A Dynamically Reconfigurable Terahertz Array Antenna for 2D-Imaging Applications

Kathirvel Nallappan[1], Jingwen Li[1], Hichem Guerboukha[1], Andrey Markov[1], Branko Petrov[2], Denis Morris[2] and Maksim Skorobogatiy[1]

[1] Ecole Polytechnique de Montreal, Montreal, Quebec, Canada
[2] University of Sherbrooke, Quebec, Canada

***Abstract*— An array of dipole antenna for multichannel near field imaging has been designed, fabricated and characterized using Terahertz time domain spectroscopy (THz-TDS) system. A 2D Terahertz image using the designed antenna can be obtained by reconfiguring the wavefront of the optical probe beam using the spatial light modulator. As a proof of concept, the THz spectrum of one of the dipole antenna is measured and presented.**

Keywords*— *Array, Terahertz Imaging, Spectroscopy

I. INTRODUCTION

Non-destructive and high speed imaging is the requirement of many industrial, medical and scientific applications. The principle of non-destructive imaging using Terahertz (THz) radiation (0.1 THz – 10 THz) has been already demonstrated in many research works. Single pixel imaging is the most commonly used method in obtaining THz image which lacks fast image acquisition. Few works has been carried out to increase the acquisition speed using multichannel detection and advanced algorithms. In this paper, we have shown the proof of concept for high speed acquisition of 2D image with improved resolution by dynamically reconfiguring the optical wavefront using spatial light modulator.

II. EXPERIMENTAL SET UP

The schematic of the experimental set up is shown in figure 1. An eight channel THz array antenna with an electrode gap of 100 µm and length of 0.5 cm is fabricated using the commercially available Gallium Arsenide (GaAs) semiconductor. By spatially reconfiguring the wavefront of the probe beam using spatial light modulator, we can excite each detector array simultaneously and record THz electric field using 8 channel lock-in amplifiers. By scanning the probe beam along the length of the array antenna with a small step size, the 2D image can be obtained with higher resolution along with frequency information. The Fourier transform of the measured THz pulse from one of the dipole array antenna is shown in figure 2.

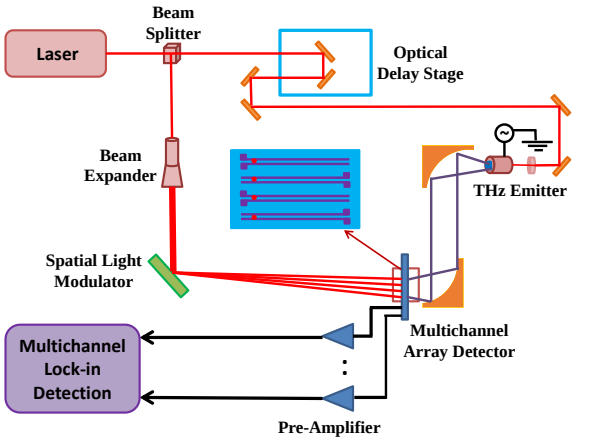

Fig 1: Schematic of multichannel imaging system

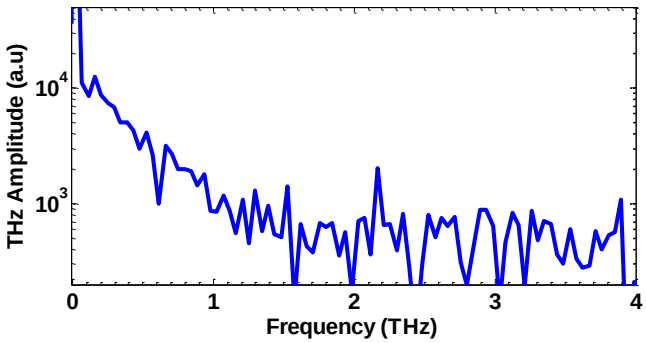

Fig 2: Fourier Transform of the measured THz pulse

III. CONCLUSION

We have presented the proof of concept of obtaining high speed, near field 2D imaging using multichannel THz array antenna. The resolution of such image can be improved by increasing the scanning step of the optical probe beam.

IV. REFERENCES

[1] A. Brahm, A. Wilms, R. J. B. Dietz, T. Göbel, M. Schell, G. Notni, and A. Tünnermann, "Multichannel terahertz time-domain spectroscopy system at 1030 nm excitation wavelength," *Optics Express* vol. 22, pp. 12982-12993, 2014/06/02 2014.

[2] D. Shrekenhamer, C. M. Watts, and W. J. Padilla, "Terahertz single pixel imaging with an optically controlled dynamic spatial light modulator," *Optics Express* vol. 21, pp. 12507-12518, 2013/05/20 2013.