DEVELOPMENT AND EVALUATION OF A HYBRID THZ IMAGING SYSTEM BASED ON 3D-PRINTED DIFFRACTIVE OPTICS

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Optical imaging systems are widely used in many scientific and practical applications, such as material inspection, security, and quality control. Many commonly used imaging methods rely on high energy radiation, for example X rays, which have several disadvantages related to safety, cost, and possible damage to the sample. Terahertz (THz) imaging is considered a safer alternative because it uses non ionizing radiation while still being able to penetrate many dielectric materials.

This work focuses on 3D printed thin diffractive optical elements that are used to generate different types of THz beams, such as Gaussian, Bessel, and Airy beams. These elements are integrated into a hybrid THz imaging system that allows both amplitude and interferometric measurements. The diffractive components are produced using extrusion 3D printing and are used for shaping the beam, focusing the radiation, and collecting the signal from the sample.

Imaging is carried out using various combinations of beam forming elements placed in different positions within the optical setup. The performance of the system is evaluated by comparing the quality of the obtained images for both amplitude based and interferometric imaging modes. The influence of different component combinations on image contrast, resolution, and sensitivity to alignment is analyzed in order to determine the most suitable configuration for hybrid THz imaging.

The results are expected to show how structured THz beams generated by diffractive components can improve imaging flexibility and provide additional information compared to conventional amplitude only systems.

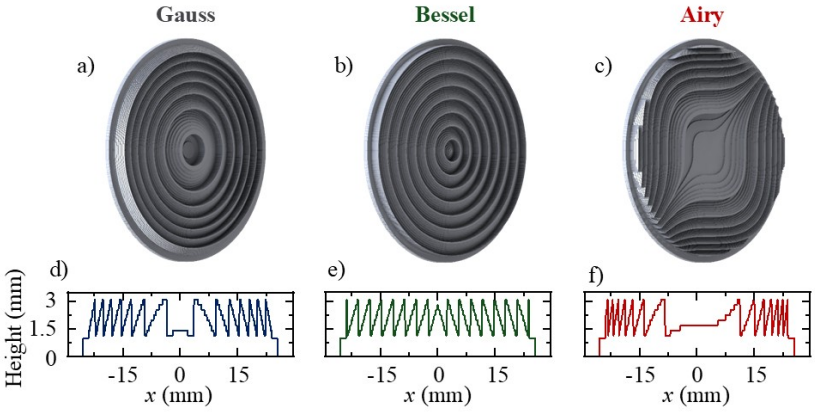

Fig. 1. (a) - (c) Physical models of THz optical components used for imaging evaluation, (d) - (f) corresponding height profiles along the *x*-axis.

[1] Valušis, G., Lisauskas, A., Yuan, H., Knap, W., & Roskos, H. G., Roadmap of terahertz imaging 2021 (Sensors, 21(12), 4092, 2021)