HEXAGON

White Paper

Motion Video Exploitation

Tools and Techniques

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Increasing the Value of Unmanned Aerial Systems

As today's military, intelligence, and public safety organizations fight terrorism and combat weapons of mass destruction and their proliferation, it is increasingly important that they expand their data collection and analytical capabilities into new and innovative methods. To this end, there is increased interest in incorporating full motion video (FMV) data sources, such as those from unmanned aerial vehicles (UAV) and other unmanned aircraft systems (UAS), into strategic and tactical analysis workflows. UAV/UAS have already been instrumental in providing real-time surveillance and operational support to military and intelligence organizations. They are now being closely evaluated as a viable source for public safety and other civilian organizations; careful attention is especially paid to post-collection analysis and integration with other forms of geospatial information.

Recent advances in the development of lightweight yet durable materials, advanced communication and navigation systems, computer hardware and software, smaller yet more sophisticated sensors, and improved fuel and battery efficiency all contribute to the rapid growth of UAV/UAS technologies. This increased usage makes it more critical than ever to establish a reliable and robust ground-side infrastructure that can effectively collect and manage video and other data, then make it seamlessly available to a wide variety of consumers for integration, visualization, and analysis. This responsible focus on the back-end system ground-side will substantially increase the value and applicability of these systems well into the future.

Hexagon's Geospatial division has expanded its rich set of geospatial exploitation solutions with applications that provide improved analysis of full motion video, integration with other forms of intelligence and geospatial information, and robust management and dissemination of imagery and video data collections. These applications exploit the power of georeferenced video sources to create profound improvements in analytical and decision-making ability.

Not Just for the Military Anymore

The Global Positioning System (GPS) and the Internet are two important examples of technologies initially developed for military applications that then transcended to the civilian space. These two technology sets have dramatically transformed government, business, and personal lives. The UAV technology set is also expected to have a substantial impact in non-military sectors and will experience rapid growth in the coming years. According to a press release by the EDA-EC Conference on Unmanned Aircraft Systems (UAS), "Military and civil UAS markets are highly interdependent, with technology developments inevitably driving both.". This includes widespread applications for law enforcement, firefighting, and numerous environmental and scientific purposes. The Federal Aviation Administration (FAA) is currently working to establish airspace safety regulations that would allow the systems to achieve wider-spread usage. Some examples of civilian applications include:

- Natural disasters and other catastrophes (forest fires, hurricane flood damage assessment, tornadoes, earthquakes, etc.)
- Search and rescue (land and sea), law enforcement, firefighting
- Monitoring natural resources
- Delivery of relief supplies and other payloads
- Harbor, coastline, and border security
- Facility security
- Monitoring and inspecting long expanses of pipelines and other forms of critical infrastructure
- Establishing ad hoc communication relay networks

High-Level Geospatial Information Workflow

A typical high-level workflow consists of four key areas that must function in harmony to properly support the end-to-end requirements of the mission. Technology must be deployed prudently in each of these four areas to support the rapid transfer of data and analytical results to other areas. These areas are the following, as shown in Figure 1:

- Automated and manual capture of geospatial information, including imagery, live and archived video, and other sensor data
- Management of enterprise geospatial content, including traditional vector data sets (layers and features), imagery, and video
- Integration and analysis of multiple overlapping sets of geospatial and non-geospatial information
- Visualization and dissemination through a variety of interfaces

