Comparing Different Numerical Methods for RCS Prediction of a Realistic Electrically Large Complex Airframe with Measured Data

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Radar Cross Section (RCS) plays a significant role in radar design and modern electronic warfare. Important radar research fields like Non-Cooperative Target Recognition (NCTR) exploit the RCS signature of a target for identification. Different computational electromagnetic (CEM) techniques can be used to predict the RCS of targets. This paper investigates the accuracy and efficiency with which various asymptotic and full wave numerical methods can predict the RCS of a realistic, electrically large, complex airframe, validated against measured data.

Numerous studies are available in the literature comparing the measured and simulated RCS of canonical structures and targets constructed from simple canonical structures. Recently a study compared the measured and simulated data of a relatively large (total length of 21λ) Boeing 777 scale model. A commercially available CAD model of the Boeing 777 was used with the CADRCS software package, which implements Physical Optics (PO) combined with ray-tracing and shadowing to predict the RCS (I. M. Martin, M. A. Alves, G. G. Peixoto and M. C. Rezende, *Piers online,* vol. 5, no. 4, pp. 377-380, 2009). In (J. C. Smit, J. E. Cilliers and E. H. Burger, *IET International Conference on Radar Systems*, Glasgow, 2012) three different electrically large targets were analysed (a trihedral corner reflector, a generic cruise missile and a Cessna 172 model) using Multilevel Fast Multipole Method (MLFMM) and PO with Shooting and Bouncing Rays (SBR).

In this paper a realistic conducting scale model (1:25) of a Boeing 707 with a total length ranging between 30λ and 70λ was analysed. Instead of representing the target as a composition of simple canonical structures or using a commercial CAD model, a very accurate 3D CAD model was created by laser scanning the scale model. Different CEM methods, using three software packages, were used to predict the RCS of the target viz., PO with SBR using SigmaHat, MLFMM using FEKO and CST and Method of Moments (MoM) with Higher Order Basis Functions (HOBF) using FEKO. The simulated data are validated against measured RCS data of the scale model, obtained in the Compact Range at the University of Pretoria, South Africa. The scale model in the Compact Range, and typical measured and simulated RCS results at 2 GHz are shown in Figure 1 and Figure 2, respectively.

Figure 1: Scale model of Boeing in the Compact Range.

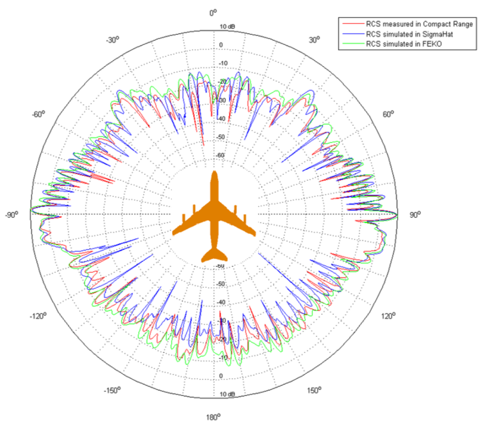

Figure 2: Typical results comparing simulated and measured data.