

## Intelligent GIS

# 4D Data Fusion for the Geospatial In

*In today's digital battlespace, GIS is a crucial component in the military decision-making process. GIS technology has the ability to successfully incorporate the vast amounts of visual data and geospatial information produced by various sensors and imaging systems currently deployed in defense applications. However, it is not just data assimilation practicality that has put GIS 'on the map' for the defense intelligence community, but its potential for rapid data integration, analysis and distribution of complex spatial information.*

By Frank Artés



Common Operating Pictures (COP) of military data feeds and GIS data create a 4-D visualization of the battlespace for decision support.

GIS provides a vital tool for both the decision maker and the warfighter. This article takes a look at defense-applicable GIS and its move from a three-dimensional desktop tool for terrain analysis and tactical planning, to a 4D battlespace visualization technology.

### Defense-wide Data Access

One of the most important attributes associated with GIS implementation within a geospatial intelligence context, is its capacity to provide a common structure that enables data accessibility across the board. It allows the necessary information to be available to everyone who needs to see it, whether it is Command and Control HQ, mobile forces in the field or international observers a conti-

nent away. GIS technology lends itself to a network-centric operations (NCO) environment, which has revolutionized conventional military data dissemination by introducing what is now termed the Common Operational Picture (COP).

Described as a single, identical display of relevant information, the COP is designed to be shared by more than one command. The boundaries between individual defense disciplines have blurred as the military's growing need for intelligence information has broadened. COP is a correlated, fused near real-time picture of the complete battlespace, which includes geo-locational information on friendly, hostile and neutral forces together with all available visual/non-visual intelligence data. It provides a comprehensive

tactical representation of the battlespace and is a fundamental component for strategic awareness, often presented in a three-dimensional visual display.

### A Significant Technology

One important indicator of just how significant GIS technology has become in defense circles is evidenced by the NGA's (National Geospatial-Intelligence Agency) decision in 2005 to take a serious look at the commercial sector for GIS technology. Rather than continue on with its existing system, the Joint Mapping Tool Kit, which had been custom-built for the Government and in use for some time, NGA was considering a system that could provide operational consistency and a superior analytical functionality.

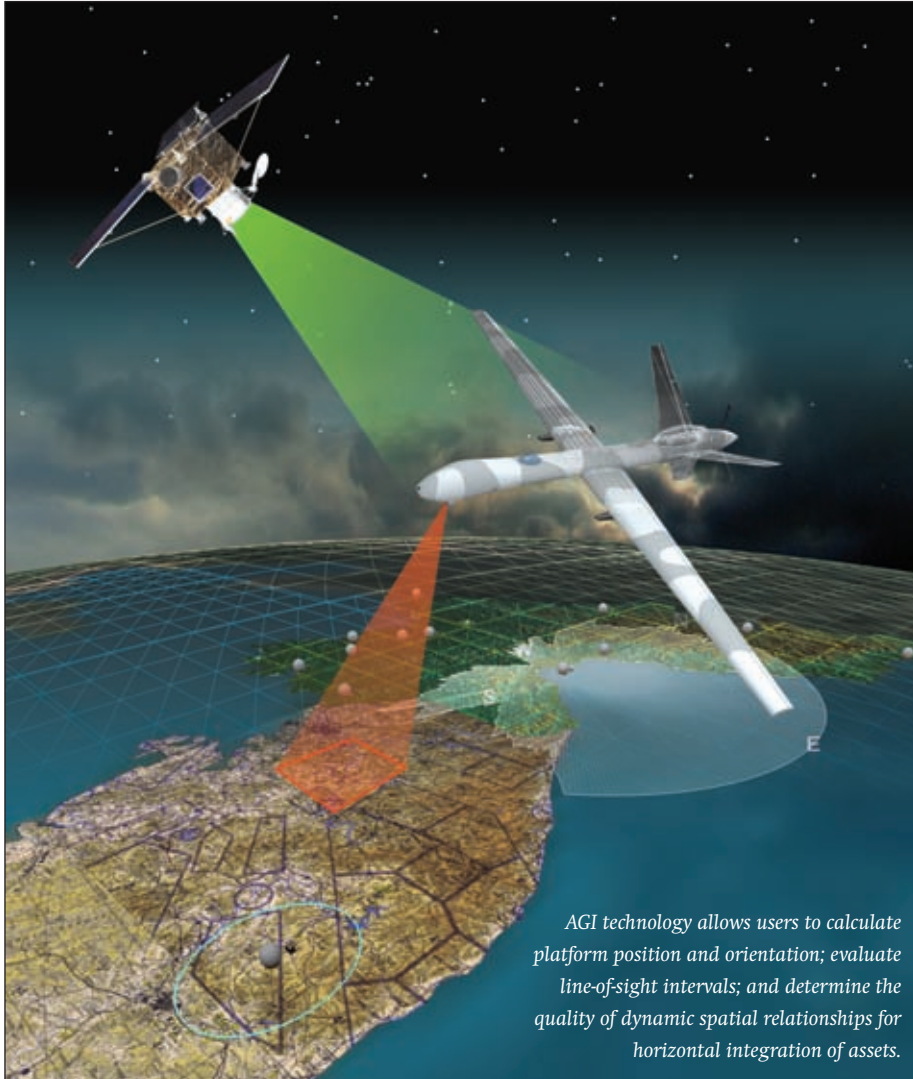
The commercial market requirements for GIS are in many ways similar to defense agency prerequisites, which demand a complete understanding of the relationships between terrain, geography, airborne/spaceborne imagery and spatial information. Emergency response organizations, galvanized into action in the wake of natural disasters, are a prime example of how important geospatial information can be, particularly for evacuation/recovery planning, and damage assessment tasks.

