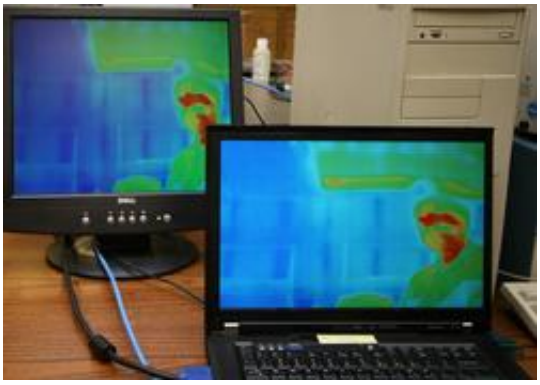
Researchers Help U.S. Military Thwart Explosive Threats

July 18 2008



Thermal images are displayed on a computer screen via an infrared camera which detects the presence of hard objects inside camouflaged boxes.

Researchers at UC San Diego are using statistical pattern recognition and image processing to help the U.S. military better detect hidden roadside explosives.

Under a grant funded by the U.S. Department of Homeland Security through the National Science Foundation, UC San Diego structural engineering professor Francesco Lanza di Scalea is working on an imagery-based surveillance technique which uses visible and infrared images, analyzed by statistical pattern recognition algorithms to detect and classify suspicious objects such as camouflaged bombs placed at roadside and in airports. Lanza di Scalea is one of a handful of researchers in the United States who was awarded the one-time, three-

year NSF grant.

The goal of the NSF program, called “Explosives and Related Threats: Frontiers in Prediction and Detection,” is to advance fundamental knowledge in new technologies for sensors and sensor networks, and in the use of sensor data in control and decision making, particularly in relation to the prediction and detection of explosives and related threats. The NSF describes this research as critical to the nation’s ability to deploy effective homeland security measures to protect civilians and U.S. military forces around the world.

“What we hope to do is use image processing and monitor different wavelengths of an object to detect a certain shape of an outside container, and to also determine whether it is empty, or if it has some metal inside,” Lanza di Scalea said. “We are focusing on trying to detect or identify improvised explosive device (IED) camouflages such as cardboard boxes and cigarette cartons found in Iraq and Afghanistan.”

According to the Defense Department, improvised explosive devices account for 50 percent of all daily attacks in Iraq. Of the three types of IEDs (roadside bombs, vehicle-born bombs and suicide bombs), roadside bombs are responsible for the most casualties. The most common IED camouflages in Iraq include shoe boxes, milk cartons, cigarette cartons, plastic bags and garbage cans.

As part of their current research, Lanza di Scalea and his team will collect both visible and infrared signatures of an object and then analyze the images and extract certain features like shape, texture and material type. The third step will use statistical pattern recognition to determine whether an anomalous object is harmless or not.

Lanza di Scalea said advances in the field of multispectral surveillance over the last few years have aided in this type of research. Multispectral

surveillance involves detecting objects and monitoring different wavelengths of radiation from an object going from visible to ultraviolet and infrared lights and combining all of those different radiation wavelengths to identify an object.

“Another area my research is benefiting from is statistical pattern recognition and being able to combine different features of an object to statistically classify it,” said Lanza di Scalea, a world-renowned expert in structural health monitoring. “For example, the brain can look at a road and learn what a normal road looks like based on different features like shapes and colors. If you put an object on the road the brain would know there is something different even thought it hasn’t seen that exact object before. It’s that kind of statistical pattern recognition we want to use with computers to detect anomalous objects without prior training on the specific object.”

Current explosive detection technology used by the U.S. government includes X-Ray machines; machine olfacation (gas chromatography and differential mobility spectrometry);neutron activation, in which the machines bombard the suspect explosives with neutrons and read the gamma radiation decay signatures to determine the chemical compositions of the sample; and specially trained dogs.

“The U.S. government is always looking for improved methodologies to detect explosives both in military and civilian arenas,” Lanza di Scalea said. “It’s very rewarding to hopefully be able to contribute to a problem of national importance because ultimately it comes down to safety.”

Provided by UCSD