A close-up photograph of a magnifying glass, a pair of tweezers, and a subpoena document on a desk. The magnifying glass is positioned over the subpoena, which has the words "DIRECT WITNESS SUBPOENA" and "REVERSE SIDE" visible. The background is a blurred wooden desk surface.

# High-Tech Crime Fighting

**Pacific Northwest  
National Laboratory**

Operated by Battelle for the  
U.S. Department of Energy

# It's not Elementary...

## *It's High-Tech Crime Fighting*

*It was his keen observational skills, instinct and ability to notice the subliminal that enabled Sherlock Holmes to solve investigations that others could not. Without a doubt, this fictional character's talent and success rate made him the most sought after detective in the 1800s-era London.*

*Today, law enforcement officials rely on smarts and intuition to solve crimes, but they also can tap into additional resources—such as science and technology—to aid in the investigative process.*

*Innovative science and technology provided by the Department of Energy's Pacific Northwest National Laboratory, located in Richland, Washington are producing forensic and investigative support tools—tools that help put offenders behind bars.*

*It's elementary, dear Watson. Or so the fictional Holmes would say. Pacific Northwest is helping by providing resources at the grassroots level—city, county, state and federal agencies. Our diverse capabilities range from visualization software that groups similar evidence, to fingerprint analysis techniques and ground penetrating radar devices to "look" for buried bodies.*



# PRISM... *Investigating Airline Crashes—Accidents or Terrorist Acts*

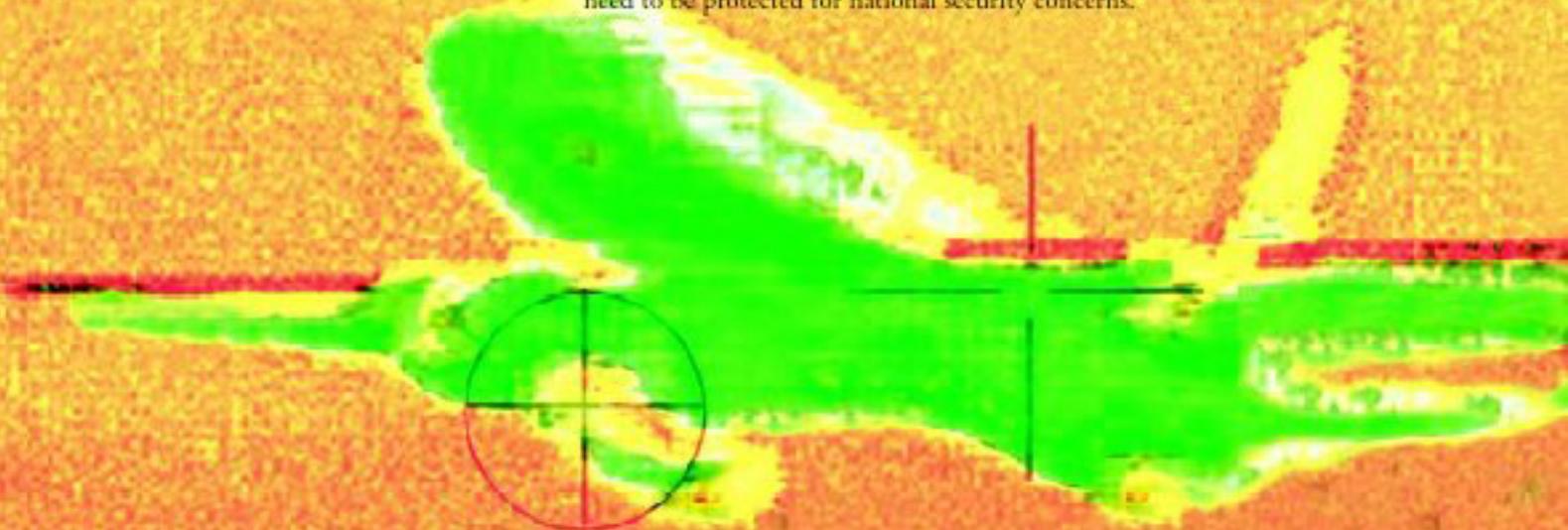
America held its breath as tragic scenes from “TWA Flight 800” flashed across TV sets several years ago. Although it was determined the plane did not go down as a result of a bomb, that tragedy was a wake-up call for Americans concerning terrorist and criminal organizations who have the ability to shoot down a commercial airliner—anywhere in the world—with a Man-Portable Air Defense System (MANPADS), commonly known as a shoulder-fired missile.

