# Comparison of WIPL-DP Calculations with EMCC and NRL Measured Data

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**Abstract:** The parallel version of WIPL-D has been used to predict scattering from a series of simple shapes for which measured scattering data exists for comparison. Where possible, the comparisons are augmented with the results of predictions made with other computer codes, including the serial version of WIPL-D run on a desktop personal computer. The focus of this exercise was to quantify the accuracy and convergence properties of the parallel version of WIPL-D while measuring the computational advantage obtained by using the higher-order basis functions employed in WIPL-D.

**Keywords:** WIPL-D, Method of Moments, RCS, EMCC, HPC, CHSSI

## 1. Introduction

The electromagnetic analysis tool WIPL-D [1] exists in commercial and professional versions, plus a parallel version that is being developed under CHSSI guidance. A preliminary version of the CHSSI version was used here to compute scattering from a series of EMCC benchmark cases that were reported on in 2001[2]. The data available from the EMCC benchmark report consists of measured scattering data for a series of simple shapes over a range of frequencies. Electrically, the test cases range from small to very large.

## 2. Numerical Results

The first test article is a simple cube, with edge length of 1 meter, constructed of aluminum and modeled as a PEC surface. Measured monostatic RCSs for 432, 1300 and 9200 MHz exist for both polarizations. In Figures 1 and 2 are shown the measured RCS compared with predictions using the WIPL-D code. The RCS, both measured and computed, exhibited enough symmetry so that only ¼ of the pattern needed to be shown for comparison. WIPL-D was used with both the default settings for integration accuracy and current expansion, and enhanced values of these parameters. At 432 MHz the default problem generated 300 current unknowns, whereas the enhanced (current = 1, integration = 2), resulted in 588 current unknowns, and for this simple problem the agreement between WIPL and measured RCS is apparent. At 1300 MHz, WIPL-D needed 2700 current unknowns for the default current expansion solution.

 

The second test article is right metal prism, with triangular faces that have interior angles of 20, 40 and 120 degrees. The sides are 30.48 cm high and the longest edge is 2.4 meters. WIPL-D required 358 and 2620 current unknowns at 432 and 1300 MHz, respectively. The results shown here are for an elevation angle of 0°. The measured RCS is saturated, as pointed out in [2] for 1300 MHz, in Figure 4. Note that, in the 0-30° azimuth sector in Figure 4(a), increasing the integration accuracy improved the WIPL-D results relative to the measured RCS. This sector is important because the test article was constructed specifically to investigate the traveling wave returns at near grazing incidence angles on this fixture.

## 3. Conclusions

Presented here are the initial results of using the CHSSI version of WIPL-D for monostatic scattering calculations based on two of the simple EMCC benchmark cases. The results have been good, and this work will continue with the application of WIPL-D to electrically larger and more complex benchmark cases utilizing symmetry, dielectrics and antenna radiation and coupling.

## References

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[2] A. Greenwood, "Electromagnetic Code Consortium Benchmarks," Air Force Research Laboratory, Kirtland Air Force Base, New Mexico, APRL-DE-TR-2001-1086, December, 2001.

