Thermal Imaging

Tomorrow's Technology for Today's Searches

By David Pease

Thermal imaging devices can be powerful additions to the arsenal of tools available to rescue technicians and firefighters. Continuous advances in technology mean that these devices are becoming lighter and more affordable.

The cost of thermal imaging devices ranges greatly, depending on the technologies utilized. Lower-end models typically utilize vacuum tubes, while higher-end devices use solid-state technology. As thermal imaging units used by rescue squads are typically the low-end variety, this article focuses on that technology.

How Thermal Imagers Work

While the concept behind thermal imaging is easy to understand, the physics that drive it are not. Dr. Wesley Snyder, a professor of electrical engineering at North Carolina State University, recently purchased a thermal imaging unit to perform medical studies.

Snyder explains that all objects give off "black body radiation." This radiation is emitted at all frequencies. The amount that is emitted depends directly on the temperature of the object: the hotter the object, the more radiation produced. At the temperature of human skin, black body radiation is most efficiently produced in the infrared (IR) frequencies. IR radiation is invisible to the human eye, but easily detected by electronic instruments. Black body radiation produces positive charges when it interferes with the material on the face of the vacuum tube in the unit. Negative electrons inside the tube neutralize the positive charge, producing a current. The more photons that hit the tube, the whiter the image becomes. The electrical source for the unit is what produces the negative electrons.

Field Testing

To test the usefulness of thermal imaging in the field, we took a basic, handheld thermal imaging unit and put it through its paces. We wanted to see if a rescue unit would want to add such a device to its search equipment.

The unit we tested was a Series 3000 thermal camera manufactured by EMX, Inc. in Winter Springs, FL. This device is marketed primarily to law enforcement and rescue services for open-air searches and surveys.

Initially, we compared the thermal camera with night vision goggles (NVG) that amplify ambient light. While NVGs have greatly aided our night searches, they have some limitations. Their visibility is limited, especially if the victim is lying down or hiding behind something.

Like the NVGs, the thermal imaging unit presented its own set of limitations. These were not specific to the unit we tested, but apply to all thermal imaging devices.

Terrain presented a problem at times, as the imaging unit cannot image what it cannot detect, but neither can a searcher see someone who is not visible. Rough terrain only means you will have to get closer to a victim before the unit picks up the heat source.

The dog days of summer presented another problem. Foliage can produce and retain a great deal of heat. If the unit is used during the day, this makes it difficult to detect someone. Even after dark, plants tend to retain their heat for some time. This problem can be minimized by adjusting the contrast of the image if this feature is available.

The user of the imaging unit also needs to be trained in its handling--mainly in what to look for while operating the unit.

In testing the unit, the resolution was good and it picked up objects from a considerable distance, although the ideal range is up to 500´. Beyond that, objects became small and difficult to identify. We were able to spot mock victims in moderate to dense underbrush at a range of 120´. This was consistently achieved using different team members with various levels of experience with the unit, and accomplished in several different terrain and foliage settings. We were able to produce excellent results from having the victims lie down or hide behind trees.

The thermal imaging unit was best utilized with a three-person tracking team, consisting of a navigation specialist, a medical/communications specialist and a tracking specialist using the device.

During the recent flooding in North Carolina, we used the unit to search for victims who were swept away in the flood waters. It worked perfectly, and we were able to cover approximately half a mile of wooded shoreline in about 10 minutes.

If you calculate the probability of detection at around 85%, it would take 12-18 searchers approximately 15-20 minutes to adequately cover one acre at night. Given the same circumstances, a three-person team utilizing thermal imaging could cover this same area in a third of the time. When you start to look at the overall search operations, it's easy to see that this would greatly reduce man-hours, as well as the number of personnel required, while increasing the probability of detection and the chances of a successful search.

Thermal imaging units come in a variety of sizes and configurations. Choose a unit based on the application for which it will be used. If you are going to use thermal imaging for fire and rescue, there are units designed for high heat and temperatures. They tend to be a little heavier than the units designed for use in the field. If you're going to use thermal imaging mostly for searches and rescue, one of the lighter units might be a better choice.

Another consideration is battery life. Some batteries last 4-6 hours on a full charge, while others last only 4 hours. Purchasing extra batteries is necessary if you plan on utilizing the unit in the field for any length of time.

Another feature that some units offer is reverse imaging. With this feature, heat-producing objects appear dark rather than white. This doesn't enhance the unit's viewing capabilities, but it does produce a more realistic image.

Cost Considerations

Thermal imaging devices aren't cheap. They range in cost from $10,000 to $30,000+. In order to justify such an expenditure, you must consider the number of searches conducted each year, budgets, available resources and personnel, and the type of terrain you will be searching in.

There are grants available, but these take time to apply for. The paperwork can be difficult, but it is worth the effort. Consider speaking with other emergency responders in your area about buying a unit and sharing its cost and usage. Also, discuss with your local government about assistance for purchasing such a device. A specific fund-raiser just for the unit, along with some good PR from your local newspaper and TV stations, may also work.

Once you have purchased the unit, train your responders on how to effectively use it in the field. Make sure that all the agencies in your area know you have a unit available and take good care of it. It is quite an investment to leave in your equipment closet collecting dust.