Often, it's a lengthy and difficult task to determine if a plane was shot down using such a weapon. But a computer tool developed by Pacific Northwest will—for the first time ever—give investigators instant access to critical information needed during the investigative and evidence gathering process. Developed for the Federal Bureau of Investigation and the Department of Defense, researchers teamed with the Naval Air Warfare Center at China Lake to develop a Portable Resource for the Investigation of Suspected MANPADS Incidents (PRISM). PRISM enables investigators to quickly determine and identify physical and trace evidence that can help evaluate if a plane was shot down using a MANPADS. PRISM even can help determine the type and source of the weapon system, by providing investigators with information about what to look for and where to look.

PRISM contains:

- MANPADS Tutorial that summarizes the terrorist threat, an aircraft's vulnerability, representative aircraft damage and missile debris
- An investigative guide that takes field investigators from crash notification through the identification and collection of MANPADS-related evidence
- Reference library that displays images and descriptive information relevant to MANPADS investigations
- Resource directory that is a searchable database of individuals and organizations with expertise and capabilities relevant to a MANPADS investigation
- Security guide that helps field investigators identify vital information that may need to be protected for national security concerns.

PRISM (Portable Resource for the Investigation of Suspected MANPADS) is a powerful tool developed by the Laboratory that helps investigators determine whether a plane crash was caused by a Man-Portable, Shoulder-Fired Missile (MANPADS). PRISM even can help determine the type and source of the weapon system, by providing investigators with information about what to look for and where to look.



It's a war tactic dating back to the Roman Empire. The British tested it on Gruinard Island off of Scotland in 1943—leaving the land uninhabitable for 50 years, and Japan's World War II program, if implemented, would have targeted the United States' Pacific Northwest region. Although biological weapons that target a country's livestock and crops contain no explosives, bullets, mines or shrapnel, they could be terrifyingly effective.

The U.S. has few means to rapidly detect, defend and thwart a growing new threat of biological attack directed against a nation's animals or crops. To become better prepared, agencies are turning to Pacific Northwest where researchers are developing field-deployable tools that will aid in automated sample processing in order to rapidly detect and identify the type of biological agent present. The team is developing fluorescent polymerase chain reaction (PCR) assays to identify a number of significant crop pathogens that could potentially be used against U.S. interests.

These PCR-based crop pathogen diagnostics can also be of use generally in the agricultural market for more rapid and specific identification of particular disease agents. Similar efforts also are underway at the Laboratory to develop rapid diagnostics for safety, human and animal disease.



## Getting to the Root of the Agroterror Problem



Attacks on the United State's food and livestock sources are becoming a growing threat.

## Keeping Evidence Close to the Vest— ScenePro

Teaming with Nichols Research, our researchers have developed an integrated system that will enable law enforcement personnel to quickly document and transfer vast amounts of information at crime scenes.

Called ScenePro, the system brings the latest in geographical information systems together with multimedia computing, in a small unit that can be worn by the user. ScenePro will enable law enforcement officials to more efficiently process complex crime scenes, better reconstruct the scene, and even reduce the potential contamination of evidence.

ScenePro is a rugged, weatherproof unit that incorporates a 266-megahertz pen-based computer system and integrates sophisticated software with a number of data collection tools:

- Digital and still cameras
- Voice to text recognition
- Handwriting to text recognition
- Barcode scanner
- Laser-range finder with AutoCAD®.

The system can store and use satellite images, terrain features maps, architectural drawings, site plans and a host of other information vital to a thorough investigation. ScenePro also serves as a portable library with access to volumes of stored information, such as maps, facility floor plans, databases, reports, forms, investigation and evidence collection protocols and scientific, technical and legal reference material.