There are several reasons for this shift, one of which is cost. It is less expensive to purchase commercially available systems rather than develop them in-house. Another is standardization. Data sharing protocols and interoperability between COTS software is commonplace in private industry. In addition, standardized training ensures everyone achieves a certain operational level and understanding of the technology, and its application potential. Also, the continued drive for technological innovation within the private sector ensures access to the latest cutting-edge developments offering additional power and flexibility, pushing the concept of intelligent GIS.

### Primary GIS for the Military

Currently there are just a handful of companies producing complete GIS software

# Intelligence Community



AGI technology allows users to calculate platform position and orientation; evaluate line-of-sight intervals; and determine the quality of dynamic spatial relationships for horizontal integration of assets.

solutions for both civil and military/defense applications. Among the most prominent are ESRI and Intergraph. Both deliver a comprehensive toolset of multi-functional software designed to effectively acquire, manipulate, and manage geospatial data across all military levels. They provide standards-based, interoperable solutions that are quickly becoming benchmark geospatial intelligence tools for rapid, accurate decision-making.

In addition to these heavyweights in the industry there are companies producing defense-specific software solutions, one of which is Analytical Graphics, Inc. (AGI), whose technology is designed to integrate seamlessly with ESRI (among others) defense-applicable GIS products. It provides “commercial-off-the-shelf”

(COTS) software to various national security and space professionals for integrated analysis of land, sea, air and space assets... with fourth-dimension optimization.

One of the company’s particular developments is the integrated geodynamic layer for GIS applications requiring a powerful analytical capability. C4ISR (Command, Control, Com-

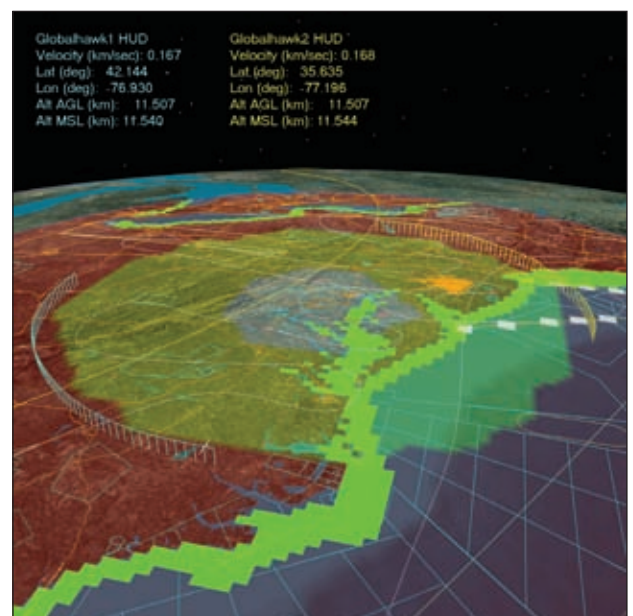
*STK combines complex computational algorithms with precision graphics to analyze and visualize data.*

munications, Computers, Intelligence, Surveillance, Reconnaissance), electronic warfare, geospatial intelligence, and missile defense etc., are just some of the areas in which the technology has had a major impact. The geodynamic layer concept is part of AGI’s geospatial intelligence framework for 4D visualization, which allows for the integration and modeling of vehicle-motion dynamics when applied to ground-based equipment, ships or aircraft, for example.

