Along Came a Spider
From crosshairs to clothing—a fascinating look at the versatility of spider silk.

Emergency Management
Streamlined data delivery for first responders is put to the test.

New Instrument Technology
A centuries-old problem for surveyors is solved.

Surveying California
Smoothing boundary “wrinkles” in the Golden State is no small challenge for today’s California surveyors.
Above left: ARIES dissemination capabilities provide situation awareness and enable first-responders to retrieve and request geospatial data via their PDAs.

Above right and right: The aircraft is equipped with a suite of sensors for data collection, a wireless millimeter wave downlink capability, and on-board PC and Gb Ethernet network technologies.
On a perfect Indian Summer day, with cloudless and sunny skies and temperatures nearing sixty degrees in mid-November, an intensively trained team from EarthData, Raytheon Solipsys, and Trex Enterprises gathered at the Picatinny Arsenal in northern New Jersey to demonstrate the capabilities of a prototype system designed to produce and disseminate geospatial data in near real time. The system’s name, ARIES, is an acronym for Airborne Rapid Imaging for Emergency Support, and I attended its first live full-system demonstration. ARIES is intended to assist emergency “first responder” personnel in maintaining awareness of conditions at a disaster site, in identifying where responders should be, and in planning their most efficient actions during disasters. The concept arose from experiences in mapping Ground Zero in the aftermath of the 9/11 attacks, when rescue and recovery workers could not seem to get geospatial data fast enough amid dangerous and unpredictable conditions. ARIES Program Manager Terry Busch has coordinated the team of experts in data transmission, communications, and mapping through ARIES phase-1 development, which culminated in the November 17, 2004 event. The day’s activities were conducted to confirm the system’s capabilities to produce and disseminate high-resolution, high-accuracy geospatial data within three hours of the return of the data from the plane.

By Wendy Lathrop, LS
The various aspects of emergency response are not onerous when approached separately, but on short notice, the simultaneous organization and mobilization of responders can be daunting and slow, wasting time that is critical to rescue operations. ARIES not only provides a system for rapid deployment and data collection, it provides near-real-time geospatial data production and dissemination, plus real-time communications among data providers, decision-makers, and responders.

The ARIES demonstration served as both a test of the system and as an opportunity to publicize the system’s capabilities, allowing interested visitors to ask ARIES team members about design, programming, interoperability, communications, radio and satellite operations, and applications. Several local newspapers attended, as expected; visitors also included members of FEMA’s Region 2 office from New York as well as other New York officials. A group of eleven cadets and two GIS instructors from
West Point also attended and were enthused about the potential use of ARIES in military tactical planning. (As an interesting side note, they already had some imagery of the seven square mile arsenal site, most of it fairly rough in scale. There was one exception, however, as one of the instructors told me, that for some reason there was one small area with very detailed topography. We laughed on realizing that I had been part of the survey crew mapping that particular shooting range and bunker area by traditional ground methods more than 20 years ago!)

Picatinny Arsenal was chosen as the site for the ARIES demonstration because of plans to create an Emergency Operations Center here in the near future. Maurice Schall, Security Specialist for Picatinny Arsenal, informed me that there are training centers for disaster-response training in about five or six different locations throughout the nation—sites to train people in handling radiological hot spots, chemical and biological weapons, and explosives. His plans for an Emergency Operations Center at the Arsenal include training emergency first responders in both natural disaster and military emergencies, as well as SWAT teams. As a Homeland Defense Training Area, the Arsenal already has a tunnel system, created of six-foot diameter sewer pipe with soil piled over it to simulate underground conditions, and it is already employed to practice using dogs and robots to investigate hazards. Schall’s plan for the training center is to use a regional approach, following the regions defined by FEMA. In June 2005 he hopes to create four simultaneous simulated disaster incidents, possibly in Picatinny Arsenal, Philadelphia, somewhere else in Pennsylvania, and Florida (which is in the same region as Pennsylvania). That simulation would test whether information was properly coming into the central hub from all sites in order to be disseminated to first responders, and verify that different programs utilized at the different sites can communicate.

