Analysis of Radar Cross Section of a FSS Radome Mounted on a Cylindrical PEC body

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A radome is used to protect a microwave antenna mounted on an aircraft or a missile from their physical environments. There have been many studies to numerically or experimentally analyze the electromagnetic characteristics of radomes since the transmitted and received radar signals are affected by the radome. Recently, the stealth aircrafts have a frequency selective surface (FSS) radome to reduce radar cross section (RCS). A FSS radome can efficiently reduce the RCS over wide frequency range due to its bandpass or bandstop characteristics. Therefore, we need to analyze the RCS of the FSS radome mounted on a conductor body to understand the stealth performance of the FSS radome. In this paper, we calculate the RCS of a dielectric radome and FSS radome mounted on a cylindrical PEC body to investigate the RCS reduction in terms of the frequency and polarizations using the ray tracing technique, Huygens's principle, physical optics (PO).

As well known, the high frequency methods such as PO and physical theory of diffraction (PTD) are useful to calculate RCS of electrically large PEC structure, and the ray tracing technique and Huygens's principle can be used to analyze multi-layer radome. Let us consider a multi-layer FSS radome mounted on a cylindrical PEC body. It has three regions: dielectric layer, curved FSS, and cylindrical PEC body. We assume that an uniform plane wave is incident from the outside. The electromagnetic characteristics of the multi-layer radome are analyzed using the ray tracing technique and Huygens's principle. The intercept point of a ray and the radome surface is determined and the rays are traced using the ray tracing technique. As the ray exits the outer radome surface, we can obtain equivalent currents from the electromagnetic fields using Huygens's principle. The scattered fields are calculated from the equivalent currents at the observation point. The flat FSS that has a bandpass resonant frequency is used to analyze the curved FSS within the dielectric layers. The reflection and transmission coefficients of the flat FSS of each polarization and incident angle are given by a commercial simulator (HFSS).

An extensive analysis is performed to illustrate the RCS reduction due to the FSS radome. The computed results of the dielectric radome mounted on PEC body are compared with those of a commercial simulator (MWS of CST) to check the validity of our method. We also compare the calculation results of the FSS radome with those of the dielectric radome to understand the RCS reduction due to the FSS radome. Our computation method can be used to analyze the RCS of stealth aircrafts or ships with FSS radomes.

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