ANALYTICAL FORMULAS TO COMPUTE NEAR-FIELD MONOSTATIC RCS IN HIGH-FREQUENCIES

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Radar Cross Section (RCS) is most of the time defined in the far-field zone. In that case, RCS is independent of the range R between the radar and the target. Below the Fraunhofer limit, the RCS depends on R and needs to be evaluated versus this parameter. For example, in many operational military scenarios, it can be essential to deal with the scattered near-field by a target. Also, measurements in anechoic chambers, when the wave illumination is spherical, need to take into account this correction. Starting from Stratton-Chu integral equations simplified thanks to Physical Optics (PO) approximation and using a near-field RCS definition, this communication presents high frequency analytical formulas to calculate monostatic RCS of perfectly-conducting flat circular and square plates, when these objects are observed in near-field for normal and oblique incidences. Two approaches are developed to evaluate the PO integral: The stationary phase approximation (SPA), which leads to simple and accurate formulas limited to describe the RCS main lobe (normal incidence), and a direct analytical integration. This latter allows expressing near-field RCS as function of the Fresnel integrals for a rectangular plate, and as function of the Bessel functions for a circular plate. Considering a PEC square plate of side 1m at 15 GHz, Fig. 1 compares its near-field RCS versus the incidence angle, calculated at a range of 5m from the PO integral and the analytical formula obtained from the Fresnel integrals. Fig. 2 compares its near field RCS versus the range R, computed at normal incidence from the PO integral and analytical formula resulting from the SPA.

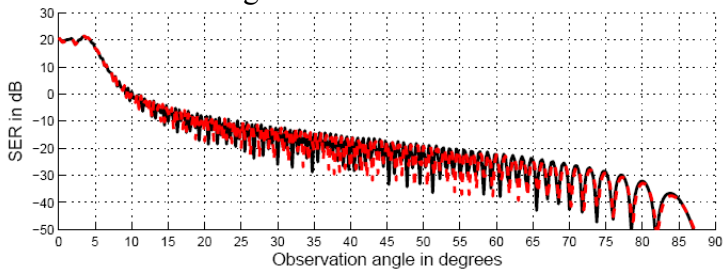

Figure 1: RCS of the square plate at 5m versus incidence angle.

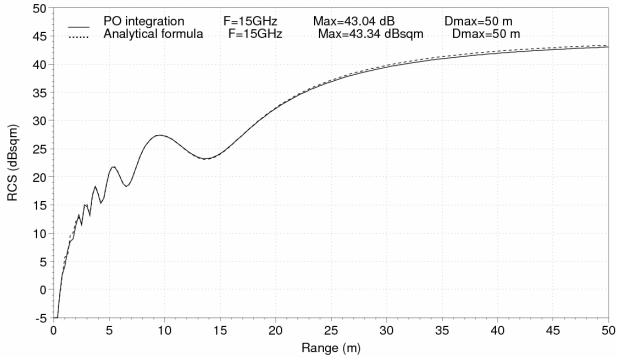

Figure 2: RCS of the square plate at normal incidence versus range.