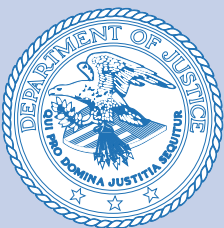




TECHNOLOGY BEAT

National Institute of Justice ■ National Law Enforcement and Corrections Technology Center

Jeremy Travis, Director, National Institute of Justice



Hands-off frisking: high-tech concealed weapons detection

June 1996

Law enforcement officials have consistently ranked the development of remote weapons detection technology as a top priority. Thus when President Clinton read an article by the eminent public policy analyst James Q. Wilson on "What To Do About Crime" in *Commentary* magazine, he marked two key passages for review and action. Wilson pointed out that although firearms play a key role in rising violence in the Nation, he saw no politically or legally feasible way to reduce the number of guns enough to have a real impact on crime. However, Wilson noted that research was under way to develop technologies that would enable police and other law enforcement officials to detect concealed weapons from a distance, making it easier to identify those involved in criminal activity.

On March 9, 1995, the National Institute of Justice (NIJ) launched an initiative to fund and field test three concealed weapons detection technologies. Each technology employs different physical principles and each has situation-specific strengths and weaknesses. NIJ's National Law Enforcement and Corrections Technology Center—Northeast, located near Rome, New York, provides technical and engineering support for the initiative. NIJ expects one or more of the new weapons detection technologies to be in commercial production within 3 years. The technologies, described below, include Passive Millimeter Wave Imaging, Low-Frequency Electromagnetic Radiation, and Magnetic Gradient Measurements.

In addition, under a memorandum of understanding, NIJ and the U.S. Department of Defense, through the Defense Advanced Research Projects Agency, have embarked on a joint research effort to explore additional weapons detection technologies. To date, the joint effort has initiated research on four weapons detection systems, including Low-Level Scattered X Rays and Computer Image

Processing, Millimeter Wave and Long Wave Infrared Receivers, Radar and Ultrasound, and a Low-Frequency Magnetic Imaging System (all described below).

Together the two initiatives have made available approximately \$4.5 million for concealed weapons detection technology research and development.

Passive Millimeter Wave Imaging

Under development by Millitech Corporation, Passive Millimeter Wave Imaging is a new technology that offers the opportunity for rapid and remote detection at a distance of up to 12 feet—without a direct physical search—of metallic and nonmetallic weapons, plastic explosives, drugs, and other contraband concealed under multiple layers of clothing.

This technology is based on the fact that all objects naturally emit a broad spectrum of electromagnetic radiation. Heat generated by the body in the infrared region is most familiar; less well known is the fact that humans are especially good emitters at millimeter wavelengths. When a person is scanned using technology with sensors sensitive to this wavelength, any concealed item shows up as a dark image against the lighter background image of the

(See "Detection," page 2)

Inside . . .

- **Winchester® issues ammunition product warning.**
- **New technologies to undergo legal and public approval.**
- **JUSTNET offers online access to products and technologies.**

“Detection”
(continued from page 1)

individual. This difference in image brightness is due to the differences in electromagnetic radiation emitted by the object and the individual.

Because this purely passive imaging technique relies solely on existing natural emissions from objects, it does not require man-made irradiation. Observations can be made remotely and with discretion as required. Although passive millimeter wave imaging devices do literally see through clothing, the resulting image display does not reveal intimate anatomical details.

The versatility of passive imaging allows for a variety of camera systems to be used for different applications. To demonstrate the technology, Millitech is currently developing a proof-of-concept camera with a 300mm aperture and monitoring console for fixed entranceway surveillance. Also planned is a handheld camera with a video screen, in addition to designs for a totally portable, battery-powered camera and a standoff camera system that can be used from a police car.

Low-Frequency Electromagnetic Radiation

In development by The Raytheon Company, this concealed weapons technology involves illuminating an individual with a low-intensity electromagnetic or “Heaviside” pulse and then measuring the time decay of the reradiated energy from the metal objects carried by the person.

The intensity and the time decay of the secondary radiation can be characterized and the “signatures” identified as a gun or nonthreatening metal object.

Much of the basic development work has been completed by Raytheon. In the NIJ project, the company will conduct an experiment testing the system’s feasibility and provide performance data on

probabilities of detection and false alarm rates. The experiment will establish whether sufficient discriminating ability exists to meet police probable cause requirements for a physical search for weapons. When fully developed, the system is expected to have a low probability of false alarms.

