

# DETECTING *Concealed Weapons:*

## TECHNOLOGY RESEARCH AT THE NATIONAL INSTITUTE OF JUSTICE

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**K**nowing what is being brought into a facility is critical to keeping that facility secure. Unfortunately, those attempting to bring contraband in are not particularly forthcoming about their efforts. They will hide, sneak and lie to get their packages through; and when the packages contain weapons, finding out may be a matter of life and death.

Recognizing the severity of the threat that offenders with concealed weapons pose to corrections and law enforcement officials, as well as the public, President Clinton directed DOJ to develop better technologies and create standards and guidelines for available technologies. In response, DOJ, through the National Institute of Justice (NIJ), initiated the Infrastructure Protection Program to address this need. The program began in 1994 with a look at the problem of concealed weapons and has since expanded to study other types of weapons. The DOJ Department of Defense Joint Program Steering Group manages this program for NIJ, in collaboration with the U.S. Air Force Research Laboratory

and the National Law Enforcement and Corrections Technology Center-Northeast.

NIJ's research into improved concealed weapons detection not only is driven by a top-down directive from Washington, D.C., but also has been established as a priority research area by the Law Enforcement and Corrections Technology Advisory Council (LECTAC) — an NIJ-sponsored panel comprising federal, state and local criminal justice professionals. LECTAC members bring their experience from the field into the policy arena and help ensure the research agenda is meeting real needs.

### DEVELOPING NEW TECHNOLOGIES

NIJ's Office of Science and Technology (OS&T) is responsible for identifying and developing new technologies for use by corrections and criminal justice professionals, including research into improved weapons detection. The process of developing a new technology is long and complicated, often taking longer than those in the field would like or expect. However, without careful testing and rigorous checks and balances, the end product may never hit the streets and if it does, it may not perform to the officers' and agencies' needs. NIJ has a number of technologies in various stages of development.

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## PORTAL TECHNOLOGIES

Although the infrastructure protection program is barely 5 years old, it already has resulted in the commercialization of an improved walk-through weapons detection portal, developed by the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho Falls. This device uses fluxgate magnetometers to detect changes in the Earth's magnetic field caused by magnetic material found in weapons carried through it. It can detect weapons with even a small ferrous (iron) content, an advantage over current portals. The portal's sensitivity to such a small ferrous content also reduces false alarms because the portal does not sound an alarm for innocuous objects, such as keys, which usually do not contain ferrous material. A prototype is in operation in the Bannock County Courthouse in Idaho, where it has been positively received by courthouse employees and the community. This technology has been commercialized and is being sold as the SecureScan 2000. NIJ is funding an evaluation of the device's use in the New York City school system. Preliminary results are encouraging: The device has demonstrated the ability to detect razor blades, which were missed by the school's conventional weapons detection portal.

## TOO CLOSE FOR COMFORT

An inherent disadvantage of existing portal systems is that it cannot be operated from a distance. The lethality of this was demonstrated in 1998, when two Capitol Hill police officers were shot to death inside the U.S. Capitol building as the metal detector sig-

naled that the shooter had a weapon. Portable and handheld devices for scanning groups or individuals for weapons at a distance of more than 20 feet are in development. The SecureScan 2000 also addresses that issue. It allows multiple portals to be operated by a security officer located at a remote and secure location. Detecting weapons remotely increases the operator's and the public's safety because it provides time to make a more reasoned decision.

Portable systems under development offering remote operation include a system using millimeter wave imaging and one using a hybrid of radar and infrared sensors. The first, being developed by Trex Enterprises, uses passive millimeter wave (MMW) imaging and does not emit energy. A passive MMW imager views heat energy emitted by the human body and other sources in the MMW band of the electromagnetic spectrum. It uses both radar and infrared sensors and also is passive. It is being developed by Lockheed Martin, which already has identified a company to commercialize it.

Both the Trex and Lockheed Martin systems, which detect metallic and nonmetallic weapons, appear promising. The Trex system was demonstrated to a regional law enforcement council in Rome, N.Y., last October. Further demonstrations are planned for this year.

