EQUIVALENT STRIP WIDTH FOR CYLINDRICAL WIRE: EXPERIMENTAL AND NUMERICAL VERIFICATION

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Reflector antennas with mesh surfaces are used in many satellite and ground antenna systems. These mesh structures have either strip-aperture or wire-grid characteristics. Butler determined that the equivalent diameter for a single narrow conducting strip is one-half its width (C. Butler, *IEEE Transactions on Antennas and Propagation*, **30**, 755-758, 1982). This equivalence has not been verified in practice for mesh reflector structures. The motivation of this work is to verify the equivalent strip width for a cylindrical wire with measurement and numerical analysis.

The study was divided into two tasks. The first task was to verify experimentally the correlation between the strip width and the wire diameter using measured data, and the second task was to numerically verify the correlation using the strip model and the wire model. For measurement purposes, X band waveguide (8 - 12.4 GHz) was used. Copper strips of similar width were cut and taped to the face of the waveguide using electrically conductive tape. These strips were positioned such that the periodicity of the structure was maintained. The transmission and reflection characteristics of the waveguide were measured using a network analyzer by connecting the waveguide with the strips between waveguide adapters. A similar experiment was performed using copper wires. For numerical analysis, a model of the experimental setup was designed and simulated in High-Frequency Structure Simulator (HFSS). By exciting the dominant waveguide mode, the transmission and reflection characteristics were obtained. A periodic strip model was simulated both in HFSS and periodic Method of Moments (MoM).

Comparing the measurement and HFSS simulated results confirmed that the numerical model was accurate. Using HFSS, it was verified that the equivalent strip width for a cylindrical wire is almost twice (≈ 1.9) the wire diameter (for an infinitely thin strip) for mesh reflector structures. A convergence study was performed on the model in HFSS to obtain an optimum meshing surface. The effect of the thickness of the strip was studied and it was observed that as the strip thickness increases, the transmission goes down proportionally. The periodic strip model in HFSS was simulated using the plane wave incidence at different angles, as was the model in periodic MoM. Transmission and reflection characteristics obtained from the two simulations were found to be similar.

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