Possible locations to use this technology range from large gathering places such as shopping malls, schools, meeting places, and airports to small stores and banks.

Magnetic Gradient Measurements

The concealed weapons detection initiative being explored by Idaho National Engineering Laboratory (INEL) utilizes a proven, existing technology used in mineral exploration, environmental characterization, military navigation, and submarine detection.

This technology is based on passive sampling of the Earth’s magnetic field. Local aberrations in the magnetic field produced by ferromagnetic objects such as guns and knives can be detected by extremely sensitive magnetometers. This is a new application of an existing technology—magnetometer sensors, which are commercially available. INEL’s approach is to construct a more reliable scanner that can be used as a stand-alone unit, much like an airport scanner system, or incorporated directly into building doorways or hallways.

Sensors in the system will simultaneously collect the data, thus providing a top-to-bottom magnetic profile of an individual. Reasonable suspicion will be dictated by the location and magnitude of the recorded magnetic anomalies. An electronic catalog of magnetic signatures will be established through the collection of magnetic profiles of a variety of weapons in differing locations and a number of non-weapon personal artifacts. These signatures will later be used in analysis schemes that will determine the presence, location, and, potentially, type of weapon carried. How-

ever, this technology will only detect ferromagnetic materials.

Low-Level Scattered X Rays and Computer Image Processing

Under development by Nicolet Imaging Systems of San Diego, California, this technology uses extremely low doses of scattered x rays, in conjunction with advanced computer image-processing techniques, to detect weapons, explosives, illegal chemicals, and other contraband concealed under a person’s clothing. An individual being scanned stands in front of the system for approximately 3 seconds. Almost immediately a computer-enhanced image appears on a monitor displaying the outline of the person and any concealed objects. Multiple views such as front, rear, and sides require individuals to turn their bodies for additional scans. The system is suitable for fixed-site configurations in controlled areas, such as prisons.

This technology requires only a fraction of the radiation level previously thought necessary to detect concealed objects. Each 3-second scan exposes a person to 3 microRem of radiation. This level compares with the 10 to 20 microRem per hour that a person receives from naturally occurring “background” radiation, 500 microRem per hour received during a commercial airline flight at 35,000 feet above sea level, and 30,000 to 300,000 microRem received during medical x ray examinations.

Through a process known as Compton scattering, the low-dose x rays collide with and bounce off electrons in the body or another object. When the x rays penetrate materials composed of elements with a low atomic number, such as body tissue, they are more likely to bounce back, causing the image on the monitor to appear light. However, when x rays pass through materials with a high atomic number composition, such as metal or

(See “Detection,” page 3)

“Detection”
(continued from page 2)

bone, the radiation is more likely to release energy through the photoelectric effect, producing a dark image on the screen. Thus, a concealed handgun would appear as a dark mass against the light background of a person’s body. Because of the low dose used in this method, most of the radiation reaches only the skin or penetrates a few centimeters into the body. The bones of the lower legs are the only internal structures likely to show up on the monitor, because they are so close to the skin.

New Technologies

The following technologies are in the early development stage:

- A passive approach under development by the Lockheed-Martin Corporation would use a millimeter wave (MMW) receiver and a long wave infrared receiver, either individually or together, to measure the difference in temperature between a concealed weapon and an individual’s body. When the two types of receivers, which are still being developed, are used in tandem and linked with a computer imaging system, it is expected that the probability of detecting a concealed weapon will increase substantially. Initially, the MMW receiver is planned for fixed-site operation only. However, it is expected that the long wave infrared receiver will be suitable for fixed-site and hand-held use.
- An active approach that combines radar and ultrasound is being explored by JAYCOR. The system operator will have to be trained to interpret ultrasound images. It is expected that the radar component will be suitable for fixed-site operation and that the ultrasound component will be suitable for either fixed-site or hand-held use.
- An active approach using a low-frequency magnetic imaging system suitable for fixed-site operation is being developed by

(See “Detection,” page 4)

Winchester® issues product warning on 9mm Luger ammo

Winchester® has moved quickly to resolve problems with its 9mm Luger 147 gr. Subsonic ammunition after the Maryland State Police (MSP) reported problems with the ammunition. In a notice issued to customers, Winchester® noted that a “small number” of rounds from two lots may cause firearms to jam or lock up and offered to replace free of charge any ammunition from the affected lots.

