P25

Terahertz imaging setup optimization by different lens configurations

Kasparas Stanaitis[1,2], Karolis Redeckas[1,2], Augustė Bielevičiūtė[1] and Linas Minkevičius[1]

[1] *Department of Optoelectronics, Center for Physical Sciences and Technology, Saulėtekio av. 3*
[2]*Faculty of Physics, Vilnius University, Saulėtekio av. 3.*
Email: kasparas.stanaitis@ftmc.lt

Optical imaging systems are widely used in both commercial and scientific fields, with applications in medicine, security, material analysis, and quality control [1]. These systems often rely on high-energy radiation, such as X-rays, which come with significant drawbacks like ionizing effects and high costs. Terahertz imaging offers a safer alternative since it uses non-destructive radiation that can still penetrate most dielectrics. For even better results, interference-based coherent imaging (homodyne detection) can be utilized.

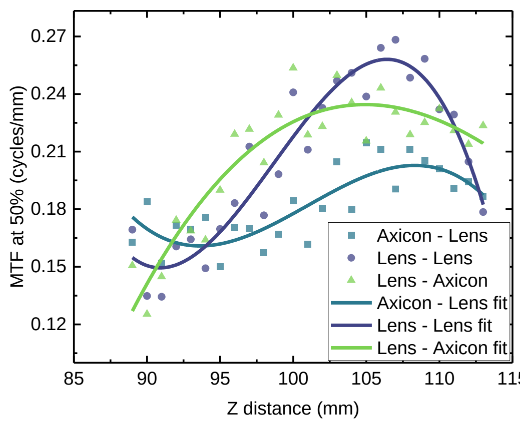

Fig. 1 MTF values along optical axis with varying compositions of Gaussian and Bessel lenses

This study aims to analyze the arrangement of optical components in THz homodyne imaging systems, specifically focusing on Gaussian and Bessel axicon lenses [Fig. 1]. The positions of these lenses were systematically adjusted within the imaging system. The modulation transfer function (MTF) was evaluated along the optical axis to gather information about the system's resolution. Contrast information was then used to determine the optimal conditions for achieving the highest resolution imaging on low absorption objects, such as thin paper layers or graphene.

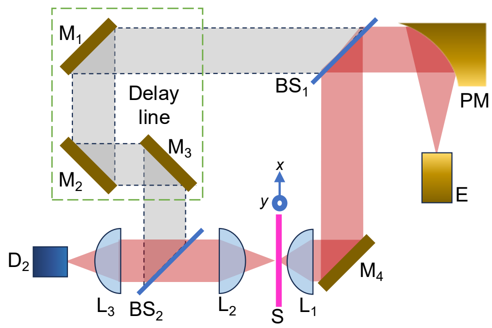

Fig. 2 Homodyne imaging setup. (E - emitter, D - detector, PM, M - mirrors, L - lenses, BS - beam splitter, S - sample

The coherent imaging approach proved to be more effective, as it accurately depicted small changes in absorption. The results indicate that the types and positions of lenses are significant in the context of terahertz imaging. This research can be further expanded by incorporating a wider variety of lens types and compositions, utilizing non-paraxial optics, and forming structured light [2].

REFERENCES

[1] G. Valušis, A. Lisauskas, H. Yuan, et al. *Sensors* **21** (2021) pp. 4092.
[2] R. Ivaškevičiūtė-Povilauskienė, P. Kizevičius, E. Nacius, et al. *Light: Science & Applications* **11** (2022) pp. 326.