Modelling and Measurement of Cascaded Tensor Impedance Surfaces For Polarization Control

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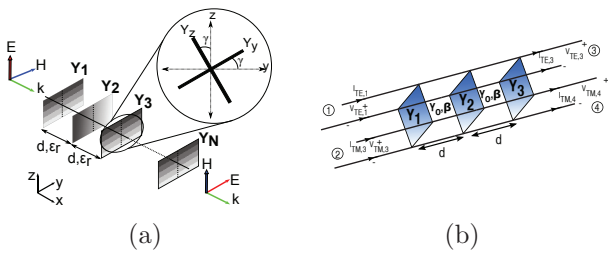
Polarization control of the electromagnetic field is an important aspect of many communication systems. One method of controlling polarization is through the use of chiral effects. This includes circular polarization selectivity and linear polarization rotation. These kinds of effects can be implemented in many ways including stacks of meander-line polarizers (*M. Joyal and J. Laurin, IEEE Trans. on Antennas and Propagation, vol. 62,no. 6, pp. 30433053, June 2014*). However, designing these surfaces using cascaded tensor impedances is a viable alternative that can minimize their physical footprint. Such designs consist of tensor impedance surface cascaded back to back as shown in Fig. 1.

The challenge in designing these surfaces is that a stack of tensor impedance surfaces has a number of variables to optimize the transmission and reflection through the overall structure. Each tensor impedance surface has three degrees of freedom and a four-layer structure for example would have twelve overall. One is then left to blind optimization techniques to find the solution.

In this work, we present a multi-conductor transmission-line model of cascaded tensor impedances. The MTL network consists of transmission lines for both the TE and TM modes and shunt impedances to model each impedance surface as shown in Fig. 1. This enables us to solve for the tensor impedance of each surface for a desired set of S-parameters. The corresponding solution is found by generalizing matching networks to their MTL counterparts. A design procedure is developed which can implement circular polarization selectivity and linear polarization rotation.

Finally we also fabricate and measure a couple of examples and we show how to fully characterize these designs in both near-field measurements and free-space S-parameter measurements.



(a) (b)

Figure 1: (a) A schematic of a cascaded tensor impedance surface (b) Its corresponding MTL model.