NIJ also has funded Quantum Magnetics to develop a device for noninvasive body cavity screening using magnetic resonance imaging, a technology best known for its use in sports medicine. Tests completed on human volunteers were successful and NIJ awarded funds to Quantum Magnetics to design a chair-configured system that would

be more appropriate for correctional settings. That design has been completed and a market survey is under way.

## HANDHELD DETECTORS

The CWD program also has two handheld weapons detectors in development. NIJ is pursuing multiple technical approaches to increase the chance of producing one or more highly effective devices. Each approach has different advantages and limitations.

One system, in development by Akela Inc., uses radar and appears to have the unique ability to detect weapons concealed behind an individual's back. The other system is an ultrasound device developed by Jaycor. It is the least expensive and the most readily developed of the two. However, ultrasound does not penetrate clothing as well as radar. The ultrasound device was well-received at a demonstration for the California Border Alliance Group in 1998. Three prototypes of this device were delivered to the U.S. Air Force Research Laboratory's Rome Research Site for evaluation.

Systems that rely on radar and ultrasound also are being modified as through-the-wall surveillance tools that will allow correctional officers to identify the location of individuals who may have secured themselves in areas with no other available surveillance.

## WHAT IS NEEDED? WHAT IS GOOD?

NIJ's Law Enforcement and Corrections Standards and Testing Program does the work that most corrections professionals have neither the time, the resources nor the expertise to do. This program takes a

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comprehensive look at the capabilities and shortcomings of existing technologies and reports them to the field. The program also develops rigorous scientific standards against which laboratories can test technologies. OS&T funds the National Institute of Standards and Technology (NIST), Office of Law Enforcement Standards (OLEs), which is based in Gaithersburg, Md., to run the Standards and Testing Program. OLES was established in 1971 through an agreement between the U.S. departments of justice and commerce to help corrections, law enforcement and criminal justice agencies ensure that the equipment they purchase and the technologies they use are safe, dependable and effective.

## SETTING THE STANDARD

One of OLES' most important tasks is developing of equipment performance standards, which are disseminated as voluntary standards by OS&T. Standards are technical documents that specify performance and other requirements that equipment should meet to satisfy the needs of criminal justice agencies for high-quality service. Purchasers can use the test methods described in the documents to determine whether a particular piece of equipment meets the essential requirements or they may have the tests conducted on their behalf by a qualified laboratory. OLES has produced standards for handheld and walk-through metal detectors, which NIJ has published.

## GUIDING DECISIONS

To accompany the highly technical standards, OLES produces technology guidelines, which are written in nontechnical language for users. They include a general discussion of the equipment, its important performance attributes, the various models on the market, objective test data, when available, and any other information that might help readers make informed selections.

## BEYOND TRADITIONAL WEAPONS DETECTION

Public safety agencies increasingly are concerned about handling attacks and incidents involving weapons that do not set off metal detectors, such as explosives and chemical and biological agents. While the nation's attention has been focused on attacks on public buildings, such as the bombings of the World Trade Center and the Alfred P. Murrah Federal Building in Oklahoma City, as well as the chemical attack on the subway in Tokyo in 1995, corrections facilities also could easily be the targets of such attacks. With information on such weapons increasingly available through the Internet, the need for information on equipment designed to detect their presence is in greater demand.

To address this need, NIJ, through OLES, published *Guide for the Selection of Commercial Explosive Detection Systems for Law Enforcement Applications* in 1999 providing public safety agencies with information to be used in the selection and use of explosives detection equipment and techniques. The guide considers a wide array of important factors that should be assessed by purchasers, including cost, sensitivity, portability and ease of use. Advice about what technologies are likely to work best in various applications and a market survey of trace and X-ray-based commercial detection systems known to the authors as of October 1998 also are included.

