Imaging tool could boost national security, local economy

by Alex Salkever

With cost effective components and some mathematical magic, a University of Hawai'i researcher and Honolulu start-up company are developing a hyperspectral sensor system with detection capabilities useful in commercial, research, military and national security applications.

A professor in UH Mānoa's Hawai'i Institute of Geophysics and Planetology and 2005 recipient of the Regents' Medal for Excellence in Research, Paul Lucey is a pioneer in remote sensing technology. He has won more than $14 million in competitive grants over the past two decades, studying the composition of the moon's crust, developing a space-based camera to map distribution of coral reefs and building sensors for on-site compositional analysis of rocks on Mars.

Hyperspectral imaging uses information from infrared to ultraviolet light to identify unique chemical or biological fingerprints known as spectral signatures. It is used in many disciplines, including agriculture, astronomy, geology and oceanography. Lucey's hyperspectral sensor system can recognize spectral signatures known to be associated with dangerous substances and convert the signatures into a visual format that humans can easily look at and understand.

The new technology grew out of successful field tests of Lucey's Airborne Hyperspectral Imager, a helicopter-mounted sensor system for detecting buried landmines that was funded by the Defense Advanced Research Projects Agency, the research and development arm of the U.S. Department of Defense. Pursuing a longer-range system that would be cheap and compact enough to deploy widely, he began experimenting with a system that combined a Sagnac Interferometer and new types of high-powered, low-cost infrared detection systems.

Hyperspectral imagers remotely gather data from across the electromagnetic spectrum to identify chemical signatures of things, such as weapons in the landscape, the human eye doesn't detect

Previous systems were based on detectors that cost close to $1 million each and used spectrometers with the size and heft of a refrigerator. The Sagnac interferometer costs $50,000 or less. "The real advantage was we put together this spatial interferometry and coupled it with these new infrared detectors," says Lucey. He has received one patent on this technology and has a second pending.

"I recognized that Paul's technology had real potential," says Edward Knobbe, former vice president at ICx Nomadics, a Stillwater, Okla., company specializing in advanced sensor technologies for homeland security, force protection and commercial applications. In 2008, he licensed the technology and formed Honolulu-based start-up firm Spectrum Photonics with Lucey as his chief of research. The company has hired nine technical employees—including five UH graduates—and secured nearly $6 million in federal research grants. In a recent round of field tests at the Army's Dugway Proving Ground in Utah, their system was able to accurately detect surrogate chemical weapon signatures from a distance of three kilometers.

Lucey and Knobbe have reduced the size of the units, which could now fit in a large shoebox. That's small enough to mount on the multi-technology Cerberus sensor platform manufactured by ICx, which has a long track record with both the U.S. Department of Defense and the Department of Homeland Security. The goal is to have a commercially viable, made-in-Hawai'i prototype ready for testing within the next two to three years. Ⓜ

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