### Here's how it works

If ScenePro was deployed at a murder scene, investigators could use the unit to create a detailed 'map' of the area using laser measurements and AutoCAD® technology. Upon discovery of the murder weapon, investigators could instantly link the evidence to its geographical position, capture still and video images of the weapon, and record detailed audio and text notes. The evidence could be recalled months or years later during a trial.

Developed by Pacific Northwest National Laboratory, ScenePro will revolutionize the manner in which emergency responders and law enforcement personnel gather and record evidence.





Scientists at Pacific Northwest National Laboratory use MALDI mass spectrometry to develop a fast, accurate and field-portable system that fingerprints and identifies biological organisms.



*Tracking Down  
Deadly Pathogens  
with*

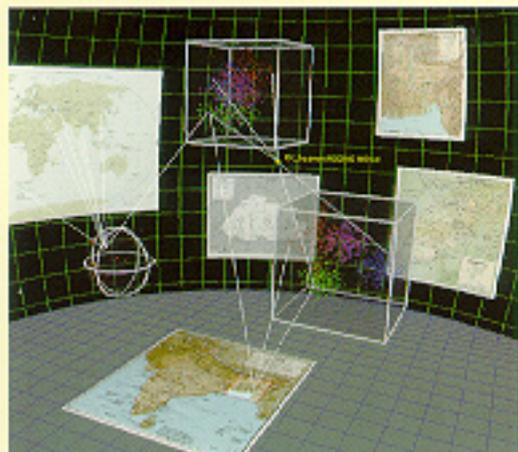
## MALDI

Our scientists are helping to track down outlaws of another kind...criminals or terrorists who could potentially release biological agents against an unsuspecting populace. When fully developed and deployed, MALDI mass spectrometry will be used in the field for near real-time screening of suspected biological agents. The methodology is designed to analyze and confirm the identity of suspect biological agents—in less than five minutes—providing vital information necessary to help direct the actions of emergency response and investigative personnel. Only minute amounts of material are needed by investigators to analyze for bacteria in forensic samples. Pacific Northwest scientists are developing a library of bacterial "signatures" or "fingerprints" that supports the system.





Starlight, an advanced three-dimensional visualization technology, has been developed by Pacific Northwest National Laboratory to help solve the problem of information overload. Already in use by the U.S. intelligence community, Starlight can be applied to a variety of other fields, such as medical data analysis, environmental security and current events monitoring.



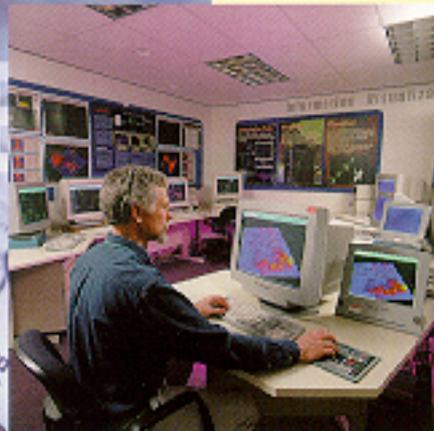
## *Sifting through the Blizzard of Evidence with* **Visualization Software**

Pacific Northwest-developed software will help investigators sift through the blizzard of data compiled in complex criminal cases. "Starlight" and similar tools under development at the Laboratory offer high-powered, three-dimensional, visualization technology originally developed for the U.S. Army.

Starlight enables users to analyze massive volumes of information contained in various media, including structured and unstructured text, maps, digital data, video and even satellite imagery. Users can analyze information content as well as complex interrelations among individual elements of large information collections. Its powerful capabilities will enable law enforcement personnel to discover unseen patterns in some of the most notorious crimes.

### **A Picture's Worth Thousands of Words**

SPIRE (Spatial Paradigm for Information Retrieval and Exploration) provides a wealth of tools for exploring information, including query, subset, and trend analysis tools. This suite of tools allows the user to rapidly discover hidden information relationships in pertinent law enforcement documents.



# Get SMART

Criminals don't always have boundaries. Murderers sometimes also commit rape and robbery. Arsonists have been known to commit murder and rape. Law enforcement, on the other hand, has very distinct boundaries including federal, state, county and city. In the larger agencies, there are even boundaries between investigative units. If a criminal commits several different types of crimes within the same district or jurisdiction, inter- and intra-agency communications inefficiencies may obscure the connection between crimes.

