NEWS

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Sensors Unlimited develops InGaAs technology for cutting-edge IR programs

BY JOHN McHALE

PRINCETON, N.J.—Experts at Sensors Unlimited Inc. in Princeton, N.J., are using indium gallium arsenide (InGaAs)-based shortwave infrared imaging (SWIR) to work with thermal imaging for military night-vision technology in DARPA's MANTIS program and LADAR (laser detection and ranging) applications.

Under MANTIS a fused imaging system is being developed that merges thermal, SWIR, and visible imaging on a soldier's helmet. This imaging can network with other soldiers, and with command-and-control authorities.

"The image produced will be a real-time blend from the four cameras mounted on the soldier's helmet—one visible, one thermal, and two SWIR," says Martin Ettenberg, director of engineering at Sensors Unlimited, in a paper, "InGaAs Short Wave Infrared Emerges as Key Complement to IR for military imaging."

"Under a DARPA contract, Sensors Unlimited has delivered an all-solid-state, 640-by-512-pixel prototype camera able to transmit analog video as well as 12-bit digital imagery. The high-resolution camera can detect a camouflaged man target at 100 meters under starlight-only conditions. Under the same program, Raytheon teamed with Sensors Unlimited to deliver a 1280-by-1024-pixel InGaAs imager that provides higher resolution at longer ranges. DARPA plans to have prototypes ready by the end of fiscal 2005," Ettenberg says.

For a 1.55-µm InGaAs LADAR and wavefront-sensor system for the U.S. Missile Defense Agency (MDA), Sensors Unlimited is developing a specialized InGaAs sensor that can image in the SWIR band and then switch to the LADAR mode, all in the eye-safe range. The system combines staring-type imaging like visible cameras with the incredibly high sensitivity of LADAR at long range and wavefront sensors for adjusting the optics in directed energy weapons, Ettenberg says.

"In this system each pixel has a built-in PIN and APD (avalanche photodiode) detector. Sensors Unlimited and Advanced Scientific Concepts (ASC), demonstrated the first 1.54-µm 32-by-32 InGaAs flash LADAR system able to image and range objects within 5 centimeter accuracy," he writes. "This is an active illumination system in which a pulse laser is fired to create an image with range information provided for each pixel. Since it is eye-safe, it does not blind your friends while you try to identify them and gather range information."

The cameras for each program are based on InGaAs focal-plane arrays hybridized to CMOS read-out integrated circuits (ROICs), Ettenberg says. "This allows us to capitalize upon the technological advances in CMOS technology while exploiting all the aforementioned benefits of InGaAs detection capabilities. Thanks to earlier DARPA programs, detectors in current InGaAs cameras have extremely low dark-noise characteristics. Thus, today's compact InGaAs cameras truly handle like a commercial digital camcorder."

Ettenberg notes that SWIR devices are a complement to thermal imaging systems for several simple reasons. "First, SWIR detectors and cameras can intrinsically see things that thermal detectors cannot, and can see them through glass. Second, they can transmit digital information more readily than current image-intensifier tubes and with greater sensitivity than I2CCDs. Third, unlike SWIR cameras based on HgCdTe or InSb detectors, InGaAs SWIR cameras operate at 20 degrees Celsius, require no cooling or mechanical shutters, and never need field nonuniformity corrections (NUCs). InGaAs is also a very proven, cost-effective material, having been used in high volumes by the telecommunication industry for more than 20 years."

"As a result, today's InGaAs SWIR cameras are as compact, versatile and simple to use as a commercial digital video camcorder," says Ettenberg. "Because they deliver simultaneous analog and digital outputs, advanced InGaAs SWIR cameras enable such easy transmission of information that command and control can see exactly what the soldier in the field sees—as he sees it," he says.

The devices are also eye-safe, Ettenberg says. This feature enables possibilities for training where the bulk of military lasers are used, he adds.

According to Ettenberg, his InGaAs technology also picks up where thermal imaging leaves off in conditions such as dawn or dusk (known as the crossover points).

"With SWIR, the foot soldier or tank gunner can easily tell a tank from a school bus, even on a moonless night. Interpretation of thermal images, by contrast, requires intensive training and, even then, does not permit definitive identifications," Ettenberg says. "Another drawback of thermal imagers is that they require costly germanium or silicon lenses and cannot see through plain glass. While a soldier can see through a window into a building with a SWIR camera, he cannot with a thermal camera. By the same token, a soldier can drive a HUMVEE at night by looking through the windshield with a helmet-mounted SWIR camera inside the vehicle. A thermal camera must be mounted outside the vehicle because it can't see through glass."

"A strong case can be made to use the SWIR waveband for covert surveillance, guidance, and fire control," Ettenberg says. "InGaAs detectors could be added to the seekers of laser-guided munitions. It could be a key to faster progress with drones and other unmanned vehicles. Virtually every object or event of interest to the military reflects or emits some SWIR radiation."

For more on SWIR technology from Sensors Unlimited please visit www.sensorsunlimited.com.

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