Physicist sees terahertz imaging as ultimate defense against terrorism

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John Federici, PhD, professor, department of physics, New Jersey Institute of Technology (NJIT) and other physicists at NJIT recently received a U.S. Patent for a Teraherz imaging system and method. Since 1995, Terahertz imaging has grown in importance as new and sophisticated devices and equipment have empowered scientists to understand its potential.

"I see the Terahertz spectrum as one of the critical technologies for defense against suicide bombers and other terrorist activities," Federici said.

Federici's research has focused on the potential applications of Terahertz rays for directly detecting and imaging concealed weapons and explosives. Another application is the remote detection of chemical and biological agents in the atmosphere. In November of 2004, Federici and.

"The idea has been to apply different methods of imaging to Terahertz rays," said Federici. His research team has focused in particular on applications of synthetic aperture imaging to the Terahertz range. "The advantage of this particular method is the ability to generate Terahertz images with a large number of pixels using a limited number of Terahertz detectors. This imaging method should also be capable of video-rate imaging, thereby enabling the real-time monitoring of people hiding concealed explosives or other dangers." A typical imaging system would be analogous to a still or video camera designed for this purpose.

Scientists favor Terahertz radiation because it can transmit through most non-metallic and non-polar mediums. When a Terahertz system is used correctly, people can see through concealing barriers such as packaging, corrugated cardboard, walls, clothing, shoes, book bags, pill coatings, etc. in order to probe for concealed or falsified materials.

Once the rays penetrate those materials, they can also characterize what might be hidden –be they explosives, chemical agents or more--based on a spectral fingerprint the rays will sense which can identify the material. Terahertz radiation also poses minimal or no health risk to either the person being scanned or the THz system operator.

Federici and his team recently published "Terahertz imaging and sensing for security applications explosives, weapons and drugs," in Semiconductor Science and Technology (Vol 20, page 266, 2005). The U.S. Department of Homeland Security, Army Research Office and National Science Foundation have provided funding for this research since 2002.

The article focused on three configurations of Terahertz systems, examining when and how best to use the rays. Transmission versus reflective detection, pulsed Terahertz detection systems versus continuous wave systems, and close proximity versus stand-off detection are compared.

"While pulsed Terahertz detection systems are capable of close proximity detection," said Federici, "there are many factors to take into account. For example, distortions to Terahertz pulses introduced by propagation through the atmosphere, favor a continuous wave system for stand-off detection."

Federici has recently garnered praise for his work. He recently received NJIT's top research honor, the Harlan Perlis Research Award. Next

month, Federici will accept an award for his work from the Research & Development Council of New Jersey. The council honors and helps those individuals upholding the legacies of Albert Einstein and Thomas Alva Edison, both of whom lived and worked most of their lives in New Jersey.

Federici's research interests span discovery of infrared quenched photo-induced superconductivity and localized energy states in nano-materials to online semi-conductor process monitoring to advanced spectroscopic imaging technologies. He has been the lead writer on more than 50 publications in scholarly journals and holds four patents. His most recent patents emphasize Terahertz synthetic aperture imaging.

Source: New Jersey Institute of Technology