URSI GASS 2021, Rome, Italy, 28 August - 4 September 2021

Fully Metallic Dual-Band Linear-to-Circular Polarizing Metasurface for Satellite Communications

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Circularly polarized (CP) electromagnetic waves do not suffer from polarization misalignment and Faraday rotation [1, p. 6], which makes them attractive for satellite communication (SatCom) applications. A polarizer can be used to generate CP waves from linearly polarized (LP) waves. This enables the use of inherently LP antennas in SatCom systems [1, p. 494] and thus alleviates the antenna design process. Additionally, an LP-to-CP polarizer allows for an independent control of the polarization transformation in multiple bands [2].

An LP-to-CP polarizing metasurface is typically composed of multiple cascaded patterned conducting layers [3]. At least three layers are needed to obtain zero insertion loss at two frequencies [4]. Increasing the number of layers results in a greater control of the scattering properties, which can be used to enhance the bandwidth [3].

The majority of the previously reported LP-to-CP polarizers requires supporting substrates [2–5], which introduces prohibitive losses in the emerging K/K_a-band SatCom applications. The supporting structure can be avoided with a polarizer based on perforated metallic screens [6, 7].

In this work, we propose a fully metallic dual-band polarizing metasurface that transforms LP into right hand and left hand CP in the K/K_a SatCom bands 19.7–20.2 GHz and 29.5–30 GHz. Compared to [6, 7], the proposed polarizer provides dual-band operation with independent control of the polarization transformation in the two bands. Furthermore, three cascaded sheets are used to obtain low insertion losses in the two bands. The insertion loss for the co-polarization is less than 0.61 dB and the axial ratio is below 0.8 dB in the two bands. The polarizer is intended to be integrated in aperture antennas suitable for SatCom ground segment terminals [8].

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