Approximative Computation Methods for Electromagnetic Scattering Reduction

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The shape of an object is often predetermined by design factors such as mechanical and aerodynamic properties. This makes electromagnetic absorbers the main candidate for radar cross section (RCS) reduction when the shape is already fixed. An electromagnetic absorber commonly consists of resonant multilayer structures of stacked dielectric materials, magnetic materials and conductive plates (E. F. Knott, et al., Radar Cross Section, 2004). Some classical absorbers are the Salisbury screen, Jaumann absorber, Dallenbach layer and circuit analog aborbers among others. When evaluating the RCS of an object with an electromagnetic absorber applied, the full structure is typically simulated in commercial numerical software. This often leads to high memory requirements and long simulation times.

Approximation methods to evaluate the RCS of an object coated with different types of absorbers are presented in this study. We introduce two methods: 1) Taking the product of the RCS of an enclosing perfectly conducting scatterer with the square of the scattering parameter of the absorber in a planar scenario, a method introduced in (D. Sjöberg, *Antennas and Propagation (EuCAP)*, 2013) and applied in (A. Ericsson et al, *Antennas and Propagation (EuCAP)*, 2016). 2) Analyzing the RCS of the object with a physical optics (PO) implementation, and treating the absorber as an angle of incidence dependent surface impedance applied to the scatterer.

Different canonical scatterers are investigated, such as a cylinder with a spherical cap, see the RCS results in Figure 1, and a conical scatterer. The strengths and weaknesses of the two approximation methods are evaluated in detail for different types of electromagnetic absorbers. Good agreement between the approximation methods and full wave simulations of the RCS is observed for specular reflections. However, certain features such as sharp edges are not completely accounted for by the methods. In general, PO is an efficient method for high frequency problems, but does not account for scattering from the "shadow zone" of the object. The alternative method yields better agreement for lower frequencies, but requires a full wave simulation of the enclosing PEC scatterer.

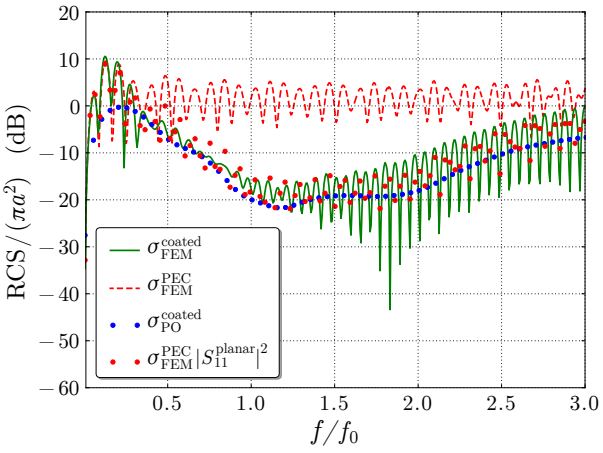

Figure 1: Normalized RCS of an object with a dielectric bulk absorber, calculated using different methods.