

CASE STUDY:

BORDER PATROL ENTERS NEW ERA OF MAPPING INTELLIGENCE, UNITED STATES



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U.S. BORDER PATROL ENTERS NEW ERA OF MAPPING INTELLIGENCE

Known primarily for its focus on fighting drug trafficking and illegal border crossings, the U.S. Border Patrol is also a key player in facility management, search and rescue operations and environmental protection.

MODERNIZATION OF THE U.S. BORDER PATROL

By the end of the 1990s, the agency had transformed from an under-funded, understaffed operation with inadequate resources, to an agency with over 2,000 agents, equipped with new information technology systems and geospatial tools. The modernization of the U.S. Border Patrol necessitated initiatives bringing together the potent mix of geographic imaging, geospatial information systems (GIS), global positioning systems (GPS), infrared aerial photography and sophisticated sensors for recording activity along the border.

The introduction of geographic imaging into the agency's security efforts has changed the investigative paradigm and unleashed new possibilities for tracking and preventing border crossings by illegal immigrants and drug smugglers.

MAPPING THE SOUTHERN CALIFORNIA BORDER

The first geospatial initiative, underway by autumn 1999, established a baseline GIS that set the stage for predictive modeling. Time and coordinate data related to border activity, captured by sophisticated surveillance devices outfitted with seismic and infrared sensors, was warehoused in ESRI's ArcView GIS. Building on this, the patrol began working more closely with ERDAS to integrate infrared aerial photos of approximately 100 miles of territory within San Diego County into the expanding GIS program.

Beginning in 2001, Leica Geosystems representatives accompanied U.S. Border Patrol and California Air National Guard into the field. During this field test, the Leica GS5+ Integrated Antennae was mounted on top of a truck, and a data stream was collected and immediately transferred to a laptop inside the truck, running ERDAS IMAGINE® software.

As the truck drove over the hilly terrain, through the complex network of trails and roads often used by illegal immigrants and drug smugglers, the exact position of the vehicle was captured by the Leica equipment, and then automatically displayed in ERDAS IMAGINE. As the truck drove along the road, an arrow followed its movement in a viewer loaded with a geo-rectified image of the area

Once the validation was complete and an appropriate location identified, Leica's VECTOR Rangefinder, GS5+ Integrated Antennae, and GS50 GPS system were used to survey and collect ground control points (GCPs). This process was challenging because of the confusing network of roads and trails, and a lack of man-made objects. Sixty GCPs were collected, providing the validation points needed to orthorectify new infrared aerial imagery using LPS.

“...the patrol began working more closely with ERDAS to integrate infrared aerial photos of approximately 100 miles of territory within San Diego county into the expanding GIS program.”



Greg Pendleton, Leica Geosystems, and US Border Patrol Agent Daniel Isenberg collect data along the Southern California border with Mexico.



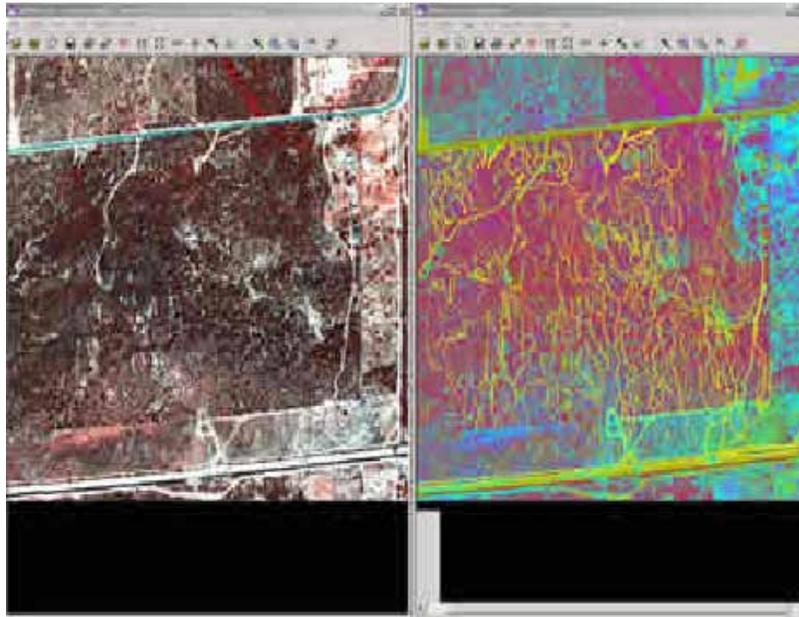
Greg Pendleton, Leica Geosystems, GPS, is collecting a ground control point. US Border Patrol Agent Daniel Isenberg is assisting.

