Integrated Terahertz Radar System Based on Leaky-Wave Coherence Tomography

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The use of terahertz waves for radar offers a higher resolution and smaller aperture as compared to the microwave radar. However, despite the recently emerging solid-state terahertz sources and detectors applicable to radar front-end circuits, integration of a phased array radar system is still challenging due to the absence of phase shifters and circulators, the basic components for beam steering and input-output isolation, respectively. To circumvent this, here we present leaky-wave coherence tomography, a method to integrate a terahertz radar system using a pair of reversely connected leaky-wave antennas [1]. With this approach, we implement beam steering and homodyne detection in one package for frequencies from 330 to 500 GHz without using phase shifters, circulators, half-mirrors, lenses, or mechanical scanners. We demonstrate that the direction and range toward targets can be identified via signal processing on acquired data. Our work paves the way to a high resolution, penetrable, and compact radar system, which is suitable to be equipped even on mobile devices and drones for a wide range of applications. As an example, we demonstrate in-situ human heartbeat detection by measuring the chest displacement on an order of 10 μm through the clothes, which provides information as with a stethoscope but remotely.

References

[1] H. Matsumoto, et al. "Integrated terahertz radar based on leaky-wave coherence tomography." *Nature Electronics* (2020): 1-8.

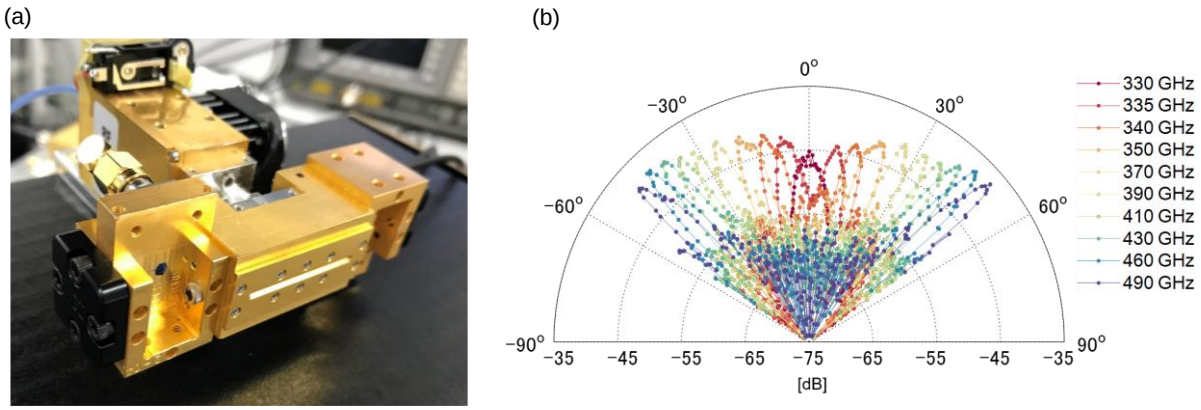

Fig. 1 (a) Appearance of the integrated terahertz radar based on leaky-wave coherence tomography. (b) Radiation pattern measured inside an anechoic chamber. The beam, with an average width and sidelobe level of 4.4° and 12.6 dB respectively, is steerable in directions from 0° to ±51° by sweeping the frequency from 330 GHz to 500 GHz. Two beams appear symmetrically.