Polarization Responsive Guides by Artificial Line Anisotropy

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The concept of artificial dielectrics has sustained much interest within the electromagnetics community. For instance, compact lenses and polarizers have been designed at microwave and millimeter-wave frequencies along with many other volumetric structures for field control. In these structures an incident wave can be confined and/or transformed due to the periodic loading of sub-wavelength inclusions within a host medium. Most recently these techniques have been adopted to more planar implementations for the routing or tailoring of guided waves. For example, when considering metasurfaces and other transformation electromagnetics-based guides for new transitions and antennas. These engineered materials and surfaces can be characterized using effective material parameters, or more exactly, by permittivity and permeability tensors which may have some spatial dependence.

Following these developments we propose a new configuration of planar anisotropic transmission lines which can offer unusual power routing capabilities. In particular, observe the cross-over guide as shown in Fig. 1(a). This structure is defined by two planar lines which are perpendicularly orientated and defined by different material parameter tensors. Wave progression within the anisotropic guides is directed and polarization sensitive. For example, good isolation values can be observed when the *x*-directed guide is excited as shown in Fig. 1(b), in that limited power is coupled into the *y*-directed guide. When both guides are simultaneously driven as shown in Fig. 1(c), field progression occurs with minimal interaction with the corresponding perpendicular guide. It can be observed that the two modes propagate with independent phase constants along the *x*- and *y*-directions, respectively. In effect, the two modes are orthogonal demonstrating isolation.

Comparable schemes have been developed in wireless and optical fiber communications systems where polarization specific fields are modulated to increase channel capacity. Similarly, our proposed waveguide crossover technique has potentials for increasing the density of transmission lines while also improving signal integrity. These novel routing techniques, which exploit line polarization and integration, are also applicable to new planar antennas and other printed circuits for enhanced data capacity and increased signal isolation.

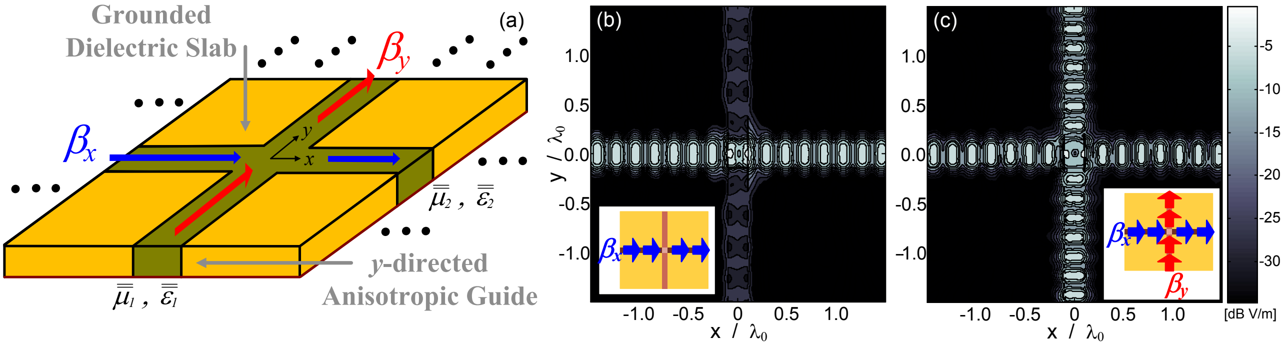

Fig. 1. (a): Proposed dielectric-based planar structure for guide cross-over with conductor backing. The host grounded slab is an isotropic material. (b): The *x*-directed guide is independently excited with field propagation defined by β_x. Minimal power is coupled into the perpendicular and the non-excited guide. (c): If both anisotropic guides are simultaneously driven, field propagation occurs within the lines with minimal interaction.