Linear-to-circular planar multisurface-metamaterial polarizer designed by anisotropic effective constitutive parameters

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Circularly polarized (CP) large array antennas are often used in both TLC and Radar applications (see e.g. meteorological anti-clutter radar, or satellite-Earth TLC links). Sometimes, the insertion of a LP-to-CP passive polarizer on top of linearly polarized (LP) array can be a low-cost strategy to modify already designed antennas. In this work, we suggest the use of a metamaterial LP-CP polarizer constituted by a multisurface metamaterial slab to be placed on top of a linearly polarized high-gain array.

Planar polarizers may be realized by using cascade of Frequency Selective Surfaces (FSS); for this kind of polarizers the challenging issue is usually represented by the operational bandwidth and the angular stability. Improved performances can be obtained by substituting the FSS with metasurfaces, i.e. periodic surfaces whose elements (slots or patches) are small in terms of a wavelength.

We propose here a general methodology for the analysis and design of a multisurface metamaterial polarizer working in the microwave regime realized by cascading a number of metasurfaces. Starting from the observation that a slab of bianisotropic medium can also be used as a polarization transformer (A.J. Viitanen and I.V. Lindell, Electronics Letters , vol.29, no.12, pp.1074-1075, 10 June 1993), the link between the transfer function of the planar device and the constitutive parameters of an equivalent slab of anisotropic homogeneous medium are used in the design. It is shown how the description of the multi-layer metamaterial structure as an equivalent homogeneous medium can provide physical insight into the problem and offer guidelines for the choice of the geometry of the metasurface elements providing an optimal performance.