Circularly Polarized Metal Antennas and Characterization-Methods for Sub-mm-wave and Terahertz Frequencies

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Wireless communication in millimeter and terahertz bands is important for emerging 5G technologies. Specifically, terahertz bands are likely to support short distance communications for applications such as Internet of Things (IoT), whereas lower millimeter-wave bands at 28 GHz, 38 GHz and 71-86 GHz can be used for medium range point-to-point communication systems. To enable such systems, antennas are needed that are low cost, show high-efficiency and are simple-to-fabricate. An added challenge is accurate characterization of these antennas, which is a concern because of small wavelength-operation, requiring elaborate measurement set-ups.

In this paper, we present 1) highly efficient metal-based antennas for sub-mm-wave communication and 2) cost-effective phaseless measurement methods for antenna characterization. First, we will show a simple-to-fabricate configuration of radial line slot array (RLSA) antenna operating at 106 GHz, showing upto 67% efficiency in WR-8 band. We note that RLSAs are compact, but inherently narrowband antennas. For wideband CP antenna solution, we propose a novel CP-horn antenna topology. The proposed antennas utilize dispersion properties of a hexagonal waveguides to obtain linear to circular polarization conversion and radiation.

Second innovation in this work is related to characterization of circularly polarized antennas at sub-mm-wave and terahertz bands. As is well known, the traditional method of CP gain measurements does not scale well for terahertz frequencies, since rotation of frequency extender units is not easy. That is, rotation of frequency-extenders cause misalignment, leading to unpredictable phase errors. To avoid this, we propose to directly measure the CP-gain of the antenna without a need to individually determine the linearly polarized (LP) field components. As such, we completely avoid antenna rotation or relative phase measurements.

At the conference, design, analysis and characterization of the proposed antennas will be presented for WR-8 (90-140 GHz) band operation. Concurrently, the measurement methods will also be validated via the characterization of these antennas.