Because the majority of crimes are committed by repeat offenders, the Washington State Legislature provided funding to develop SMART— Supervision Management and Recidivist Tracking. Through SMART, the Department of Corrections and the Attorney General Office and local and state law enforcement work together to monitor and track violent offenders who are under the Department of Corrections' (DOC) supervision. Currently, information about offenders under the supervision of a community corrections officer is put on a brief field interview report and forwarded on a weekly basis to the DOC.

That process soon will be automated with the help of Pacific Northwest researchers who are enhancing the SMART and the Homicide Investigation Tracking System databases to include field interview reports data.

Working with the Washington Attorney General's Office, Pacific Northwest will provide the state's law enforcement community with one of the nation's most advanced criminal investigative systems. The new system will provide:

- One-on-one monitoring and tracking of violent offenders who are under parole supervision
- The ability to search, analyze and compare information and cases with agencies in Oregon, Idaho and California
- Information within minutes, rather than days or weeks
- Information unobtainable in the past
- Maps showing locations of crimes and the addresses of possible offenders that live or have lived in that area
- Photos and photo montages of possible offenders
- Greatly reduced man-hours needed to investigate violent crimes.





## CATCH *Me*

### *if You Can*

In King County, the Washington State Attorney General's Office is helping pioneer computer assisted crime fighting by testing one of Pacific Northwest's new software systems. CATCH, short for Computer Aided Tracking and Characterization of Homicides, uses a neural network to discover unseen patterns in the state's computerized murder-investigation records database called HITS—Homicide Investigation Tracking System.

The Attorney General's team fed data on 5,500 Washington homicides—solved and unsolved—into CATCH. CATCH uses mathematical algorithms to analyze the connections between the data. The program lumps together similar crimes based on over 200 variables. Homicides grouped together could be the work of one person. CATCH is a collection of tools that assist the crime analyst in the investigation process. The neural network employed in CATCH learns about existing crime cases in the HITS database using parameters identified as modus operandi and signature characteristics of the offender. The neural network clusters cases containing similar signature elements, and to a lesser degree, modus operandi elements, into groups. The proximity of cases within the neural network allows the analyst to compare one case to others within the database.

### *Defensibility of*

## Forensic Evidence—

### *By the Numbers*

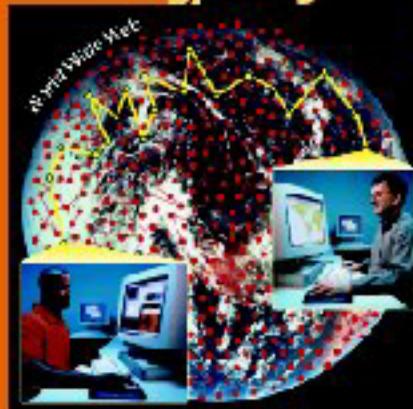
Recently, the entire court system has been questioning the accuracy and strength of scientific testimony based on virtually all forms of forensic evidence, which investigators use to make probabilistic statements that link a suspect to a crime scene. Statisticians at Pacific Northwest are developing methods for assessing the accuracy and strength of forensic evidence. In collaboration with the forensic community, our statisticians are developing techniques for:

- Validating the principles behind new and existing forensic methods
- Assessing error rates associated with forensic comparisons
- Determining the strength of a link between evidence and suspects.



Pacific Northwest has established the Critical Infrastructure Protection and Analysis Laboratory—CIPAL—dedicated to research and development for new technologies and capabilities necessary to help safeguard the nation's key infrastructures. Telecommunications, gas, oil, power distributions, transportation, water and other important systems are, in many cases, inter-linked, increasing their susceptibility to physical or cyber attack. This interconnectivity could cause a cascading effect throughout infrastructures. CIPAL provides a completely isolated network for simulated attacks where researchers, engineers and users of critical infrastructure protection-related technologies can address the complete cycle of computer or network vulnerabilities and information assurances—without the potential of harming real-world applications. Research within CIPAL focused on:

- Vulnerability Simulation
- Plug and Play Vulnerability Assessment
- Software Agents, a computer program that allows web analysts to quickly review and analyze large amounts of web content
- Information Assurance
- Advanced Software
- Engineering Processes
- Information Warfare
- Supervisory Control & Data Acquisition
- Critical Infrastructure Modeling.



