Millimeter-wave Scattering Imaging Using Xenon Lamp as Illumination Sources

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1. Introduction

Passive millimeter-wave imaging is effective for security screening to detect concealed threats in clothes and baggage. However, it is strongly influenced by the surrounding environment, such as ambient temperature and background radiation, which often results in images of low contrast and degraded object visibility. Therefore, it is necessary to illuminate the targets by using external illumination sources, enabling more robust signal acquisition and improved contrast between the target and its surroundings.

In this study, a low cost and simple millimeter-wave scattering imaging system is proposed where xenon lamps are used as an illumination sources.

2. Measurement set up and results

In the experimental setup, a xenon lamp (7 inch, 100W, 6000K) was used as illumination source, and a horn antenna (PNR-28-440-6, 26.5GHz-40GHz) was used as the receiving antenna. A low-noise amplifier (QLW-30402540-GO) and a Cross Damain Analyzer (U3872) were used in the receiving side, as shown in Fig. 1.

In the experiment, a metal plate was used as the target, which was placed between the xenon lamp and the receiving antenna and mechanically scanned to acquire spatially resolved measurements. For this purpose, the receiving horn antenna was fixed on a mechanical scanning stage, and two-dimensional power scans were performed over an area of 240 mm × 50 mm under two conditions: without the metallic conductor and with the metallic conductor present. The power distributions obtained in these two cases were subtracted point by point at corresponding spatial positions, resulting in the two-dimensional power distribution shown in Fig. 2 at 35 GHz using a xenon lamp as the millimeter-wave source, in which a clear contour of the target object can be observed. Fig.3 shows one-dimensional power profiles extracted from two representative rows of the two-dimensional power distribution in Fig. 2. The red curve corresponds to the line of y = 5 mm, while the black curve represents the line at y = 0 mm. A clear difference in received power is observed between the two cases, indicating the blocking caused by the metallic conductor.

3. Summary

In this report, millimeter-wave imaging using the xenon lamp as illumination sources were successfully realized and the spatial imaging of a metallic conductor was clearly obtained.

References

[1] A. Maeda, H. Sato, R. Nishimura and Q. Chen, "Active Millimeter-Wave Imaging Using Incoherent Illumination with Multiple Incident Angles," *2020 International Symposium on Antennas and Propagation (ISAP)*, Osaka, Japan, 2021, pp. 809-810, doi: 10.23919/ISAP47053.2021.9391466.

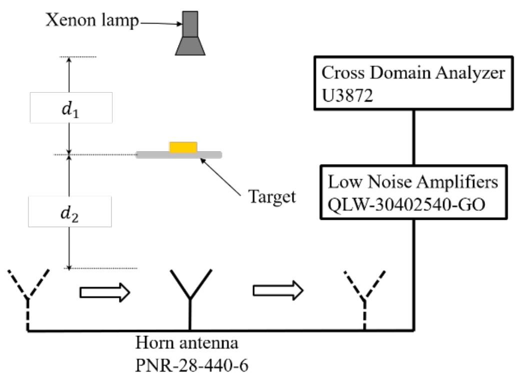

Fig. 1 Millimeter wave image measurement system

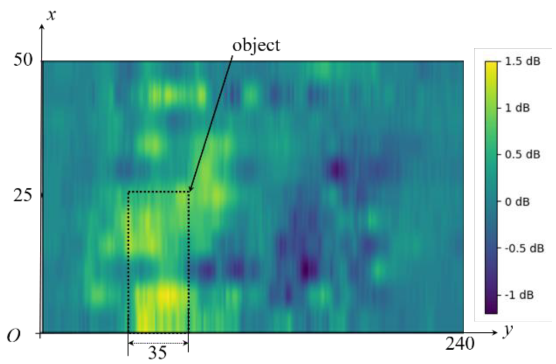

Fig. 2 Two-dimensional power distribution in millimeter-wave imaging

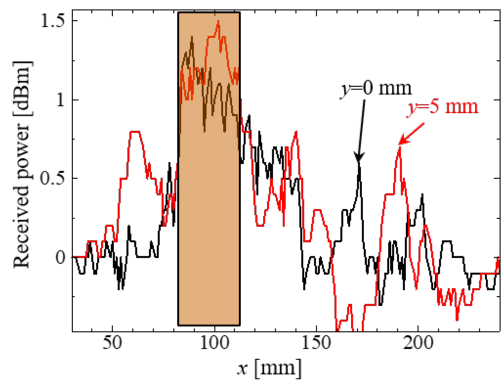

Fig. 3 One-dimensional power distribution in millimeter-wave imaging (35 GHz)