files.	IMAGINE Essentials (v8.3.1) IMAGINE Vector (v8.3)
Feature Extraction	Mapping	Automatically extract polygon features such as lakes and tree stands using spectral comparison tools (Seed).	IMAGINE Essentials
Display and Query Vector Files	Mapping	Display and query vector files separately or as an image overlay. Select color and symbology based upon attributes of the data.	IMAGINE Essentials
Vector Product Format	Mapping	Import and export vector product format.	IMAGINE Vector
ADRG Format	Mapping	Import ADRG format.	IMAGINE Essentials
DTED Format	Mapping	Import DTED format.	IMAGINE Essentials
ADRI Format	Mapping	Import ADRI format.	IMAGINE Essentials
Land Cover Analysis	Terrain Analysis	Determine land cover features for terrain analysis modeling using multispectral imagery.	IMAGINE Essentials IMAGINE Professional
Line of Sight	Terrain Analysis	Conduct line-of-sight analysis between two points. Show areas that are seen or hidden between the two points.	IMAGINE Essentials
Route Profile	Terrain Analysis	Determine the elevation profile along a designated route.	IMAGINE Essentials
Intervisibility	Terrain Analysis	Determine areas of visibility from a selected point or multiple points. User determines range and extent of the looking azimuth.	IMAGINE VirtualGIS
Shaded Relief	Terrain Analysis	Render elevation data as a shaded relief to show terrain. User controls sun angle and sun elevation. Merge shaded relief into imagery or overlay to enhance the display with terrain.	IMAGINE Advantage
Terrain Modeling	Terrain Analysis	Create and use various GIS models to generate special terrain analysis products. These models may include but are not limited to: cross country movement analysis, helicopter landing zones, key terrain, cover and concealment.	IMAGINE Advantage

Function	Military Application Area	Description	ERDAS IMAGINE Module
Perspective View	Terrain Analysis	Create 3D perspective views of the terrain by displaying imagery over a model of the terrain.	IMAGINE Essentials (Image Drape), IMAGINE VirtualGIS
Build Mission Planning Data Sets	Mission Planning	Create digital elevation files, maps, and image products to be used in mission planning systems	IMAGINE Advantage
Create 2D Threat Overlays	Mission Planning	Use vector with appropriate symbology and intervisibility to create 2D threat overlays to be draped on a 3D image.	IMAGINE Essentials with IMAGINE VirtualGIS
Set Flight Line Route	Mission Planning	Set flight line on a 2D overview map. Set way points and elevation. Store flight line data.	IMAGINE VirtualGIS
Fly Through	Mission Planning	Fly through a 3D model of the terrain with imagery or map overlays. Fly either dynamically or along a predetermined flight path. Query annotation objects within the 3D image.	IMAGINE VirtualGIS
Display Order of Battle Information	Command and Control	Using vector files and symbology, users can create extensive databases of information pertaining to friendly and enemy situations.	IMAGINE Essentials
3D Situation Maps	Command and Control	Situation overlays can be rendered as overlays on 3D dynamic maps in IMAGINE VirtualGIS.	IMAGINE VirtualGIS

Information subject to change without notice.

For more information about our Geographic Imaging solutions, please contact us. We'll respond immediately.

http://www.erdas.com

ERDAS Corporate Headquarters
(U.S.A.)
Phone: 404-248-9000
Fax: 404-248-9400

ERDAS International Headquarters
(All regions except U.S.A. and Europe)
Phone: +1 404-248-9000
Fax: +1 404-320-8451

ERDAS International
(Europe)
Phone: +44 1223-881774
Fax: +44 1223-880160