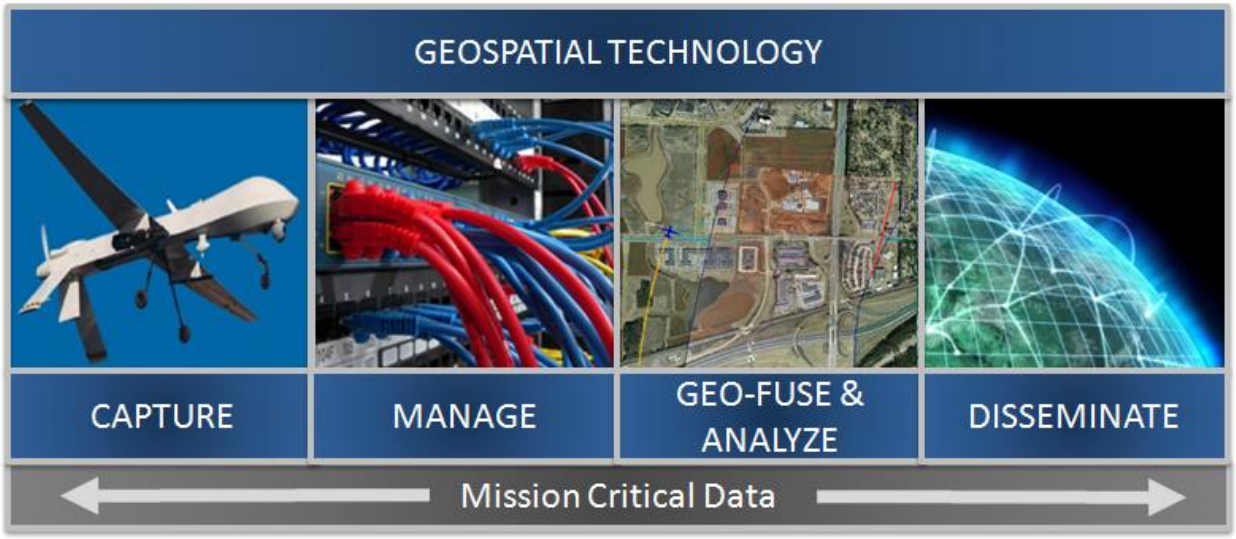

Figure 1: These four key areas must function in harmony to properly support the end-to-end requirements of a mission.

It is important to note that standard formats for imagery, full motion video, and other data types are essential for the smooth transfer of information from one workflow segment to another. This gives system designers improved flexibility to choose what type of technology to deploy at each stage. Proprietary formats limit the choices of technologies and force the selection of compatible technology elements at other points along the workflow. To that end, Hexagon's Geospatial division does not store data in a proprietary format. It rather embraces open standards for data storage and open dissemination of geospatial information, such as through Open Geospatial Consortium (OGC®) Web services. This methodology encourages innovation throughout the workflow by allowing a seamless upgrade and integration of technologies.

Geospatial Fusion of Video and GIS Data

Video-based data sources provide the most recent view of a situation and can augment other forms of geospatial intelligence – such as satellite imagery and aerial photos – to provide a richer, more detailed view of the area of interest. However, to effectively use video as a source of intelligence, the analyst needs to seamlessly fuse the video with these other types of intelligence such as map features and annotations, as shown in Figure 2. This is highly beneficial, as these other sources can help orient the analyst's point-of-view and improve understanding of the activities occurring within the video by eliminating the "tunnel vision" effect of viewing the video in a dedicated video window. Hexagon has developed a solution that supports this direct fusion of video and GIS data and provides a rich decision-support environment through the GeoMedia Motion Video Analyst Professional extension to the GeoMedia product.

GeoMedia is a powerful, flexible GIS management platform that enables you to aggregate data from a variety of sources and analyze them in unison to extract clear, actionable information. GeoMedia provides simultaneous access to geospatial data in almost any form and displays it in a single unified map view for efficient processing, analysis, presentation, and sharing. GeoMedia's live data connections and queries make it ideal for extracting information from an array of dynamically changing data to support making informed, smarter decisions. The GeoMedia Image Professional extension integrates advanced image processing capabilities including rigorous on-the-fly reprojection and enhancements, band chooser, advanced image registration, registration grid, extract image chip, load CIB/CADRG images, save image, and more. GeoMedia Image Professional operates on images directly in GeoMedia map windows and includes an integrated high-performance 64-bit electronic light table window.

Figure 2: Fusion of video information, including telemetry, with imagery and other geospatial content can greatly improve analysis and decision-making.

This analysis and integration can greatly assist in properly orienting the analyst and provides insight into actions and objects occurring within the video, as shown in Figure 3. In many cases, the UAV-based video represents the most recent information pertaining to the battlefield. So, when it is effectively integrated into an existing intelligence analysis workflow, it can yield a powerful analytical advantage and serve to make future planning activities more effective. It is important to understand the advantages and disadvantages of UAV video sources to effectively incorporate those sources into existing architectures.

The geospatial layer then serves as a backdrop for integration of the video sources with additional forms of intelligence, such as human intelligence (HUMINT), signals intelligence (SIGINT), and measurement and signature intelligence (MASINT). Information value can be derived in innovative and exciting ways from these disparate intelligence sources. However, they must be geo-fused and correlated to allow for proper analysis, understanding, and information visualization.

By blending georeferenced video with other forms of geospatial information, the video source can function as a method for geospatial data collection. In essence, the video can be a source of updated information on the location of portable assets or characteristics of existing features, such as the length of a runway. Analysts may use the video source to update attributes of existing features, such as the operational status of an industrial plant, or bomb damage assessment on a target of interest.

Figure 3: Geospatial features, such as road networks and text annotations, orient the analyst to better understand the environment covered by the video.

