Dual-Polarized MAW Spirals

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Applications of an antenna which can detect the entire polarization matrix over most directions are extremely useful for number of applications including remote sensing, multi-functional communications, radar, radar warning receivers and other electronic warfare needs, just to mention a few. Ideally, one would like to receive two orthogonal polarizations through a sensor that uses the same aperture for both polarizations. The most commonly used antenna for omni-polarized, broad frequency and beam coverage applications, is sinuous antenna invented by R. DuHamel in 1987. Dual-circularly polarized alternatives include: four-arm planar log-periodic antenna, inside-outside fed spiral and a modulated arm width (MAW) spiral developed by P. Ingerson around 1970.

In this paper, we start with the performance comparisons between MAW spiral and sinuous antennas including the discussion regarding the trade-offs between the above-mentioned antennas. Impedance, polarization purity, beam squint and other parameters are contrasted. A need for pattern calibration tables in evaluating the tilt matrix of an interferometer, and effects of various MAW spiral parameters on these, are discussed next. Finally, to address the restrictions in the MAW spiral design imposed by the use of coplanar technology we propose a bi-layer arm tracing with half of the arms patterned on either side of the dielectric. This allows greater flexibility in choosing a modulation ratio, which is one of the most important parameters for the MAW. The modulation ratio, defined as the ratio of the low impedance arm width to the high impedance arm width, is typically restricted to about 8 to 1 with conventional etching tolerances and lower growth rates needed for best performance. Conclusions are supported by method of moments and finite element simulations and measurements.