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Wideband Superdirective Array Antenna with Beam steering capabilities

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The development of 5G standard and the emergence of some of its applications such as Internet of things (IoT), have generated a need for compact, directive and wideband antennas. To fulfill these requirements, extensive research has been conducted on superdirective arrays, to develop compact antenna structures with directive radiation patterns. This kind of antenna, allows the precise orientation of the beam of radiated power towards desired (useful) directions, providing a wide coverage and thus a significant increase in the number of users. Also, they reduce the environmental effects of wireless devices such as electromagnetic pollution and interferences. Furthermore, due to their high gain, efficient superdirective arrays can provide a high data bit rate compared to the classical omnidirectional antenna systems. In this paper, we present the design of a high-gain wideband compact parasitic antenna array with electronically spatial scanning (beam steering) capabilities in the azimuthal plane. This antenna architecture is designed to operates in the 5G NR n28 frequency band between [758-803 MHz] using the optimization approach proposed in [1]. It allows the coverage of the four main directions of the horizontal plane (Fig. 1). The antenna structure exhibits a compact form factor with respect to the operation wavelength ($\lambda = 384mm$) of $153 \times 153 \times 150\ mm^3$ (Fig. 1) and a wide impedance bandwidth of 12.8 % (Fig. 2). In the band of interest [758-803 MHz] the antenna achieves a high realized gain greater than 8 dBi (Fig. 3) and a total efficiency greater than 90% (Fig. 4).

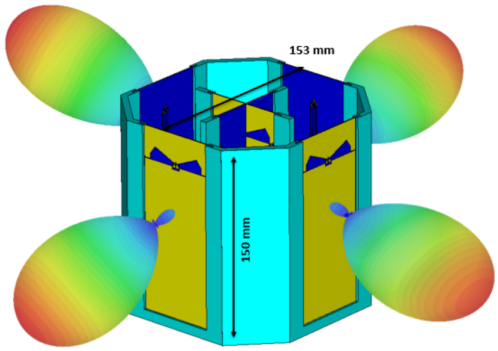

Figure 1. Superdirective Array Antenna with Beam steering capabilities

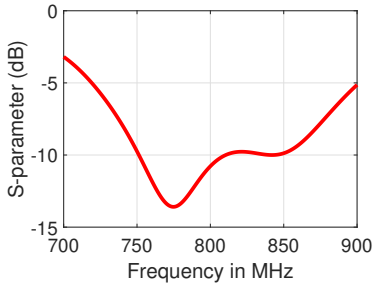

Figure 2. Antenna input reflection coefficient

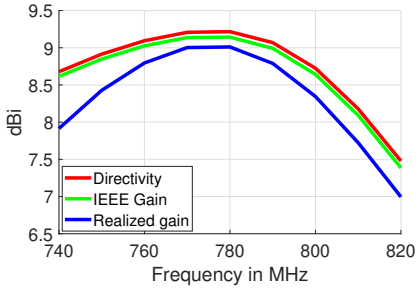

Figure 3. Directivity, IEEE gain and Realized gain versus frequency

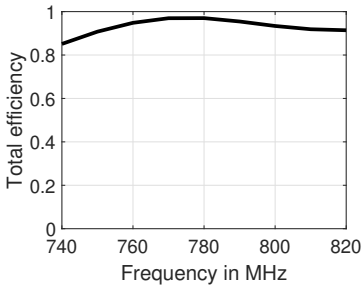

Figure 4. Antenna total efficiency

References

[1] Touhami, A., Collardey, S., Sharaiha, A.: "A multi-objective optimisation for compact wideband and efficient superdirective antenna arrays design using network characteristic modes". IET Microw. Antennas Propag. 1–14 (2022). https://doi. org/10.1049/mia2.1232