Homeland Security
Science and Technology

TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science and Technology (S&T) Directorate of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

Information provided by the SAVER Program will be shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as federal, state, and local responders.

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, please see the SAVER Web site or contact the SAVER Program Support Office.

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SPAWAR
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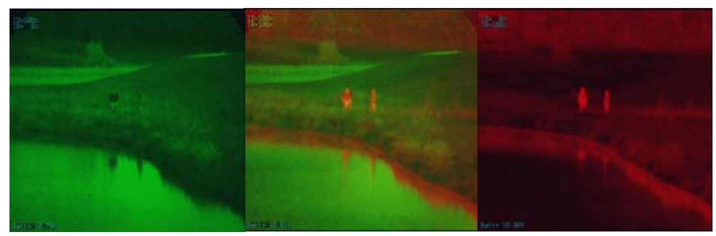
Integrated Night Vision Systems

Night vision systems can use various types of technologies to allow users to see in low or no light scenarios. Each of these technologies has inherent advantages and disadvantages. Integrated night vision systems (INVSs) combine image output from two or more different types of night vision sensors into one composite (fused) image in order to take advantage of the strengths of each type of sensor.



I^2 imaging Fused image Thermal imaging

Figure 1. Digital Image Fusion

The most common form of sensor fusion used for emergency responder applications is the coupling of an image intensifier (I^2) with a thermal imaging sensor as shown in Figure 1. Generally, I^2 sensors provide an image of the surrounding environment under low-light scenarios, while thermal imaging sensors allow for the identification of objects and targets of interest by showing the thermal signatures of the objects in the environment. INVSs that combine these two technologies provide emergency responders with enhanced detection and recognition capabilities in fog, rain, and smog, as well as in poorly illuminated conditions.

Technology Overview

Ultraviolet (UV), visible, and infrared (IR) light make up a portion of the electromagnetic spectrum. As can be seen in Figure 2, only a narrow portion of the electromagnetic spectrum is visible to the unaided human eye. The ability to create an image using portions of the spectrum outside the visible range allows for the visualization and identification of objects that would be difficult or impossible using the unaided human eye.

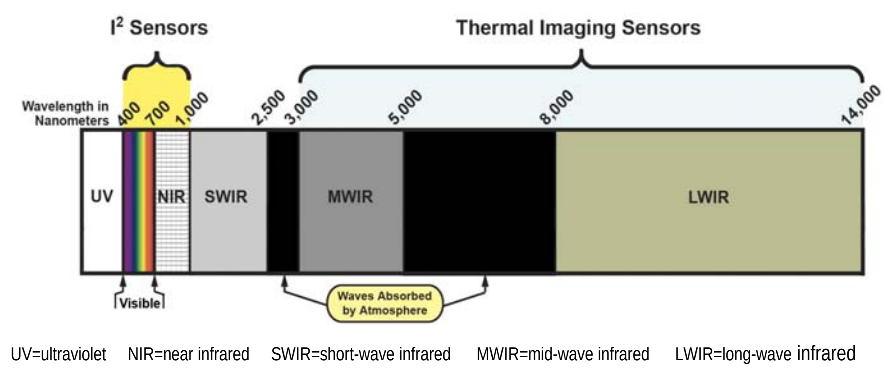


Figure 2. The spectral wavebands of I^2 and thermal imaging sensor technologies in the electromagnetic spectrum

I^2 night vision devices operate in the visible and near infrared (NIR) electromagnetic spectrums, while thermal imaging sensors operate in the mid- and long-wave infrared (MWIR and LWIR) spectrums, illustrated in Figure 2. In addition to creating images from a broader portion of the electromagnetic spectrum, INVSs that utilize I^2 sensors require a small amount of ambient illumination to operate effectively. Light entering an I^2 sensor is amplified thousands of times to produce a visible image for the end-user.

INVSs with thermal imaging sensors are capable of showing temperature differences as small as 2°–3° C between an object and its environment, thus allowing users to readily pick out objects with different heat signatures. Thermal sensors also provide the end user with improved visibility through many weather conditions that typically limit visibility such as fog and haze.

Fusion Methods

Fusion of images from each night vision sensor can be accomplished either optically or digitally. Optical fusion relies upon an optical combination of sensor images, while digital fusion employs digital signal processing to combine sensor images.

Optical fusion in INVSs can be accomplished in two ways. One approach uses a beam combiner to fuse images from two sensors into one image. The second approach, dichoptic fusion, provides the user with two independent sensor images, one for each eye. The fusion of the images occurs in the brain of the user. INVSs using a beam combiner are generally monocular systems, while INVSs using dichoptic fusion are binocular systems as shown in Figure 3.

Figure 3. Monocular and Binocular INVS Configurations

Digital fusion INVSs use digital signal processing to combine the images from each sensor into a single image. The hardware, software, and power requirements of digital signal processing typically increase the overall size and weight of digital fusion INVSs. As a result, digital fusion systems have traditionally been fixed-mount configurations. In contrast, optically fused systems require less power because the image fusion is not digitally processed.

Considerations

Digital fusion systems may outperform optical fusion systems since digital fusion systems typically deliver improved imagery attributed to digital signal processing features, such as image optimization and stabilization. Due to additional components required by digital fusion systems, the deployability and portability of digital fusion INVSs is often limited. In addition, digital fusion INVSs are generally more costly than optical fusion INVSs; most commercially available digital fusion systems retail for over $50,000, while commercially available optical fusion INVSs are typically available for approximately $13,000 to $20,000.

Emerging Trends

Earlier INVSs developed for use by the U.S. military were limited to vehicular and airborne applications due to the physical size and weight of these systems. The current trend in INVS design is the development of systems that are more portable and therefore easier to deploy in the field.

Recent advances in technology have dramatically miniaturized I^2 components. Thermal imaging devices have also undergone similar advances, which have sharply reduced power consumption and cost, while improving the image display and overall reliability. INVS technology has progressed as a result of the technological advances made with each sensor technology and has also become smaller and lighter than previously available systems.

Additional Information

Handbook of Night Vision Technologies, SAVER
➢https://www.rkb.us/saver

Design Challenges and Considerations for Image Fusion in Multi-Spectral Optical Systems, OASYS Technology
➢http://oasystechnology.com/PDFs/DesignChallenge.pdf