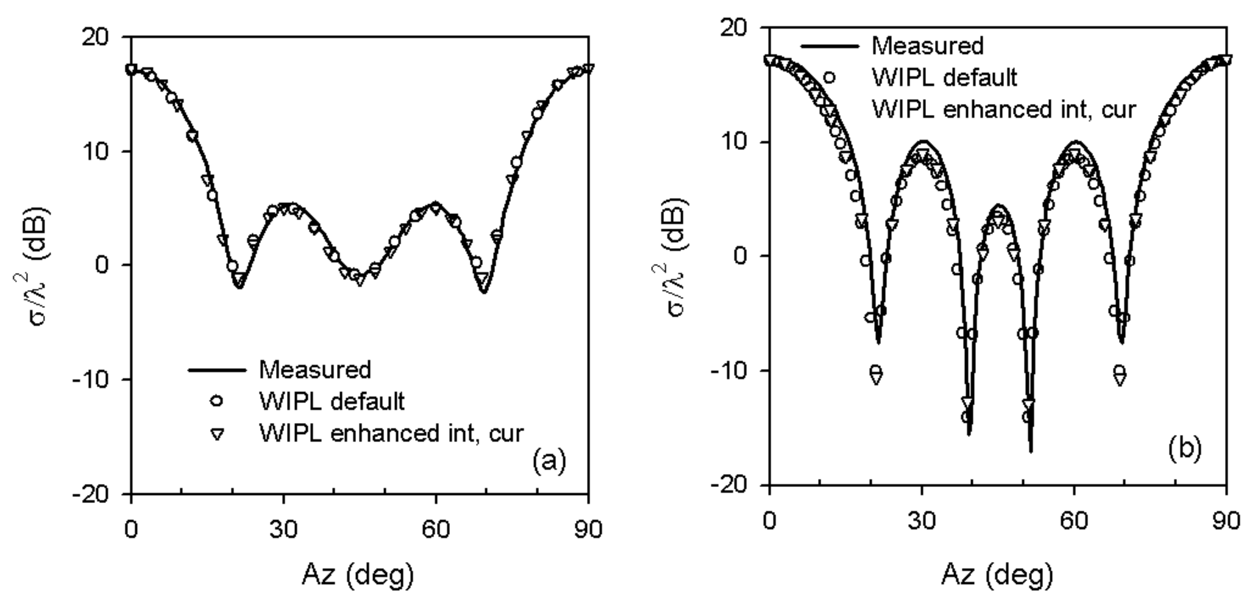


Figure 1. Measured and computed RCS of a 1 meter metal cube at 432 MHz, (a) VV, (b) HH polarization.

 

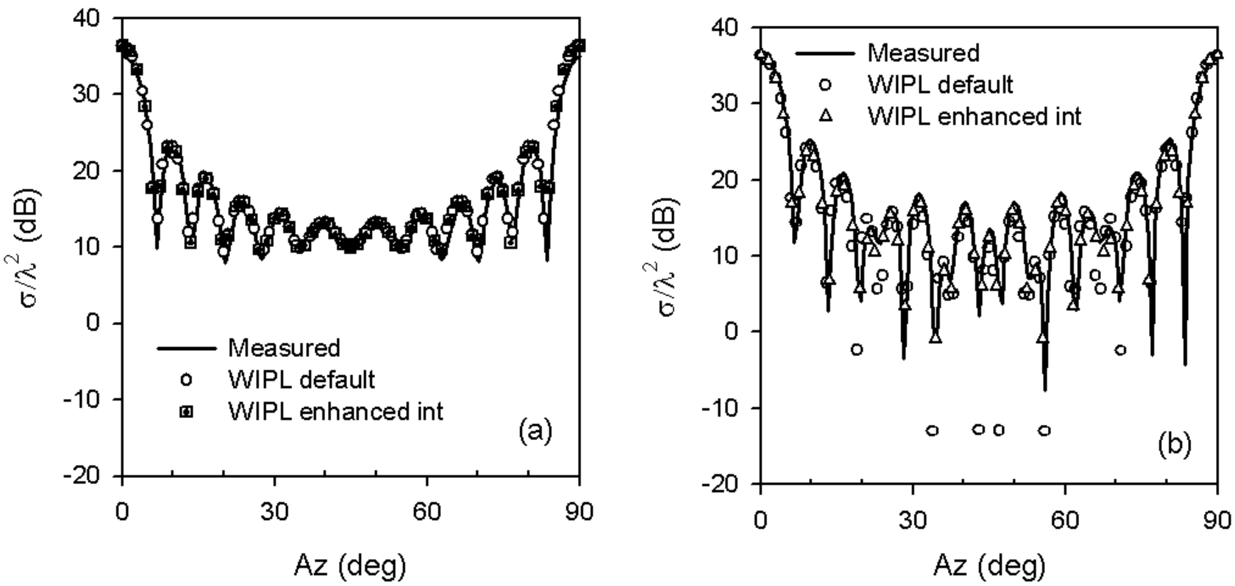


Figure 2. Measured and computed RCS of a 1 meter metal cube at 1300 MHz, (a) VV, (b) HH polarization.

