Construction and Testing of Metamaterial Polarizers

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Metamaterial polarizers (S. Yan, G. A. E. Vandenbosch, "Compact circular polarizer based on chiral twisted double split-ring resonator," Applied Physics Letters 102, 103503, 2013) have many potential applications to antennas. These polarizers use a two-layer structure of double split-ring resonator (DSRR) elements to transform an incident wave from linear polarization to circular. From the planar form factor that was initially introduced, advanced cylindrical versions have been developed that have superior performance. This work explores the technical issues with the fabrication and testing of these cylindrical metamaterial polarizers.

A cylindrical polarizer design is optimized using computational methods and translated into a prototype using commonly available materials and fabrication techniques. The polarizer is made by fluid dispensing conducting inks onto a thin planar substrate and rolling it into a cylinder. However, this rolling of the planar sheet distorts the DSRR elements and must be compensated for in the design. Support structures that hold the polarizer form in place without interfering with performance must be implemented as well.

The testing of cylindrical polarizers also presents challenges. The common S-parameter test setup, consisting of two horn antennas facing each other, is not practical for verifying the final performance of a cylindrical polarizer. Instead, verification must be done by testing the fully integrated polarizer/antenna assembly on a calibrated test range.

This work presents details on how various cylindrical metamaterial polarizer prototypes were made by fluid dispenser printing of conducting ink onto various planar substrates. The substrates were formed into cylinders and then integrated with monopoles and tested, which confirmed the design simulations. Challenges of manufacturing and testing and their practical solutions are presented. Conclusions and recommendations for future work are given.