## Predictive Computation

Todd Smith, Product Manager, Enterprise Integration at AGI explained how its technology allows georeferenced analysis and the visualization of various scenarios, to be determined within a time-dependent protocol, such as simulated time or real-time.

“Monitoring vehicle movements of cargo along mountain roads in Afghanistan, is a good example of predictive computation, where we need to know the location of the convoy at all times along the route. Situational analysis can be undertaken by adopting various forward-in-time or backward-in-time algorithms, and using all available GEOINT to determine where along the route will positioning and communication with the convoy be lost as a result of terrain interference... and what are the potential consequences?”





AGI technology allows UAV mission analysis and optimization based on complex sensor coverage, communications link, and navigation accuracy prediction.

What Smith referred to as 'Predictive Computation' is an ability to establish time periods that can adversely affect various mission objectives and constraints, and supply answers to questions, such as:

- What assets are available in my area of interest should I need them?
- Which available assets can best accomplish this task, UAV, manned aircraft, or satellite?
- Where are the adversarial forces located?
- Where is the ground-based GPS jamming equipment located?
- What area coverage does air defense radar have ?
- Will air support be affected by GPS jamming?

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#### Maintaining Spatial Context

GIS provides the infrastructure for all ISR (Intelligence, Surveillance, Reconnaissance) information. Integrating a 4D perspective to layered GIS-based vector and raster data, on top of airborne/spaceborne imagery, topographic line maps and other types of reconnaissance material, produces a very comprehensive and

powerful picture. The geodatabase maintains its spatial context and the relationships between sensors, systems and various battlespace elements remains stable across multiple networks and internet-based workstations. It is complete data fusion in time and in space.

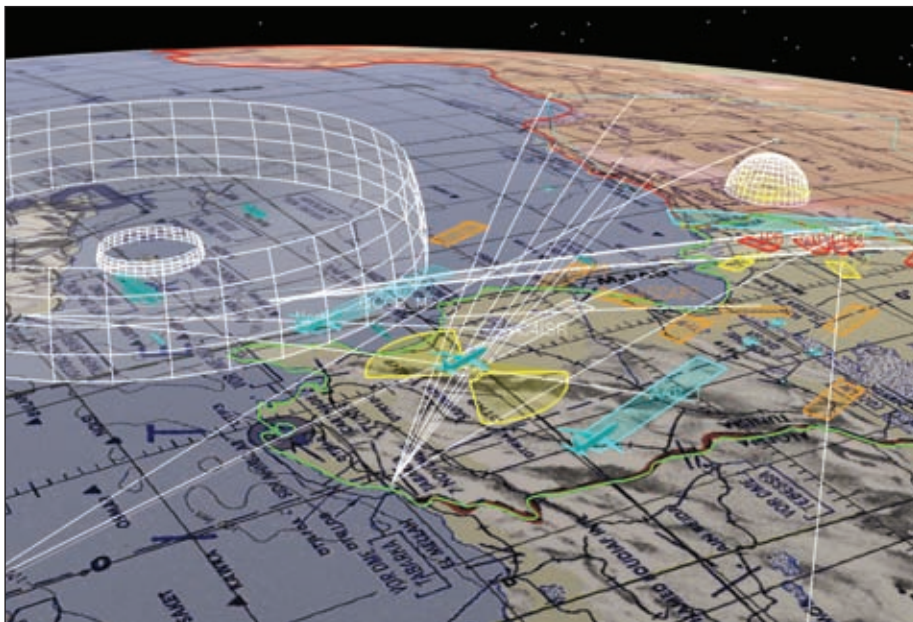
Temporal geospatial analysis and the use of defense-specific GIS technology, is now making a mark in the geospatial intelligence arena. By offering enhanced situational awareness capabilities over and above the standard operating methodologies, command and control decisions can be made with all the information available for extremely accurate projection analysis and forecasting.

#### Looking Into the Future

This ability to generate 4D visualization in a potentially hostile environment offers a tremendous tactical advantage for intelligence analysts working with ISR data. We are doing more than just looking ahead, we are looking into the future.

*Special thanks to Joanne Welsh, Media/Public Relations Manager, Analytical Graphics, Inc.*

*Frank Artés (fartes@geoinformatics.com) is a contributing editor of GeoInformatics. For additional information on AGI, and its approach to breakthrough geospatial analysis, visit [www.agi.com/stk8](http://www.agi.com/stk8).*



By fusing the available tactical information in both 2-D maps and 3-D globes, AGI software can display multiple theaters of operation and thousands of tracks and events simultaneously.