USE OF ASYMPTOTIC BOUNDARY CONDITIONS ON THE DESIGN OF ANTENNAS WITH SOFT AND HARD SURFACES

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Recently, asymptotic boundary conditions (ABC) are used to treat corrugated surfaces and surfaces loaded with periodic narrow metallic strips with period, P, much smaller than the wavelength. These surfaces have been classified as artificially soft or hard surfaces under certain conditions related to the dielectric thickness or the corrugation depth with the strips direction or corrugation directions along the wave propagation direction (hard surface) or in the transverse direction of the wave propagation direction (soft). If the surface is corrugated, the boundary conditions are referred to as the asymptotic corrugation boundary condition (ACBC). If the surface is loaded with periodic strips, the boundary conditions are referred to as asymptotic strips boundary conditions (ASBC). Lately, an idealization for these surfaces in the soft and hard conditions are looked at as a periodic structure with each period made of perfect electric conducting (PEC) strip attached to a perfect magnetic conducting (PMC) strip with P approaching zero (PEC/PMC surface). In this case, the boundary conditions in the asymptotic form are defined as the tangential electric field along the strips is zero and the tangential magnetic filed along the strips is zero. The PEC/PMC boundary conditions are implemented in a general 2D code and a general body of revolution (BOR) code. The codes are based on the surface integral equations and the method of moments. These codes allow the use of the asymptotic boundary conditions with other conventional boundary conditions. These implementations expand the use of these codes to analyze problems that could not be analyzed in a simple form such as the use of hard surfaces in axi-symmetric horns.

The BOR code using the asymptotic PEC/PMC boundary conditions is verified with some special cases of soft horns with the corrugations replaced by PEC and PMC rings of finite width to model ideal soft surface with finite period P. In addition, the 2D code using the asymptotic PEC/PMC boundary conditions is verified with a cylindrical structures that are made of PEC and PMC longitudinal strips of finite period. In the BOR, when the strips are oriented along the body axis, the ideal PEC and PMC strips can't be analyzed with this code, but the asymptotic PEC/PMC boundary condition can be implemented and analyzed. In such a case, the impedance boundary condition model is used for verification because both models can be analyzed by the same code. This allows the analysis of the hard horns with the ideal hard condition.

Several examples will be presented indicating the usefulness of using the asymptotic boundary conditions in the analysis of these antennas efficiently.