ARIES includes five major components: ground, airborne, downlink, processing, and dissemination. The ground component comprises a forward deployable self-contained tent that houses the ARIES data processing and communications operations. The tent was set up in fifteen minutes, although connecting the interior duct work for ventilation and heating or cooling and installing the workstations took an additional hour. The five specially designed tables that hold the workstations incorporate all the necessary wire channeling on their undersides so the only loose or hanging wires seen anywhere were the power cords that plug into the generator. Each table is about the size of a large office desk and each contains a 2-gigabyte network. The 50-pound tables fold up for easy transport.

The ARIES system arose from experiences in mapping the 9/11 attacks, when the first images of the disaster areas took many hours to collect and disseminate.

Operations Center at the Arsenal include training emergency first responders in both natural disaster and military emergencies, as well as SWAT teams. As a Homeland Defense Training Area, the Arsenal already has a tunnel system, created of six-foot diameter sewer pipe with soil piled over it to simulate underground conditions, and it is already antennae for both the plane and the ground crew, satellite dish, and wireless fidelity (WiFi). If phone service is interrupted, Iridium can be utilized instead of the Verizon network. This allows the ground crew to communicate with the air crew by phone or to interact with emergency responders by either phone or Internet.
The ARIES airborne component, which includes the aircraft, sensors, and communications equipment, simultaneously collected optical, lidar, and thermal data from an altitude of 5,500 feet above mean terrain (AMT). The seven-flight-line one-hour mission collected data over the entire arsenal (15 square miles). Following collection, the plane orbited the arsenal at an altitude of approximately 5,000 feet AMT at a distance of 6 kilometers from the ground antennae to enable downlink for data transmission. The 1.2-gigabits-per-second ARIES downlink component transmitted the 5 gigabytes of data collected during the flight directly into the central storage system within the ARIES processing center on the ground.

The data processing component receives the data from the aircraft and processes the data to produce a variety of geospatial products. The ARIES data dissemination component includes a web-based map system, a file transfer protocol system, as well as softcopy and hardcopy replication capabilities. The web-based mapping system provides users with the ability to...
view and interact with the ARIES data. Access to the web server may be limited if the data is sensitive. This component can support PDAs, enabling the ARIES team, decision-makers, and responders to monitor changing conditions and responders’ needs at disaster sites. Ground crews can update the mapping with conditions encountered on site, and the data analysts see it immediately on their screens. During the demonstration, I used a PDA to track one team member as he walked around outside then indicated the location an imaginary burning truck with a touch on his PDA screen, which instantly added the location to the overall mapping inside the tent.

The possible applications for ARIES stimulate “what if” speculation about single and multiple types of disasters. The resulting mapping could be utilized in evacuation from danger areas, with real-time updates allowing for changes as some routes either close or are in imminent danger of closing. Tracking wildfires could assist in identifying best locations to concentrate different fire-fighting efforts and to know where post-fire flooding might occur (due to the change in surface chemistry from the fire’s heat). Other uses include post-disaster verification of flood maps, tracking seismic shifting patterns, and of course rescue operations from attacks as occurred on September 11, 2001.

With such a variety of uses, how could this highly technical, tightly coordinated, and presently very expensive system best be made accessible? Because the system is mobile, having one ARIES system per FEMA region would allow rapid deployment; locations at regional governmental operations or military reserve unit posts are one possibility for this plan. Contracts with different federal agencies might allow more units. Non-mobile units on permanent sites could also be useful.

Near the end of the day I asked Terry Busch how he felt about the day’s events and whether the goal of three-hour processing time had been met. His reaction was that of a true inventive spirit: the lidar processing had been completed within 1.5 hours, orthorectification of the optical data using the lidar-derived DEM had required an additional 45 minutes, and Busch talked about the potential to reduce those times. Busch also had some ideas about how to make in-production mapping viewable (but not downloadable) by first responders. The ability to work with interim updates in view-only format could be invaluable in deploying the appropriate emergency personnel or identifying newly inaccessible ground routes. We also discussed how to keep the ARIES team safe during a disaster, as the six-mile range for the widest bandwidth, which yields the greatest detail, could be hazardous in certain situations. Busch noted that the system could be deployed from up to 200 miles away if using a narrower bandwidth, such as for color video.

All in all, the demonstration clearly revealed ARIES’ capabilities as well as the system’s promise for the future.

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