According to MSP Superintendent David P. Mitchell, a number of rounds from certain lots of Winchester®-manufactured 9mm Luger 147 gr., jacketed hollow point Subsonic ammunition, product code XSUB9MM, failed to chamber properly in department-issued Beretta models 92F and 92FS autoloaders.

An indepth investigation conducted by MSP and Winchester® revealed that lots 68GF92, 87GF92, and 016GF92 all contained rounds with cartridge cases of excessive length. MSP also found rounds with bulged cases. Either of these defects could prevent the slide from going into full battery, temporarily disabling the firearm. Often these defective rounds proved to be extremely difficult to extract.

After having identified the cause and extent of the problem, Winchester® issued a nationwide product safety warning.

According to Kathleen Higgins, Director of the Office of Law Enforcement Standards (OLES), domestic and foreign firearms and ammunition sold in the United States today are made to specifications set forth by the Sporting Arms and Ammunition Manufacturers Institute.

“As such, it may be assumed that all ammunition will function safely and efficiently in any firearm for which it is chambered, regardless of the manufacturer,” Higgins says. “Generally, that is exactly how it

works. However, as the MSP discovered, such is not always the case.”

As revolvers give way to autoloaders for law enforcement work, Higgins says, it will become increasingly important that agencies ensure absolute compatibility between the firearm, its ammunition, and the officers to whom they are issued.

“It is the responsibility of each law enforcement agency to randomly sample, closely inspect, and thoroughly test all newly acquired lots of ammunition before any of it ever hits the streets,” Higgins says. “The Maryland State Police have begun a rigid inspection procedure for each new lot of ammunition purchased. This includes the use of a simple cartridge gauge to ensure each round is within specifications. All departments should consider a similar program.”

Editor’s note: With facilities at the National Institute of Standards and Technology, the Office of Law Enforcement Standards provides the National Institute of Justice with expertise and guidance on technical issues related to law enforcement equipment and technology.

The Office’s primary mission is to apply the latest scientific and technological knowledge to meet the needs of the criminal justice community, including law enforcement, corrections, forensic science, and the fire service.

For additional information, contact Kathleen Higgins, Director, Office of Law Enforcement Standards, National Institute of Standards and Technology, Building 225, Room A323, Gaithersburg, MD 20899; 301-975-2757.

“Detection”
(continued from page 3)

Systems and Processes Engineering Corporation.

According to NIJ, existing and useful technologies to help fight crime today can be quickly identified and adapted through technology transfer.

“We exploit what’s already out there—by taking products straight off the shelf or spending some time adapting them to police use—and we make gains in efficiency,” said David Boyd, Director of NIJ’s Office of Science and Technology. “And while developing new technologies for law enforcement and corrections is critically important, equally important is the ability to deliver existing technologies into the hands of the police right now.”

Under NIJ’s charter, relative to its grants program, the Institute is authorized to:

- Sponsor R&D to improve and strengthen the Nation’s system of justice with a balanced program of basic and applied research.
- Evaluate the effectiveness of criminal justice and law enforcement programs and identify those that merit application elsewhere.
- Support technological advances applicable to criminal justice.
- Test and demonstrate new and improved approaches to strengthen the justice system.
- Disseminate information from research, development, demonstrations, and evaluations.

New technologies to undergo legal and community review

Research sponsored by the National Institute of Justice (NIJ) on a police department experiment in Kansas City, Missouri,¹ showed that crime rates went down in neighborhoods where police seized illegal weapons.

This experiment was based on adherence to fourth amendment limitations on searching only those individuals for whom there was reasonable suspicion that they were carrying concealed weapons. But what would happen if technologies, such as those described in this issue’s cover story, would permit less intrusive searches?

With an increasing demand by law enforcement and corrections for new and improved technologies to help combat crime, issues related to civil liability that may arise from the use of those technologies need to be defined and addressed.

To provide input on potential legal problems resulting from the use of new and developing technologies, NIJ established a task group to review liability issues associated with technology implementation.

In addition to legal implications, new technologies must also be acceptable to the public. In 1994 NIJ entered into a cooperative agreement with the Institute for Law and Justice, Inc., (ILJ) to study public reaction to and acceptance of the use of emerging less-than-lethal (LTL) weapon technologies by law enforcement and corrections officers.

