Terahertz Waves for Imaging Explosive Materials using Tomography Methods

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Terahertz (THz) radiation has demonstrated the ability of penetrating several non-metallic targets such as plastic and cotton textile. The goal of this work is to examine tomography methods, in the terahertz band, for retrieving weak scatterers such as DNT material immersed in cotton, for example. The conventional Born and Rytov approximations will be employed in this work.

Synthetic data of the scattered electric fields will be generated using the open source numerical package DDSCAT. The Discrete Dipole Approximation (DDA) is a computational technique that calculates the scattered fields from irregular objects upon breaking them into small dipoles and calculating the moments of each dipole. The excitation is plane waves. The DDA technique was implemented by Bruce Draine at Princeton University and Piotr Flatau at the University of California at San Diego and was provided to the electromagnetic community as an open source code known as DDSCAT. This package is capable of calculating the scattered electromagnetic fields from discrete or periodic irregular objects composed of one or several dielectrics. The versatility and robustness of the DDSCAT code were proven on a large variety of applications in the literature. However, to the best of our knowledge it was not used in the THz region yet, which is one of the tasks in this work. The goal is to understand the capabilities of DDSCAT and integrate it with Born and Rytov approximations to solve the inverse scattering problem of weak scatterers in the THz band.

The presentation will demonstrate several tomography results from a plethora of thin layers of explosive patches of irregular shapes immersed in cotton or in other textile media.