

Space Frame Scattering Analysis of Metal Beams with Rectangular Cross-Section

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Large radar antennas are generally covered with spherical radomes to protect them from extreme weather conditions and to enable their continuous precision operation without sacrificing their performance. The radomes are assembled from many panels interconnected with metallic beams because of their large size. From an electrical viewpoint, the beams with rectangular cross-section may be regarded as a collection of scatterers, which scatter the energy incident upon them from the transmitting antenna and perturb its radiation pattern and increase its losses. Fig.1 shows the geometry of a typical space frame radome.

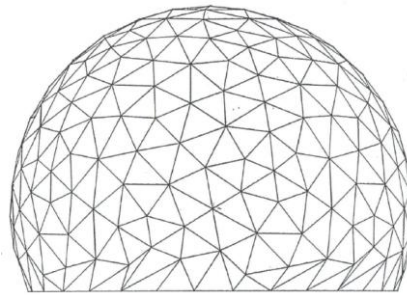


Fig.1-Geometry of a typical space frame radome with metal beams.

The window panels have little effect (especially for frequencies below X band) hence, the presence of the radome can be determined solely by evaluating the scattering properties of the beams and superimposing the effects in the far field. The radome is designed to have a quasi-random geometry in contrast to a regular geodesic dome design to reduce the cumulative effect of scattering from the beams. The degree of randomness of the beam geometry can increase with a decrease in the beam length. The analysis of the scattering effects from the beams was first conducted by Kay (A. F. Kay, "Electrical Design of Metal Space Frame Radomes," *IEEE Trans. Antennas Propagat.*, vol. 13, no. 2, pp. 188-202, 1965) by using array theory for an ensemble of radiating apertures approximating the beams scattering effect with the geometry of the projected beams on the incident plane wave of the enclosed antenna in the radome. This type of analysis ignores the mutual coupling scattering between the beams and results in inaccurate estimate of the insertion loss due to the metal space frame radome and the effect of the scattering on the enclosed antenna radiation pattern.

In this study, we analyze the beams scattering mutual coupling effect on an enclosed reflector antenna using full wave analysis and compare the results to the approximate analysis using array theory ignoring mutual coupling between beams. Analysis for different beams geometries will be presented at the symposium.