In addition, NIJ is publishing a series of guides that discuss equipment used by first-responder agencies, the first of which was published by NIJ in 2000 — *Guide for the Selection of Chemical Agent and Toxic Industrial Material Detection Equipment for Emergency First Responders* provides information about detecting chemical agents and toxic industrial materials and selecting equipment for different applications. Because of the large number of items identified in that guide, it is printed in two volumes;

the first presents a general overview of the technologies and the second contains detection equipment data sheets. The commercially available products described in the report include those known to the authors as of May 2000.

Forthcoming in the series are guides that address equipment designed to detect agents, as well as guides on personal protection, communications and medical equipment, and chemical and biological decontamination equipment.

## SCIENCE: HARD AND PURE

Beyond developing standards by which existing equipment is measured and guidelines for determining which equipment is right for which agency or facility, OLES, as part of the Electronic and Electrical Engineering Laboratory at NIST, performs an important research function. The research projects discussed earlier focus on developing the actual tools. The research being performed at OLES focuses more on the science behind the tools and the science needed to improve them.

According to the OLES report on its programs, activities and accomplishments, "There are no monolithic imaging array technologies that are being developed in the frequency range of 100GHz to 1 THz." The report further states, "This range is the most appropriate for concealed weapons imaging," which is why OLES scientists are developing a technology that promises to be inexpensive and considerably more rugged than other approaches.

When secured facilities first began to use metal detection to scan for concealed weapons, some members of the public wondered what the machine was doing to their bodies and if it could hurt them. For most people, the machine is harmless, but there are some who still must be cautious. Handheld and walk-through metal detectors emit medical fields that may



## RECOMMENDED READING:

*Guide for the Selection of Commercial Explosives Detection Systems for Law Enforcement Applications, NIJ Guide 100-99.* National Institute of Justice, Washington, D.C. September 1999.

*Guide to the Technologies of Concealed Weapons and Contraband Imaging, NIJ Guide 602-00.* National Institute of Justice, Washington, D.C. February 2001.

*Guide for the Selection of Chemical Agent and Toxic Industrial Material Detection Equipment for Emergency First Responders, NIJ Guide 100-00, volumes I and II.* National Institute of Justice, Washington, D.C. June 2000.

*Handheld Metal Detectors for Use in Concealed Weapon and Contraband Detection, NIJ Standard-0602.01.* National Institute of Justice, Washington, D.C. September 2000.

*Office of Law Enforcement Standards: Programs, Activities and Accomplishments.* Electronics and Electrical Engineering Laboratory, National Institute of Standards and Technology. January 2001.

*User's Guide for Handheld and Walk-Through Metal Detectors, NIJ Guide 600-00.* National Institute of Justice, Washington, D.C. January 2001.

*Walk-Through Metal Detectors for Use in Concealed Weapon and Contraband Detection, NIJ Standard-0601.01.* National Institute of Justice, Washington, D.C. September 2000.



cause malfunctions in personal medical devices, such as defibrillators, infusion devices or spinal cord stimulators. OLES is working on an affordable magnetic field emulator that manufacturers may use to test such devices for interference from weapons detection devices, thus reducing the liability risk to both the manufacturer and the facility in which the detection equipment is being used.

The criminal justice community's demand for greater and greater performance from weapon detectors has resulted in performance tests that are more expensive, complex and time-consuming than previous procedures. To allay the costs of tests and expedite development of more complicated systems, it is critical to have reliable data on

the electromagnetic properties of the metals used in weapons, from which simulations can be performed. OLES labs are measuring those properties and will develop a materials database.

### THE NEED TO KNOW

OS&T's Infrastructure Security Program is in place to help corrections and law enforcement professionals maintain the security of their facilities and to better provide for public safety. Corrections professionals must know what they are up against and what is entering their facilities. The technologies developed and under development through this program, combined with the standards and guidelines publications, will allow them to do

just that by helping them choose the necessary equipment.

### REFERENCES:

*Office of Law Enforcement Standards: Programs, Activities and Accomplishments.* Electronics and Electrical Engineering Laboratory, National Institute of Standards and Technology. January 2001.

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