

Applied Physics



Pacific Northwest
NATIONAL LABORATORY



NATIONAL SECURITY

Technology Showcase

Improving Product Quality

Intelligent manufacturing is only possible and achievable by integrating modern nondestructive examination into the production process. Pacific Northwest National Laboratory's (PNNL) Applied Physics group offers a wide range of nondestructive inspection capabilities to help industrial and government clients address their products, processes and inspection challenges. PNNL provides a set of inspection capabilities that are non-invasive and provide real-time data. Used throughout the manufacturing process, these technologies can transform manufacturing by improving quality.

From technology assessment to hardware development, we tailor an approach that maximizes benefits in a cost-conscious environment.

Solid Science...Solid Solutions

Our capabilities in acoustics and ultrasound, optics, radar and millimeter wave imaging, electromagnetics and technological assessment are being applied to the development of cutting-edge solutions. Our strength is bridging the gap between advances in science and practical, innovative solutions. Behind these capabilities is a staff of experts with a world class reputation in inspection physics and engineering.

Composed of engineers, scientists and technicians, our staff have extensive experience working with government, industry and academia and are highly competent over a wide range of scientific and engineering disciplines. For more than 35 years, our staff have provided customized solutions in the following areas:

- Diagnostics and prognostics
- Inspection procedure development
- System performance demonstrations
- Advanced R&D for nuclear and aerospace industries
- Materials and structures characterization
- Process monitoring, measurement and control.

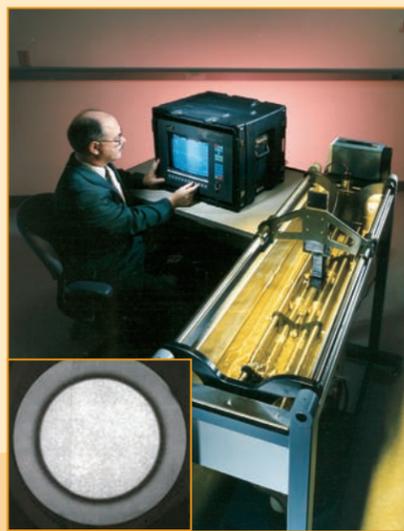
Our staff excel in the innovative research and development of first-of-a-kind systems to meet a client's specific needs. At the same time, our experts are able to adapt those original systems for multiple applications that provide solutions for a diversity of problems. The ability to recognize multiple applications for one technology opens up opportunities for discovering new solutions; it is one of our major strengths.

Several of our senior staff have been instrumental in and are internationally recognized for development of inspection procedures, codes and standards that have had major impact in the inspection and assessment of facilities in the nuclear industry. In addition, the innovative technologies developed by our staff have earned numerous awards, including the R&D Magazine awards for the top 100 innovations, and the Federal Laboratory Consortium (FLC) awards for successful transfer of technologies to the industrial sector. A number of patents also have been issued for our technologies. These honors represent national recognition of our expertise in applied physics and materials characterization.

The *Ultrasonic Doppler Velocimetry (UDV)* technology is a prime example of technology developed at PNNL for process monitoring and control. The UDV uses ultrasound to measure viscosity-flow profiles and other important physical properties of liquids and slurries flowing through pipes. The UDV is non-invasive and can be mounted on the outside of piping for continuous monitoring. The UDV has potential applications for a wide array of consumer products. For products like shampoo and sauces, such as tomato paste, the UDV quantifies key product attributes to assess conformance to quality standards. Current and future efforts in slurry characterization are aimed at developing the next generation of devices capable of characterizing important slurry properties, including concentration and particle size in non-dilute slurries, either in combination with the UDV apparatus or as separate devices.



The *Ultrasonic Microstructural Analyzer* was developed by PNNL to provide a means of non-invasively quantifying the hardness depth profile for steel automotive components. This technology takes advantage of the unique interaction of ultrasonic waves with the subtle changes in microstructure resulting from the case-hardening process. This method alleviates the need to perform destructive testing of the product and provides for more efficient processes and enhanced product quality. This system won both an R&D 100 Award for top innovation and a FLC Award for successful technology transfer to public and private sectors.



The *Millimeter Wave Holographic technology*, highlighting our radar imaging and optics capabilities, uses non-harmful, ultra-high-frequency radio waves to penetrate clothing and non-metallic objects to detect concealed objects as well as obtain accurate body measurements. The technology was originally designed for personnel screening and homeland security applications and was adapted for body measurements for the clothing and apparel industry. The technology has been successfully licensed to SafeView for use in the security arena and promises to dramatically reduce the threat posed by criminals and terrorists. The technology also has been licensed to Intellifit Corporation to create a body-scanning system that provides shoppers with precise head-to-toe body measurements in less than 10 seconds.



