Sensor Defeat Technology

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LONG-TERM GOALS

The long-term goal of the program is development of technology that will enable EOD technicians safe access to improvised explosive devices/special improvised explosive devices (IEDs/SIEDs) for performance of a render safe procedure when protected by denial devices.

OBJECTIVES

The major objective of this program is to develop active and passive technologies and techniques for detecting and defeating area denial sensors to allow EOD technician access to threat devices.

APPROACH

An active infrared (AIR) security device employs a transmitter, receiver, and a pulsed infrared beam. When the infrared beam between the transmitter and receiver is interrupted or broken, the AIR denial device enters an alarmed state. The transmitter and receiver may be up to 1,000 feet apart.

The circuitry of the transmitter “pulses” the electronic beam many times a second to provide greater security and to minimize false alarms. Similarly, the receiver circuitry looks for these “pulses.” Therefore, this technique minimizes the ability of an ordinary light source to trigger a false alarm in the receiver.

Our approach is to detect active infrared (IR) energy, which is present without having to break the direct sight beam. We will attempt to extend the performance of the existing tools by applying signal processing and energy collection techniques with more recent commercially available IR detectors. Our energy collection techniques will focus on the development of one or more wave guides to amplify the S/N seen at the detector. Our signal processing improvements will focus on the use of autocorrelation and similar techniques. For example, two or more pyramid wave guides may be used side by side

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and/or one atop the other because of their small size. If the signals from a pair of pyramid wave guides are labeled A and B, the signal may be added electronically to increase the signal to noise ratio of the combined signal.

Another approach would be to multiply signal A by signal B to increase the signal to noise ratio. The procedure should have the same or similar results as the use of an autocorrelation technique. Here, the signals may have to be digitized before they are multiplied together.

The investigator will analyze the potential configurations and determine the best circuitry and energy collection technique, which will enhance the signal to noise ratio and therefore increase detection ranges. The proposed circuitry will be breadboarded and tested. Because of the availability of numerous types of signal processing chips, miniaturization of the tested circuitry should not be a problem. Laboratory test beds with pyramid type reflectors and signal processing means will be assembled and tested. An effort will be made to conduct field experiments.

WORK COMPLETED

The technology to pick up the AIR signal remotely is now accomplished with phototransistors mounted on a wand that is placed in the path of the AIR beam. A small wave guide that is comprised of four sides in the form of a pyramid to focus IR energy onto a 300 series photo diode was developed. The sides of the pyramid are fabricated of acrylic sheeting with an interior surface that has a first/front surfaced mirror thereon. The length/height of the horn/pyramid is approximately 11 inches. The base/front aperture is approximately 1.80 X 1.80 inches square; the top/rear, 0.25 X 0.25 inches square. The enclosed angle between the disparate sides of the pyramid is approximately 8 degrees. The photo diode is mounted at the 0.25 X 0.25 inch square aperture. An important feature of this arrangement of wave guide and detector is the ability of the wave guide to shield the detector from the sun under certain conditions. In addition, modifications were successfully made to an available commercially-off-the-shelf (COTS) detector with a 300 series photo diode to increase its sensitivity. Tests were conducted with the aforementioned wave guide and improved detector/electronic circuitry to gather data and determine an approach to optimize the system.

RESULTS

Tests conducted with the pyramid wave guide and modified COTS detector had four times the range of the presently employed wand detector against an IR wand test source. The pyramid wave guide was also superior to other parabolic wave guides which were tested.

The parabolic reflectors tested were polished aluminum 18” and 24” diameter. One test was conducted with gold plating on the reflector but no significant difference was observed.

Following those tests, a two pyramid wave guide device with 300 series photo diode detectors was directly hooked up to a 741 operational amplifier that was set up as a summing amplifier. The output from the pair of detectors was stronger than from either one individually. This experience together with other preliminary signal chain analyses has shown that signal processing techniques will enhance our AIR detection capabilities.

IMPACT/APPLICATIONS

The impact on systems applications will be that EOD technicians will have new tools to use against AIR area denial devices. These technologies will allow EOD technicians to defeat sensors in less time and in a safer manner than previously.

The improved AIR detection device will give the EOD operator greater standoff distance when searching for AIRs from afar.

TRANSITIONS

The improved AIR detection device will transfer to the DoD Technical Response Team and to EOD technicians with the SIED units. The aforementioned recently developed pyramid type wave guide and COTS detection means were demonstrated to the 749th EOD, Major Pride, Bechtel personnel, British EOD Sappers and command personnel, and Defense Establishment Research Agency personnel on 27 Jul 98 during Impact 98 participation at Cowbyres, Barry Buddon Camp, Angus (near Dundee), Scotland.

RELATED PROJECTS

None.

PATENTS

Active Infrared (AIR) EOD Security Device; Michael Greene, Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV). A Record and Disclosure of Invention form was signed by Michael Greene on 24 Feb 98 and forwarded to the NAVSEA Patent Counsel for a patent. *Patent pending.*

Robotic Arm of Tubular Type Construction to Maximize Its Moment of Inertia for Maximum Lifting; Michael Greene, Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV). A Record of Disclosure of Invention, *Navy Case Number 79541*, has been submitted. *Patent pending.*