Fast Radar Cross Section Computation by Using Iterative Physical Optics Method in Conjunction with Adaptive Model Based Parameter Estimation

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Iterative Physical Optics (IPO) method has been used to predict Radar Cross Section (RCS) and antenna patterns associated with large platforms (R. J. Burkholder, Ç. Tokgöz, C. J. Reddy and P. H. Pathak, *IEEE-APS Intl. Symposium Digest*, 2005). Efficiency of the IPO method has been improved by using the fast far field approximation (R. J. Burkholder, *ACES Journal*, 16, 53-60, Mar. 2001), forward-backward iteration (R. J. Burkholder and T. Lundin, *IEEE Trans. Antennas Propagat.*, 53, 793-799, Feb. 2005) and parallelization with Message Passing Interface. In this study, efficiency of the IPO method in computing the RCS of large platforms is further improved by adaptive application of Model Based Parameter Estimation (MBPE). First, an RCS pattern for an interval of frequency or scattering angle is interpolated by using a simple ratio of polynomials. Accuracy of the interpolation is checked in the middle of the interval against the results of the IPO method without MBPE. The process is adaptively repeated by dividing the intervals, where sufficient accuracy is not obtained, into two subintervals, applying MBPE and checking the accuracy of the interpolation in the middle of each subinterval. The process is terminated when sufficient accuracy is obtained in the middle of all subintervals. Once polynomial coefficients of the MBPE interpolation are determined for a frequency or angle interval, they can be used to generate an RCS pattern with any frequency or angle increment in that interval without requiring additional CPU time. Therefore, CPU time saving with MBPE increases as the desired frequency or angle increment in the RCS pattern decreases. Numerical results were generated for the RCS of a tilted trihedral with and without MBPE. These results revealed that 10 times speed up can be achieved with MBPE when the RCS of this target is computed with 1 MHz frequency increment or 0.1° angle increment around 3 GHz. Application of the IPO method in conjunction with the adaptive MBPE for computing the RCS of large platforms will be described and numerical results for some benchmark targets will be presented to demonstrate the improvement in computational efficiency with MBPE.