The *Acoustic Inspection Device (AID)* showcases our expertise in developing and commercializing acoustics/ultrasonic technologies for diverse applications. AID provides non-invasive examination of sealed containers and can help screen bulk solids. It was initially developed for chemical weapons identification for treaty verification activities between Russia and the United States and for non-invasive measurement of rockets/munitions by United Nations weapons inspectors after the first Gulf War conflict. The AID technology has been adapted to address problems for clients such as the U.S. Department of Homeland Security, the U.S. Internal Revenue Service, the FBI and industry.



The *Dual Use Analyzer (DUA)* is a portable, battery-operated instrument capable of rapidly and non-intrusively identifying high-value, strategic or nuclear dual-use materials. An excellent representative of our electromagnetic capabilities, the DUA uses eddy current technologies to make non-contact measurements that reflect the electrical and magnetic properties of materials. The instrument enables a single inspector to interrogate and identify a strategic material in the field in less than 5 seconds. As a screening tool, this technology supplants the expensive and time-consuming process entailing on-site sample collection and offsite laboratory sample analysis.

Markets

Our diverse and multi-disciplinary technical staff leverages years of experience, state-of-the-art facilities and technology developed for government clients for application and customization in addressing industrial and commercial needs. Our markets include:

Key Industrial Markets

- Agriculture and food
- Aviation/aerospace
- Automotive
- Chemicals
- Energy
- Petroleum
- Pharmaceuticals and medical products
- Biotechnology.

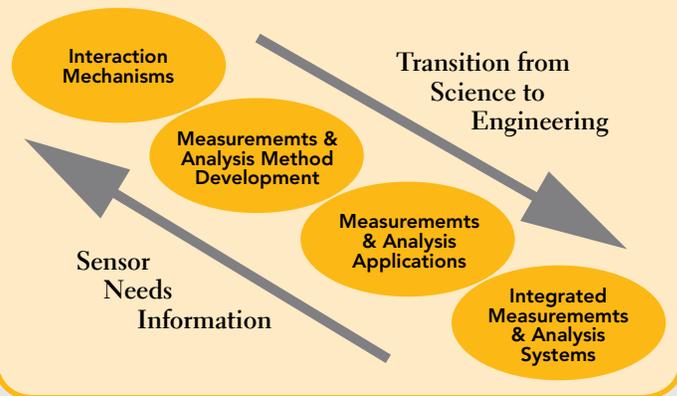
Key Government Markets

- U.S. Department of Energy
- U.S. Department of Defense
- U.S. Nuclear Regulatory Commission
- Environment
- Health and Public Policy
- NASA Technology
- National Security
- U.S. Department of Homeland Security
- U.S. Department of Transportation.

activities, can provide a continuum of expertise from basic science theory through hardware development. For example:

- We use wave propagation theory to predict the effects of complex microstructures when performing measurements on various materials.
- We use our advanced modeling capabilities to guide the design and fabrication of customized nondestructive examination systems.
- We apply our fabrication and engineering expertise to design and build prototype systems, install and field test these systems and train the systems operators prior to final turnover for field use.

Our ability to examine a problem at any point in the development cycle enables us to meet diverse client requirements and ensure the delivery of cost-effective solutions.



Also, unlike many firms that offer only a narrow set of expertise and products, PNNL leverages multi-disciplinary teams to address your unique inspection needs. Our ability to form teams of experts from across PNNL and team with other national laboratories, universities and industrial partners enables us to develop new and innovative tools that expand your ability to improve product quality.

A Continuum of Science to Systems

A unique strength of PNNL is our ability to leverage an in-depth understanding of the relevant science while at the same time involving the appropriate engineering disciplines to develop systems that provide practical solutions to product-quality problems. Our talented and versatile engineers and scientists, using technical capabilities and drawing upon knowledge gained through more than 35 years of government and industry-sponsored research

About Pacific Northwest National Laboratory

Pacific Northwest National Laboratory is a U.S. Department of Energy Office of Science research facility that delivers breakthroughs in the areas of environment, energy, health, fundamental sciences and national security. Battelle, based in Columbus, Ohio, has operated PNNL since 1965. A unique agreement with the U.S. Department of Energy enables us to work with industrial clients and leverage DOE's vast resources. We have a strong history of working with industry over the past 40 years. PNNL is located in Richland, WA, and has an annual business volume of more than \$700 million and more than 4,000 employees.

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