IDENTIFYING TRAIL NETWORKS

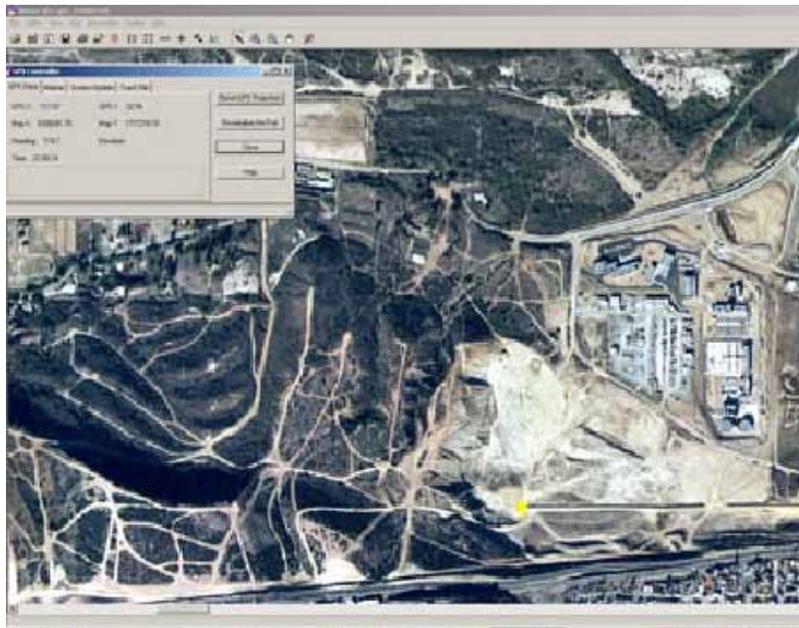
To help the patrol profile trail networks used by illegal immigrants and drug traffickers, San Diego State University (SDSU) used ERDAS IMAGINE to develop algorithms to specifically analyze the spectral characteristics of the bands within the infrared photos. SDSU researchers conducted the project through a NASA Affiliated Research Center (ARC), in conjunction with Blackhawk Helicopters of El Cajon, California. The project focused on the use of very high-resolution digital multispectral imagery captured from low-flying helicopters to monitor changes in foot trails and vegetation. ERDAS IMAGINE was used to discern healthy vegetation from stressed vegetation resulting from foot traffic and other human impacts, and reveal changes in paths. The information gathered helps the patrol understand the temporal component of border activity.



US Border Patrol Agent Daniel Isenberg views Mexico in the distance. The Leica GPS antenna on the car was linked to a GPS unit in the car that in turn was linked to ERDAS IMAGINE. Using the GPS tool, the team was able to find its location on the imagery.



The image at right shows an edge detection analysis performed in ERDAS IMAGINE, which was used to identify foot trails that the illegal immigrants may use to cross into the US from Mexico. The capture to the left is the original image.



This image of the California and Mexico border shows a ground control point (yellow dot) collected while in a car using a Leica GPS connected to a laptop running ERDAS IMAGINE.

CONTINUING EFFORTS

New imagery will continue to be acquired and used to evaluate changes within the trail system. ERDAS IMAGINE software has given the U.S. Border Patrol full capabilities for processing raster data and the ability to build a new model for signature feature extraction. IMAGINE VirtualGIS™ is being used for modeling and visualization of the trail systems.

Another application of the Border Patrol's GIS technology is the impedance grid project. By integrating slope, aspect, vegetation and terrain data with the sensor-captured data, agents will be able to precisely locate interdiction points. Once an illegal crossing is detected, an agent could pinpoint on-screen where the people will be next and when they are likely to get there, in a matter of minutes.



Borders between the United States and Mexico. The United States border is on the right and the Mexican border is on the left.

For more information on the U.S. Border Patrol's efforts to track and prevent illegal border crossings with the use of geographic imaging, and drug smugglers visit: <http://www.uscis.gov/portal/site/uscis>.

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