Level Set Algorithm for the Shape Reconstruction in the Terahertz Band

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Terahertz (THz) imaging has been receiving rising interest due to several favorable features at this frequency range such as: sub-millimeter resolution, sensitivity to water content and capability to penetrate most dry non-metallic media such as plastic and cloth. Due to the previous features, THz imaging has been proposed in a wide variety of applications such as cancer imaging and detection, non-destructive evaluation, security screening and inspection of IC devices.

However, most of the THz imaging research reported in the literature achieves the image due to direct reflection and/or transmission through the target. Only few reported works employ inverse scattering algorithms in the THz range. The main advantage of full wave inverse scattering techniques is that the solution accounts for multiple reflections, attenuation, dispersion and diffraction which results in significant improvement in the reconstructed target.

The goal of this work is to employ the level set algorithm to reconstruct the shape and location of targets in the THz band. The level set has proven to be robust in reconstructing multiple targets of different materials and arbitrary shapes. The algorithm is based on implicitly defining the evolving object during the reconstruction as the zero level of a higher order function. The evolving object will deform from the initial guess to a reconstructed shape of the target. The deformation velocity is function of the surface currents and scattered fields at multiple frequencies and incident and scatter directions. The level set has been recently and successfully implemented in the microwave range for two and three dimensions targets.

In this work, the level set will be examined in the THz band to reconstruct unknown targets to be compared with direct reflection and/or transmission. In particular, we are concerned with assessing the resolution limits of the level set algorithm in the THz band as well as its capability in reconstructing objects hidden in a person's clothes. Numerical results will be presented in the conference.