

Deploying Hyperspectral Imaging on Predator

Onboard Predator, Big Things Must Come in Small Packages

Mercury expertise helps SCC's Integrated Sensor Data Processor perform critical calculations.

When the United States Air Force (USAF) sought to integrate hyperspectral imaging (HSI) aboard their General Atomics Aeronautical Systems (GA-ASI) MQ-1 Predator unmanned air vehicle (UAV), they gave the challenge to Space Computer Corporation (SCC). Based on their recognized expertise in real-time HSI processing for demanding environments, SCC accepted the challenge to develop a ruggedized, compact, and deployable solution at half the size of the previous implementation. This effort is part of the Hyperspectral Collection and Analysis System (HyCAS) Advanced Concept Technology Demonstration (ACTD) program. The HyCAS ACTD is a joint Army/Air Force program for which the National Air and Space Intelligence Center (NASIC) is the technical manager.

Challenging Applications for Hyperspectral Imaging

Hyperspectral imaging is a relatively recent technology that holds promise for a variety of applications. It represents the convergence of two technologies: spectroscopy and remote imaging. The resulting combination enables HSI to measure light from the earth's surface using airborne sensors to differentiate many types of materials such as minerals, plants, man-made materials, and water.

Useful applications of this technology can be found in many commercial and defense industries, with significant advancement in capabilities for search and rescue missions, drug interdiction, automated target detection, ecological measurements, disaster evaluation and relief, and homeland security.

Performing HSI processing in real time requires intensive computations on large volumes of data. Hyperspectral data contains hundreds of spectral bands for each pixel. This spectral information can be compared with known material signatures using matched filters and correlated with surrounding pixels to detect anomalous features. Although HSI does not rely on high spatial resolution, it can be coupled with high-resolution imagery from a panchromatic camera or radar imagery for increased detail at a known location.

The user sets the threshold levels for detecting anomalies or how closely the filters must match the collected data. If desired, the system can perform the analysis in real time. When the system detects an anomaly, it can create a high-resolution "chip" for easier identification. These high-resolution image chips are identified by the system as possible targets of interest with their locations recorded in latitude, longitude, and elevation. If further analysis is required, the HSI system can record data to ruggedized hard drives for post-flight processing.



Figure 1. An enhanced, high-resolution chip containing a potential target of interest.

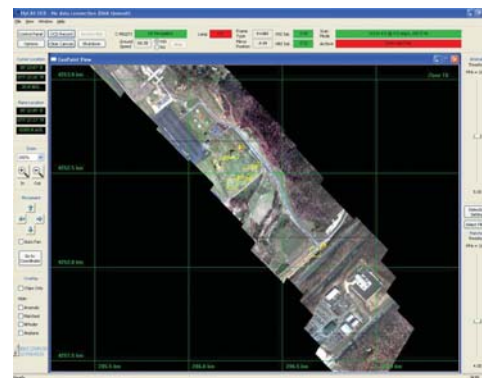


Figure 2. SCC's GUI depicts geo-registered data, inlaid with panchromatically enhanced image chips.

SCC Accepts the Challenge

SCC specializes in solving information-processing problems associated with advanced sensor systems. Their work in these areas extends from algorithm development and data analysis through design and fabrication of specialized signal processing hardware and field operations in support for data-collection experiments. SCC has established an exceptional reputation in real-time HSI processing, having deployed over fifteen real-time HSI systems for the Navy, AF, Army, DoE, and the Civil Air Patrol. In 2001, SCC demonstrated a commercial-grade HSI system onboard a Predator UAV as part of the Navy's WARHORSE program.

The USAF approached SCC and requested a ruggedized version of their HSI system for deployment on the MQ-1 Predator, but at one-half the size of the commercial version. Because of the size, weight, and power constraints of UAV payloads, the Predator system could not deploy the commercial-grade system demonstrated in 2001. In meeting these demands, SCC has not only created a ruggedized system at half the size of the commercial version, but they have also introduced more functionality and processing into the solution.

SCC Applies the Mercury Advantage

SCC has incorporated Mercury Computer Systems' high-speed fabric and Altivec optimized SAL library in their Integrated Sensor Data Processor (ISDP) system to perform the necessary calculations for matched filtering, anomaly detection, and image correction on the UAV itself. Mercury's ruggedized products allow SCC to manufacture their solution for an operating environment with many difficult requirements that cannot be met with standard commercial-grade components. Additionally, Mercury provided a clear advantage in performance density and ease of deployment for defense applications.

Ready for Deployment

SCC's ISDP system – comprising an HSI sensor, an auxiliary panchromatic high-resolution camera, and real-time, high-density processing and storage – is slated for testing and deployment aboard the upcoming MQ-1 Predator UAV's GA-ASI. The ISDP meets the stringent size, weight, and power constraints for the Predator, allowing the use of hyperspectral imaging sensor technology for broad area reconnaissance and automated target detection.



Figure 3. SCC's Integrated Sensor Data Processor (ISDP), slated for deployment in the Predator.

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