Analysis of Iris-Excited Centered Longitudinal Slots using Entire Domain Basis Functions with Edge Conditions

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The conventional slot arrays employing alternating offset longitudinal slots in the broad walls of rectangular waveguides exhibit undesirable radiation called butterfly lobes in non-principal planes. Centered longitudinal slots excited by probes, wires or irises have been proposed in the literature as possible solutions to this problem. A centered longitudinal slot excited by an L shaped compound iris was found to have desirable properties (R. Tang, IRE Trans. Antennas Propagat., 8, 1, 97-101, 1960). In that work a linear array of such slots was designed and built based on experimental characterization of isolated slots. Since the frequency behavior of the iris and that of the slot are complementary this type of radiating element provides broader impedance bandwidth compared to a conventional offset longitudinal slot.

This paper provides an analysis of an iris-excited centered longitudinal slot in the broad wall of a rectangular waveguide. Coupled integral equations were formulated in terms of the equivalent magnetic currents in the two slot apertures of a thick slot and the induced electric currents in the iris. Entire domain sinusoidal expansion functions with multiplicative edge conditions were used as basis and test functions in the iris region (S. R. Rengarajan, IEEE Antennas Wireless Prop. Lett., 4, 47-50, 2006). Since these basis functions create discontinuities in currents in the region where they overlap, additional basis functions were employed to avoid such discontinuities. In the slot region entire domain sinusoidal basis and test functions were used along the slot with uniform transverse distribution. No edge conditions were needed for the slot region. The numerical results exhibit good convergence and show excellent agreement with published results for two special cases of inductive and capacitive irises (N. Marcuvitz, Waveguide Handbook, McGraw Hill, 1951). Computed data on the scattering parameters and the slot aperture electric field have been obtained for a range of values of slot and iris dimensions. They will be presented at the meeting.