Revealing Images



The CWD portal accurately pinpoints the location, size and number of concealed weapons while differentiating personal artifacts such as coins, keys and belt buckles.

National Security

Concealed Weapons Detection

Using a magnetometer-based portal to detect potential threats

A Weapons Detection Solution

Terrorists, both domestic and foreign, are introducing new and emerging threats in the smuggling of weapons through security checkpoints. To address these threats, INL, through the support of the National Institute of Justice, developed a portal-style concealed weapons detection system that uses passive magnetic sensors. The system provides a non-intrusive method for rapid detection, location, and archiving of data – including visual data – of potential suspects and weapon threats.

Multiple Networked CWD systems controlled via central monitoring station



Method of Operation

The Concealed Weapons Detector (CWD) senses disturbances in the ambient earth's magnetic field – disturbances such as those caused by a weapon passing through the aperture of the portal. The CWD uses sixteen magnetic gradiometer sensors arrayed on both sides of the portal aperture. Data are collected from each of the gradiometers, and the change in the magnetic field over ambient background is determined. An overall response is derived and the CWD sensors are processed as a group to determine the location and size of detected objects. The system provides a graphical interface to the operator by using freeze-frame video capture technology, and places icons over the video indicating where suspected weapons may reside on a person.

Using a single camera, the technology displays and tracks more than one person at a time who might be carrying concealed weapons, greatly simplifying the process of divesting suspicious objects. The product does not interfere with any medical device, including pacemakers. The CWD can be installed as a stand-alone checkpoint screening tool or as a fully integrated security system encompassing multiple, networked CWD units that can be controlled via central station monitoring.

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Enhancements allow detection and discrimination of small magnetic field items such as composite metal guns

Sensor Fusion Testbed

Experts agree that threat detection can be improved through the concurrent analysis of multiple signatures, such as magnetics, ultrasonic, acoustic, mm wave, and infrared. The INL CWD system can serve as a platform to combine various detection mythologies into a single portal system. The CWD is built on an open data acquisition platform. The portal configuration can be tailored for specific applications and threats. INL welcomes partnering with other institutions to further evaluate novel weapon detection configurations and technologies.

Field Evaluation Capabilities

The INL has established field evaluation capabilities at Bannock County Courthouse in Pocatello, Idaho. Three CWD systems have been networked together as part of an integrated INL-designed security system. Command and control functions for the entire security system are accomplished at a central security center, where one security guard can monitor and communicate with the entire security system using audio, video, and computer networks. The CWD system also interfaces with an automatic door locking system to control egress if a threat is detected.

Technology Enhancements

We have demonstrated that certain classes of weapons and electronic items, such as pagers and cell phones, produce unique spectral signatures that can be used for automated identification and classification. We use statistical analysis tools and a variant of a probabilistic neural net (PNN) to analyze the spectrum generated when a person passes through a portal. The algorithms perform a type of pattern recognition and calculate a probability factor that the collected spectrum signature correlates to a known database of weapon vs. non-weapon responses.

The CWD data acquisition system performs a spatial analysis (x-y-z axis) of the magnetic spectra and computes the location of the threat object. A graphic representation of threat location is overlaid onto a live video image of a person walking through a sensor portal. The ability to define three-dimensional target signatures greatly improves the predictive precision of the pattern-recognition algorithm.

We have developed a variable detection threshold method to tailor the CWD to local security conditions and to dynamically adjust the CWD's threshold sensitivity in order to decrease system false alarm rates.

R&D Status

Personal items such as steel shank shoes, under wire bras, and cell phones, often generate false-positive alarms and are routinely ignored as nuisance events by conventional detectors. Terrorists may attempt to exploit this weakness in security screening. Research is in progress to establish a database of magnetic signatures that represent common threat/non-threat items. The INL has the capability to develop and implement intelligent magnetic spectra pattern classification algorithms to further detect, classify and discriminate customer specific screening requirements.

System Specifications

- Accurately pinpoints concealed weapons
- Reduces false alarms
- Passive non-contact imaging
- No medical device interference
- Reduce workload of security personnel
- Video archiving
- Can be integrated with CCTV, two-way voice, door interlock, cardkey access systems and biometric applications



Concealed Weapons Detection System

For more information

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