## Protecting our Critical Infrastructures



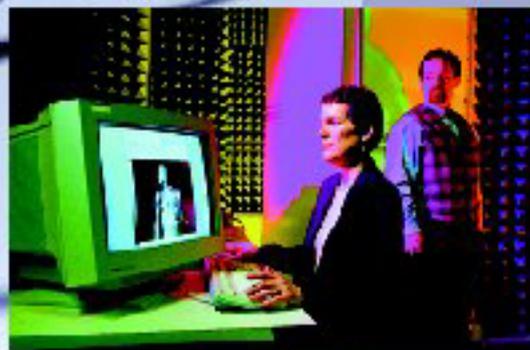
**CIPAL**

*Reading Between the Lines...*

## Handwriting Analysis

Pacific Northwest and the U.S. Postal Inspection Service are collaborating to make the identification of an individual's handwriting more scientifically defensible. A portion of this project involves the development of a computer-assisted screening tool that would group previously stored candidate writings that closely resembles the handwriting on a questioned document. The analyses of handwriting to determine the author of a document is used frequently in law enforcement and security. However, the expertise of handwriting examiners and their processes has been questioned in several court cases. This uncertainty creates a need for scientific support for the methods used by the handwriting examiners and specific emphasis on the existence and development of measurable, identifiable handwriting characteristics and an automated measurement and analysis system.

Through a joint research project with document examiners from the U. S. Postal Inspection Service, Pacific Northwest statisticians, imaging analysts and computer scientists are helping to define and develop standards and procedures for the industry and an automated method for screening down to a set of candidate writings that match up with a questioned writing. In initial tests, using an artificial neural network, researchers at Pacific Northwest have developed a computer program that could potentially correctly identify the author of a document. If successful, this three-year project is expected to end with a defensible statistical statement about handwriting identification, some standardized processes for the handwriting examination community and a prototype automated screening tool. Once the system meets its design objectives, the Laboratory and the Postal Inspection Service will identify a commercial partner and explore the feasibility of commercializing the automated prototype.



Unlike current metal detectors, the system developed at Pacific Northwest detects all threats or contraband—from metal, plastic, liquids, drugs and ceramic weapons hidden under clothing.

## Looking for Hidden Objects...*Non-Intrusive Weapons Detection*

Concealed weapons made of plastic, ceramics and metal can be detected with a holographic imaging system developed at Pacific Northwest. Like a CB radio that transmits and receives, the holographic imaging system's transceiver reflects a millimeter-wave signal off the body and any objects carried on it. Unlike current metal detectors, the system developed at the Laboratory detects all threats or contraband—from metal, plastic, liquids, drugs and ceramic weapons hidden under clothing. The holographic imaging system was tested in 1995 at the Seattle-Tacoma, Washington, International Airport, and was proven to be ideal for use in government buildings, mass transit systems and public gatherings.



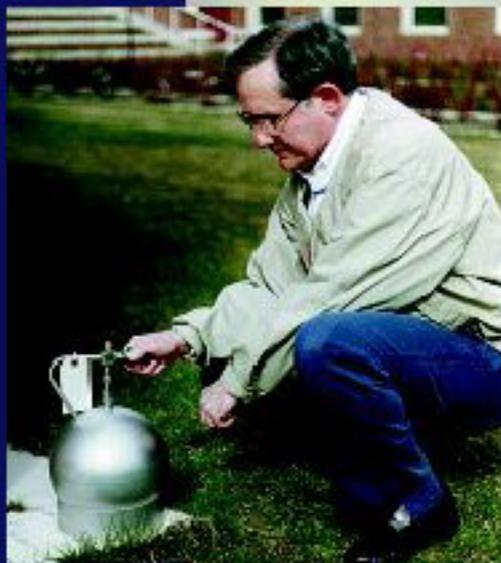
## Getting AID *with* *Pacific Northwest Developed Technology*

What lies beneath the surface may not always be what's expected. In fact, hiding objects—from drugs to contraband—has been a common practice for criminals for centuries. But a new technology developed at the Laboratory provides law enforcement officials with a "peak inside" sealed containers.

