Multi-Frequency Reflection Only Linear Polarization Converters

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The capability of controlling the polarization of an electromagnetic wave creates numerous applications. Millimeter-wave and sub-millimeter wave imaging applications and remote environmental monitoring applications employ polarization converters (Euler, M., et al. *Antennas and Propagation, IEEE Transactions on* 58.7 (2010): 2457-2459.). They have also been employed in the design of circulators and isolators. Polarization converters are typically fabricated with birefringent materials or dichroic crystals (Kotlyar, Maria, et al. *Optics express* 13.13 (2005): 5040-5045.). Using these conventional methods to carry out advanced polarization control inflicts demanding requirements on material properties and equates to a limited performance. Relatively cumbersome devices are required for these conventional methods. In light of this, creating novel polarization control devices that are lightweight and thin is important. More recently, polarization conversion using plasmonic metasurfaces or metamaterials has been proposed. Through careful design, a number of intriguing functional devices can be developed based on metal-dielectric structures, such as high-impedance surfaces, radar absorbing materials and electromagnetic cloaks. In particular, much thinner polarization controllers can be developed via the use of these bidimensional metamaterials.

This presentation will introduce an approach to the design of a multi-frequency polarization converter. The device converts a linear vertical polarization in a horizontal one or vice versa. It is realized with a periodic surface that uses a unit cell with chiral topology. The elements that constitute the unit cell are end-loaded dipoles printed on a thin dielectric substrate. The polarization converter can work simultaneously on different frequency bands whose position within the electromagnetic spectrum is established in the design phase. The appropriate design of the unit cell allows for the modification of the overall features of the polarization converter. In particular, the number of dipoles is related to the number of working bands of the polarization converter. This choice of the end-loaded dipoles shows significant improvements over the converters employing dipoles. The dipole-based converters have a good polarization conversion only when the electric field impinges with an azimuthal angle equal to 45°. Differently, the polarization conversion of the proposed device is reasonably maintained even when the incident wave impinges with an azimuthal angle different from 45°. The latter situation is useful in scenarios where the polarization angle of the incident wave is unknown, e.g. passive sensors or chipless RFID.