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Paper Title: Terahertz Imaging Nondestructive Maintenance Inspections

Author:

Patric Lockhart

Naval Undersea Warfare Center

Rhode Island

(401)832 4462

patric.lockhart@navy.mil

Abstract: Terahertz (THz) imaging combines some of the best of both the Optics world (high resolution imaging) and the Radio / Microwave world (waves can penetrate walls, coatings, and other optically opaque materials) to yield an imaging technology capable of nondestructively generating millimeter-resolution images of objects or defects inside and through non-metallic materials and coatings. THz waves do not pass through all materials identically which can allow discrimination of one material hidden behind another, much like an electromagnetic version of Ultrasound. This capability allows imaging of individual interfaces in a stacked material structure or examining buried objects. Metal reflects THz waves like a mirror which can provide high signal-to-noise-ratio (SNR), one-sided imaging of coated metal surfaces, such as a ship hull. Thus, THz imaging scans of ship coatings and hulls can be performed from outside of the ship. Water, on the other hand, is highly absorptive to THz waves, allowing for very sensitive water intrusion inspections. These qualities make THz imaging an advantageous nondestructive testing and evaluation (NDT&E) maintenance inspection tool for reduced total ownership cost (RTOC), fleet readiness, and warfighter performance initiatives via improved quality of deliverables during new ship and system construction, maintenance, and prototyping (verifying the prototype is defect-free for accurate assessment).

The potential for Navy THz imaging applications will be discussed including highlights from NUWC-NPT internal and sponsored research, collaborative efforts with other Navy labs, and a current Phase II SBIR (N121-064) for VA-Class submarine hull maintenance inspections to rapidly find corrosion, debonds, and mechanical damage without removing the hull coating during maintenance availabilities. Examples of the benefits of THz imaging and the types of defects that can be detected will be shown. The goal of this talk is to inform the DoD community of this advanced inspection technique by showing proof of performance to detect defects of interest as we strive to transition this technology to the fleet.