Ultracompact Omnidirectional Circularly Polarized Antennas

(Invited)

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In order to avoid polarization mismatch problem that may occur in future Internet-of-Things (IoT) ecosystem, wireless systems require omnidirectional CP antennas (OCP) that have a broad radiation coverage. Moreover, antenna miniaturization is another concern as future IoT systems are evolving into more compact platforms. The general concept to design OCP antenna is to produce a pair of parallelly-orientated electric and magnetic dipoles that are balanced in amplitude and have 90 degree phase difference [1] – [3].

Two compact OCP antennas were developed based on different techniques. The first technique is to combine a monopole with four meandered wheel-shaped radiators that are extended from the monopole [4]. The second approach is to design a four-arm helical antenna with one half-wavelength driven element and another three parasitic elements [5]. Two prototypes were successfully demonstrated. The first is operating at 28 GHz and fabricated on a small piece of disk-shaped PCB substrate. Excellent OCP radiation performance has been realized, e. g., gain variation in the omnidirectional plane is less than 1.5 dB; maximum realized gain is 2.2 dBic; operating bandwidth covers the licensed 5G band entirely from 27.5 to 28.35 GHz. The overall volume is an ultracompact cylindrical with 2 mm diameter and 1.57 mm height. The second prototype is operating at 1 GHz. Excellent OCP performance has been achieved as gain variation in the omnidirectional plane is less than 0.5 dB and the maximum realized gain is 2.2 dBic. Moreover, ultracompact size has been realized. Its ka value is only 0.39 where k is the wavenumber and a is the radius of the smallest sphere that encloses the antenna. Note an antenna is considered as electrically small antenna if $ka < 1$. Above two OCP antennas achieve decent OCP characteristics and have ultracompact physical size. They are ideal candidates for device-to-device (D2D) communications in future wireless IoT systems.

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