Substance Detection for Security Screening Using Terahertz Imaging Technology

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***Abstract*— The ability of terahertz radiation to render many non-metallic and non-polar substances transparent provides for many security applications [2], [3], [4]. In this paper we will focus on the possible application of terahertz radiation scanning the contents for illicit substances in common use suitcases in secure areas. Suitcases and contents were simulated by sandwiching a cotton sheet between nylon or plastic, with the cotton being laced with illicit substances of varying concentrations. Data was then obtained by use of terahertz spectroscopy and the substances were identified based on reference samples.**

I. Introduction

THz-TDS has previously been proven to be able to successfully detect various substances normally invisible to other forms of imaging [1]. Illicit substances such as drugs, explosives have already been shown to be readily detectable by terahertz radiation [2], [3], [4]. This promises the application of terahertz radiation being used to scan bags and packages in secure areas for these illicit substances in a safe manner, without opening the package and physically testing the substance contained inside.

This paper aims at simulating a bag or suitcase with common clothing contained inside possibly laced with some potentially hazardous unknown substance. The bag or suitcase and contents are simulated by a scaled down sample using various plastics to simulate the bag or suitcase material and cotton to simulate clothing, which is then placed in the terahertz system.

II. Approach

Various samples of plastics, such as nylon that are used in typical suitcases and bags were initially tested for transparency under terahertz radiation and the resulting spectra recorded. The plastic samples were held in place via a specially designed metal bracket to accommodate a 50 mm square sample. Once the transparency of the plastic was proven, a cotton sheet was then wedged between two sheets of the plastic, forming a reference sample to which a reference spectra was recorded.

The spectra of a clean cotton sheet was recorded as a reference, thereafter several other sheets of cotton were laced with various substances and the spectra again recorded for comparison to the wedged plastic samples. Laced cotton sheets were placed in between the wedged plastic samples and scanned by the terahertz system.

The resultant spectra from the laced samples were compared with the reference wedged plastic sample and the laced cotton samples. The plastic's spectrum was then removed from the obtained data, and was then compared the laced cotton sample's data to attempt to determine which substance was present in the wedged plastic sample.

III. Conclusion

From these experiments it was difficult to determine the substance contained in the sample. However, a proof of concept for use of a terahertz system in secure areas was successful. In future, more refined and improved experiments would most likely yield more promising results for improved accuracy of substance detection and for a larger range of substances.

IV. Outlook

In future, through further advances in the terahertz field it may be possible to have a single unit scanning bags, suitcases and packages in secure areas, such as airports, shipping yards and postal agencies. This would provide a safe, fast and efficient option for detecting substances that would otherwise be invisible to other imaging techniques.

References

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