Called the Acoustic Inspection Device, or AID, this innovative technology enables users to identify or discriminate the contents of liquid in sealed

containers. AID also identifies concealed compartments that could contain contraband, explosives, drugs or other threats. Already in use at international borders, AID will be a powerful addition to the law enforcement communities tool kits.





*Something's  
in the Air...*

## Clandestine Drug Lab

What began with neighbors complaining of problems ranging from nausea and vomiting to headaches, ended with a drug bust by the Tri-City Metro Drug Task Force in Southeastern Washington. Police didn't have probable cause to enter the suspected house, so they called upon researchers at Pacific Northwest. Applying expertise in environmental monitoring, our researchers collected air and water samples, which were analyzed positively for signatures, indicating methamphetamine production. The suspects were arrested and pleaded guilty.

## Anticipating Every Move...

Through the National Counter-Narcotics Center, federal, state and local drug interdiction forces will be trained to operate in a coordinated, integrated, and well-executed fashion; to anticipate and counter the agility of drug-trafficking organizations to quickly shift to new sources, routes, and transit methods; and to employ the latest technologies and practices to effectively combat illegal drug trafficking enterprises. In accordance with the architecture and requirements developed by researchers at Pacific Northwest, the Center will employ interactive simulation technology to:

- Provide interoperability training under realistic operational conditions and environments
- Capture lessons learned from past counter-narcotics efforts
- Conduct mission rehearsals.



# Probing for Answers

Working with the Federal Bureau of Investigation, our scientists are using a Raman Spectrometer with a fiber optic probe as an accurate and reliable forensic tool for the identification of potentially hazardous chemicals in a variety of closed containers or on surfaces in the open environment. The tool identifies items such as chemicals and biological warfare agents, toxins and culture media, hazardous industrial chemicals and explosives. The tool boasts many benefits including:

- The ability to detect and analyze hazardous chemicals in clear or translucent closed containers
- Identifying an unknown content without exposing personnel to potential hazards
- Maintaining the integrity of evidence because handling the sample isn't necessary
- Safety and health.

## *The Chemistry*

### *behind Latent*

# Finger Printing

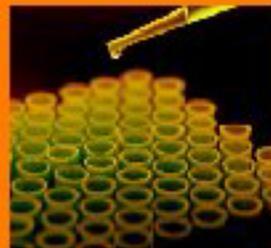
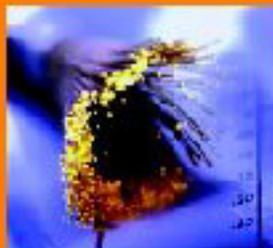
Dusting for latent fingerprints is among the first steps officers take when investigating a crime scene. Fluorescent reagents currently being used to process prints react exclusively with the water-based components of the latent print, but not with the lipid or oil based substances, which are more durable. Water-soluble substances, on the other hand, often degrade in a relatively short time and fingerprint ridge detail is easily destroyed by exposure to the environment making it impossible to develop an identifiable print. Working with the forensic community, our researchers are exploring advanced techniques with illuminating results—literally. We are attempting to develop a fluorescent reagent that will react with the lipid components often found in latent prints, and are exploring methods to alter the chemistry of these oil based lipid components so that the water based fluorescent reagents will react with them.



## The Science of Investigation

These are just a few of the many capabilities offered by Pacific Northwest National Laboratory for the law enforcement community. The Laboratory currently is looking for research partners to develop these and other technologies.

Battelle operates Pacific Northwest for the U.S. Department of Energy. Battelle is a research and development powerhouse with laboratories located around the world. A unique agreement between Battelle and DOE enables scientists at Pacific Northwest to conduct work for private and government organizations. For more information, contact us at 1-888-375-PNNL or visit our web site at <http://www.pnl.gov>



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