Detecting Electronic Initiators Using Electromagnetic Emissions

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EXECUTIVE SUMMARY

The accurate and timely discovery of radio receivers can assist in the detection of radio-controlled explosives. By detecting radio receivers, it is possible to indirectly infer the presence of an explosive device. Radio receivers unintentionally emit low-power radio signals during normal operation. By using a weak stimulation signal, it is possible to inject a known signal into these unintended emissions. This process is known as stimulated emissions. Unlike chemical traces, these stimulated emissions can propagate through walls and air-tight containers. The following case study discusses methods for detecting and locating two different types of radio receivers. Functional stimulated emissions detectors are constructed, and their performance is analyzed. Stimulated emissions are capable of detecting super-regenerative receivers at distances of at least one hundred meters and accurately locating superheterodyne receivers at distances of at least fifty meters. These results demonstrate a novel technique for detecting potential explosive threats at stand-off detection distances.

ORGANIZATION BACKGROUND

Remote detection of improvised explosive devices is essential to guaranteeing safety in conflict-prone environments. The Missouri University of Science and Technology (Missouri S&T) works closely with the Awareness and Localization of Explosive-Related Threats (ALERT) center in order to develop practical, cutting-edge technology for countering explosive-related threats. Missouri S&T is a state university located in Rolla, Missouri and is formerly known as the University of Missouri—Rolla.

In recent years, the university has experienced steady, aggressive growth. Since 2003, according to institutional research reports, undergraduate and graduate enrollment have each increased by over 40%, and operating revenue has grown by 134%. University research is funded principally by grants and contracts from participating institutions. In 2012, the university accrued over $31.2 million U.S. Dollars in such funding, which is a 17% increase since 2003 (Kumar et al., 2012). A portion of this funding is used to finance emerging research for detecting improvised explosive devices (IEDs).

Missouri S&T's counter-IED research takes place in concert with government agencies, such as the Department of Homeland Security, and military organizations like the Leonard Wood Institute. The executive director of the Leonard Wood Institute has praised the university's accomplishments, asserting that Missouri S&T is "the number one place to do something about detecting IEDs" (Bruns, 2009). As of early 2013, the university maintained at least fifteen different counter-IED projects in areas such as detection, neutralization, and blast mitigation. The research conducted for the ALERT Center of Excellence focuses on the detection of explosive devices and blast mitigation.

The following case study presents the key findings from the ALERT Center project for the detection of electronically-initiated explosive devices.

CASE DESCRIPTION

Explosive devices typically contain at least three components: propellant, a payload, and an initiator. Each of these components provides a different opportunity to detect the device. Although the first two components are the most specific indication that explosives are present, another way to detect potential explosive devices is to detect the initiator. Explosive devices are commonly initiated using proximity sensors or remote triggers (Wilson, 2006; Griffith, 2007). Such initiators generate electrical signals which can radiate into the environment as electromagnetic emissions. By detecting potential initiators, it is possible to indirectly infer the presence of an explosive device.

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