The 220 GHz stepped-frequency Imaging Radar

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Terahertz imaging technology is actively being developed in response to the demand for security applications in recent years. The advance in technology of terahertz (THz) has made possible the detection of THz radiation with solid-state devices operating at room temperature. THz wave has also emerged as a more powerful tool in various areas such as medical, communication, non-destructive inspection of various pharmaceutical, agricultural, and industrial products[1-2].Terahertz imaging is being adopted for non-destructive evaluation (NDE) applications in aerospace and other government and industrial settings[3-5].

Several works have been directed for security applications. Reference “A 600 GHz imaging radar for concealed objects detection” presents the experimental results from a 600 GHz imaging radar with sub-centimeter resolution in all three spatial dimensions. The radar system used a FMCW transceiver built on a back-end of commercial microwave components-with a front-end of custom designed frequency multipliers and mixers. And the resolution is better than one centimeter in all spatial dimensions.The system uses linear sweep frequency (FMCW) across a bandwidth of 30GHz at the center of 580GHz to achieve a range resolution of about 0.5 cm has been demonstrated at Jet Propulsion Laboratory in [6]. Reference [7] also describes how a 630 GHz single-pixel scanned imager was modified to achieve a range resolution of about 2 cm at 4 m range.

All of these systems adopted the CW or FMCW terahertz signals. In the paper, the stepped frequency terahertz pulse series is provided to get the high resolution in axial spatial direction, and other two dimensions are realized. Simulation and experiment both have been finished. The bandwidth of 220GHz stepped-frequency imaging radar is 6GHz. The theoretical resolution is 2.5cm. Some microwave anechoic chamber imaging experiments have been executed. While it is applied in space detection, earth atmospheric composition, chemistry and dynamics of the troposphere, temperature and pressure distribution, dynamics, volcanic activity and ice particles in clouds, surface parameters etc. can be achieved , which will play valuable role in scientific research.

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