Managing and Serving Geospatial Information

Another important factor in using video for analytical purposes is the ability to easily query vast archives of video for specific clips that meet an analyst's search criteria and to rapidly deliver the results to the analyst's exploitation environment. Some of these criteria may include sensor type, date and time of collection, geospatial extents of the video coverage, and keywords that directly describe objects or activities occurring within the video. The key to providing this type of robust query ability is establishing an enterprise content management system that handles the variety of video formats. The end result is a scenario where an analyst can quickly zoom to a part of the world – possibly even down to a street corner resolution – and instantly queue up segments from video collected over the last 10 days that pertain to that street intersection. The analyst can then fuse those results with satellite images and signals intelligence and effectively plan out an activity, such as the routing of a convoy.

Although the growing volume of imagery, motion video, and other location-based sensor data provides greater coverage and information, it also creates data-handling challenges. Traditionally, analysts maintain data in a file-based format. The data-management challenges that arise from this practice can easily overwhelm the analyst and impose limitations on data sharing. In some cases, the analysts might spend more time searching through the file/folder hierarchy than they do analyzing the data. To further elaborate on the problem, data often is copied directly to the analysts' hard drives without important accompanying metadata. This practice may also lead to duplicated files in storage and cluttered disk space, which requires the analysts spend precious time "cleaning house."

Hexagon provides technology to automate the management of very large amounts of satellite imagery, aerial photos, motion video, and other digital files that are essential to the geospatial intelligence exploitation workflow. This includes built-in support for SQL Server for video and ERDAS APOLLO, Hexagon's commercial off-the-shelf (COTS) solution for enterprise image management, which provides multiple users with transparent access to large amounts of common imagery and other geospatial formats. This technology can greatly reduce the time between collection and exploitation while improving efficiency, collaboration, and quality. The imagery can be indexed and catalogued, which makes it discoverable to end users performing manual searches for imagery and to image exploitation applications that need the most recent set of images covering an area of interest.

Just as imagery ingestion and management are the keys to more effective use of imagery in a time-sensitive environment, the same holds true for collected video. In order for the video to gain increased usage and value after real-time collection and surveillance, it must be tagged in a way that makes it easily retrievable in the future. For seamless integration, it must be tagged by date, time, and other metadata as well as geographic context. In some cases, depending on the size of the video clips, some of this tagging may happen on an individual frame basis rather than on the entire video clip.

Conclusion

As defense and intelligence organizations work to expand the use of motion video sources for a wider variety of purposes, it is important to appreciate that many civilian organizations are incorporating video data sources into their existing processes and systems by establishing offices and programs to address UAS; they may include organizations in federal, state, and local government as well as private entities. As these systems become more reliable and economical and as policies for their safe operation are implemented, a vast array of new and innovative applications will emerge. To make the most effective use of aerial video collection in a civilian and military context, it will be extremely important for these organizations to implement technologies that provide reliable enterprise data management, fusion with other forms of geospatial information, enhancement and stabilization of jittery video, and superior analytical abilities. The combination of these components is the key to providing the right information at the right time, achieving improved analytical quality, maintaining high performance, and enabling superior decision making. Hexagon looks forward to working with partners and customers to provide these types of essential capabilities.

Military and intelligence agencies are faced with the need to adapt to wider-reaching demands and quicker response times than they have in the past. Furthermore, they are assimilating and analyzing more data than ever before, especially high-resolution imagery, real-time video, and GPS-tracked objects. Never before has there been a greater focus worldwide on security and emergency preparedness. Today's military and intelligence agencies must also meet the expectations of people and organizations who must respond to natural disasters and devastating global events. Therefore, they need to quickly and effectively collect and analyze relevant information that helps assess situations and reduce conflict around the world. With the continued evolution of technological features such as service-oriented architectures, advanced geospatial applications, mobile technology, and speed and method of transmission, it is time to provide powerful and intuitive geospatial intelligence (GEOINT) solutions that can help military and intelligence agencies be more effective and cost-efficient.

Hexagon has met the challenges of civilian, military, and intelligence agencies with proven solutions – including products, processes, and experienced professionals – since 1969. Hexagon continues its role as a worldwide geospatial solutions provider with its innovative technology for the workflows of geospatial intelligence agencies. Integrating geospatial data and workflows with scalable enterprise technology, our solutions help professionals meet their operational goals and enable data sharing across the enterprise. Agencies around the world consistently rely on Hexagon to provide advanced solutions for every facet of their operations.

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About Hexagon

Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications.

Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous — ensuring a scalable, sustainable future.

Hexagon's Geospatial division creates solutions that deliver a 5D smart digital reality with insight into what was, what is, what could be, what should be, and ultimately, what will be.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 20,000 employees in 50 countries and net sales of approximately 4.3bn USD. Learn more at hexagon.com and follow us @HexagonAB.