ILJ is a nonprofit organization specializing in providing research, consulting, training, and technical assistance to law enforcement agencies.

“We realized early on in our efforts to develop new tools for law enforcement that we needed a way to ensure that what we were develop-

ing met three critical requirements,” notes David G. Boyd, Director of NIJ’s Office of Science and Technology.

“The technology had to meet a genuine law enforcement need with an affordable product. It could not expose law enforcement agencies to unacceptable risks. And, most importantly, it had to be acceptable to the community. So, to make sure we heard from all voices having an interest in law enforcement technology, we asked ILJ to create a special panel that could involve a wide range of community groups. It is their task to help us ensure that we never lose sight of the real purpose of our work: enhancing the safety of our communities without jeopardizing the principles we hold most dear.”

The panel is composed of representatives of the NAACP, American Civil Liberties Union, National Rifle Association, League of Women Voters, Handgun Control International, and members of various police review groups.

“The reason for creating the panel,” Boyd says, “is that we wanted to find out up front which technologies we simply could not introduce into the community. The panel has been very helpful in identifying the technologies we ought to produce.”

Note

1. Sherman, Lawrence W., and James W. Shaw, *The Kansas City Gun Experiment*, Research in Brief, Washington, D.C.: U.S. Department of Justice, National Institute of Justice, January 1995 (NCJ 150855).

JUSTNET offers online technology information and dialog

Anyone interested in the advancement of technology and improvement in the equipment and products available to law enforcement and corrections will be interested in JUSTNET (Justice Technology Information Network).

A service to the criminal justice community under the auspices of the National Institute of Justice (NIJ), JUSTNET serves as an online technology information gateway for law enforcement, corrections, and other criminal justice professionals. JUSTNET, which is administered and maintained by the National Law Enforcement and Corrections Technology Center (NLECTC), offers a wide variety of features and services via the Internet and World Wide Web.

From JUSTNET's main menu page, a user can access news and information on NIJ programs and new products and technologies, as well as link to NLECTC Regional Centers and Offices and other criminal justice Web sites. JUSTNET also features a *chat area*, which offers live, online dialog between users, in addition to *topic boards*, which provide a user with the ability to post electronic "sticky notes" under specific topics. Other users can then post replies. For criminal justice users, NLECTC can provide special chat areas and topic boards with password protection.

JUSTNET also offers access to a data base containing information on products and technologies com-

mercially available to law enforcement and corrections. Finally, JUSTNET provides online access to NLECTC publications, equipment standards, and testing initiatives, some of which are downloadable to the user's own computer.

For more information about becoming a JUSTNET user or to obtain a copy of the JUSTNET user's guide, contact NLECTC at:

■ Tel: 800-248-2742

■ E-mail: dlinn@aspensys.com

Director's Notes

The National Institute of Justice's (NIJ's) grants program, operated by NIJ's Office of Science and Technology, has supported research on numerous and diverse issues of importance to law enforcement executives, as well as to officers on the street. Improving fingerprint and trace-evidence identification and the development of DNA standards are some of the notable areas of research. In the late 1980's and early 1990's, a renewed interest in less-than-lethal (LTL) weapons by the criminal justice system led Congress to allocate special funding to NIJ to begin an R&D program in this area.

In late 1992 and early 1993, NIJ initiated an expanded program to investigate all aspects of this issue and to develop a broad-based research program that would lead to new tools and use-of-force options for law enforcement officers. The program has evolved into one that looks not only at weapons but also at the sociological aspects of the use of LTL weapons, e.g., liability and community acceptance issues.

It has also become clear, however, that technologies other than weapons may effectively address the same operational goals of reducing the incidence of death and injury to officers, suspects (or prisoners), and the public when force has to be used to effect an arrest or combat violent behavior during transport or other custodial duties.

Research on new technologies for hands-off detection of weapons, drugs, and other contraband discussed in this issue of *Technology Beat* provides an outstanding example of NIJ's initiatives in this area.

Jeremy Travis
Director
National Institute of Justice

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The National Institute of Justice is a component of the Office of Justice Programs, which also includes the Bureau of Justice Assistance, Bureau of Justice Statistics, Office of Juvenile Justice and Delinquency Prevention, and Office for Victims of Crime.

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