Design of Artificial Impedance Surfaces for Conformal Antennas

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Controlling the radiation from surface waves propagating on surfaces is the key to designing radiation patterns of conformal antennas located on complex objects. By developing approaches to engineer this surface wave radiation, one can expand the design space available to antenna designers. This enables products with better radiation/scattering performance without compromising their aesthetic, structural or aerodynamic properties.

The approach we have developed for control of surface wave radiation is based on the general theory of modulated surface impedance (A. Oliner and H. Hassel, IEEE Trans. on Antennas and Prop., vol. 7, no. 5, pp. 201-208, Dec. 1959) combined with the concept of artificial impedance surfaces. The complex object of interest is coated with an artificial impedance surface consisting of a lattice of sub-wavelength metal patches on a grounded dielectric. The effective surface impedance depends on the size of the patches, which is varied as a function of position to realize the proper surface impedance distribution to achieve the desired radiation/scattering characteristics.

Previously we have reported on an approach using the concept of microwave holograph to determine the proper surface impedance distribution to achieve the desired radiation/scattering characteristics (D. Sievenpiper *et al*., 2005 IEEE Antennas and Prop. Symposium Digest, 256-259). This holograph approach gives a good first order design of the required surface impedance distribution, but ignores affects such as surface wave propagation constant variation with surface impedance and surface wave scattering from edges. In this presentation we will report on an improved approach to determine the required surface impedance distribution that takes into account many of the affects ignored in the first order holograph approach. Using this new approach we have demonstrated improved mainbeam shape and sidelobe control for pencil beam patterns off of flat surfaces and better control of beam angle position for radiation off of curved surfaces.