Terahertz Reflection Imaging for Concealed Interface Inspection

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Recent advancements in terahertz (THz) technology have led to innovations in imaging, spectroscopy, and non-destructive evaluation (NDE) techniques. THz frequencies of light lie between the microwave and infrared ranges on the electromagnetic spectrum. At these frequencies, radiation propagates through many non-conductive materials such as composites, plastics, foams, and insulation with minimal losses. The non-ionizing nature of THz radiation minimizes health risks, competing with X-ray technology, while maintaining an acceptable resolution by its sub-millimeter wavelength. The nature of picosecond pulse generation of THz light gives this form of radiation a spectacular advantage by allowing direct measurement of the electric field in the time-domain, making it possible for depth profiling and 3-D imaging. NDE in the THz range has led to successful defect imaging in the foam insulation of the NASA space shuttle. THz reflection imaging has also proven its value in detecting corroded and delaminated materials under insulating layers, including the inspection of submarine hull integrity beneath opaque, rubber acoustic tiles that provide sonar cloaking.

I will present my current research involving a reflection imaging system using the THz time-domain spectroscopy (TDS) system available at UNBC to non-destructively evaluate and identify various concealed materials in a sample of opaque plastic. In-depth analysis algorithms were developed for subsurface THz reflections in the time domain for different materials in order to construct an image of the sample and identify the concealed materials. This project will help expand NDE techniques and concealed interface inspection at THz frequencies, and broaden the application range of THz imaging technology.

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