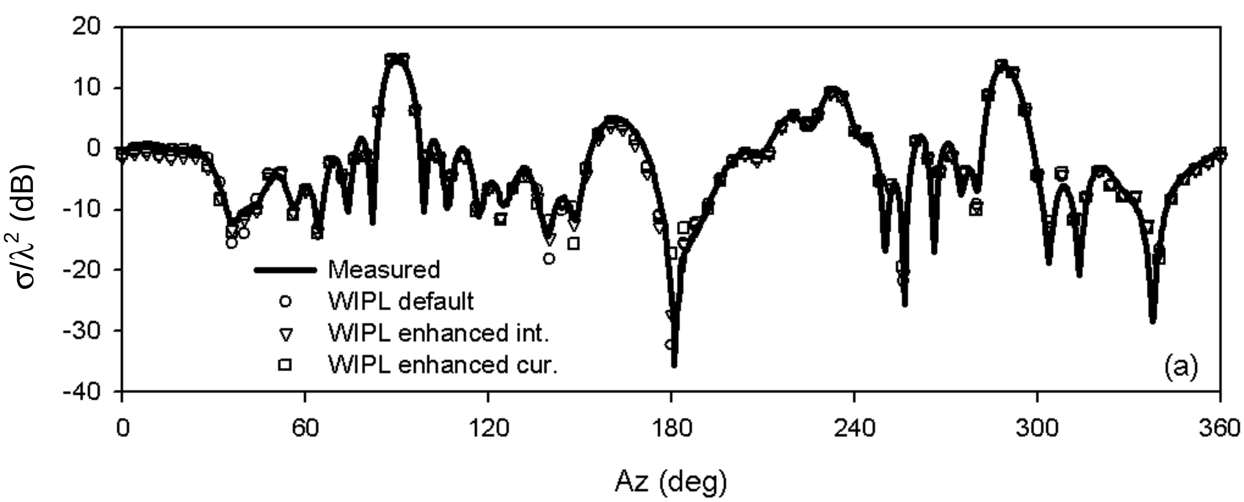


Figure 3. (a) Measured and computed RCS of Prism at 432 MHz, HH polarization. The large returns at 90° and near 290° are specular returns from the large faces, the large lobe near 170° is a traveling wave return.

 

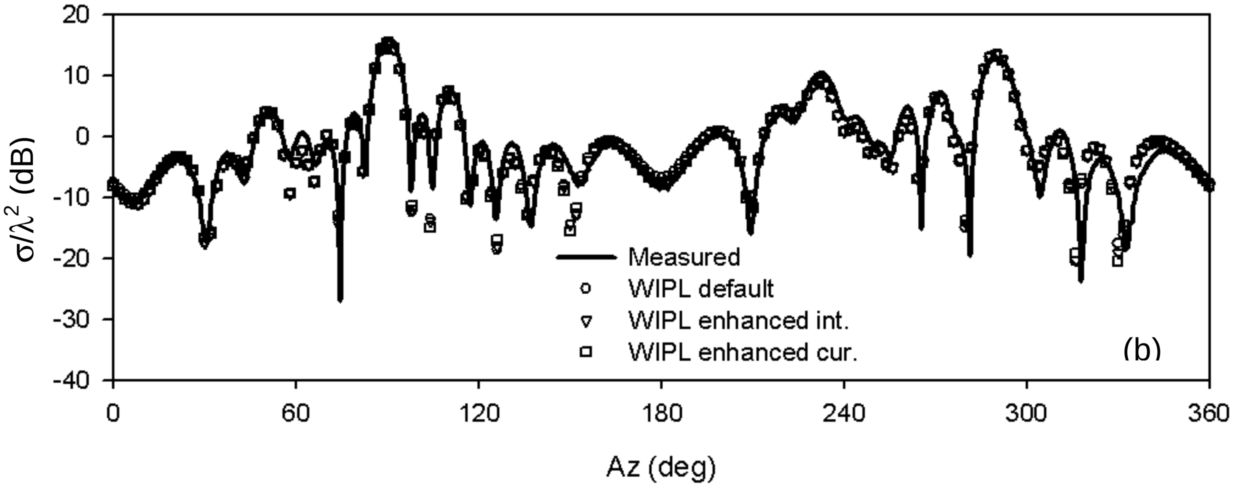


Figure 3. (b) Measured and computed RCS of the prism at 432 MHz, VV polarization.

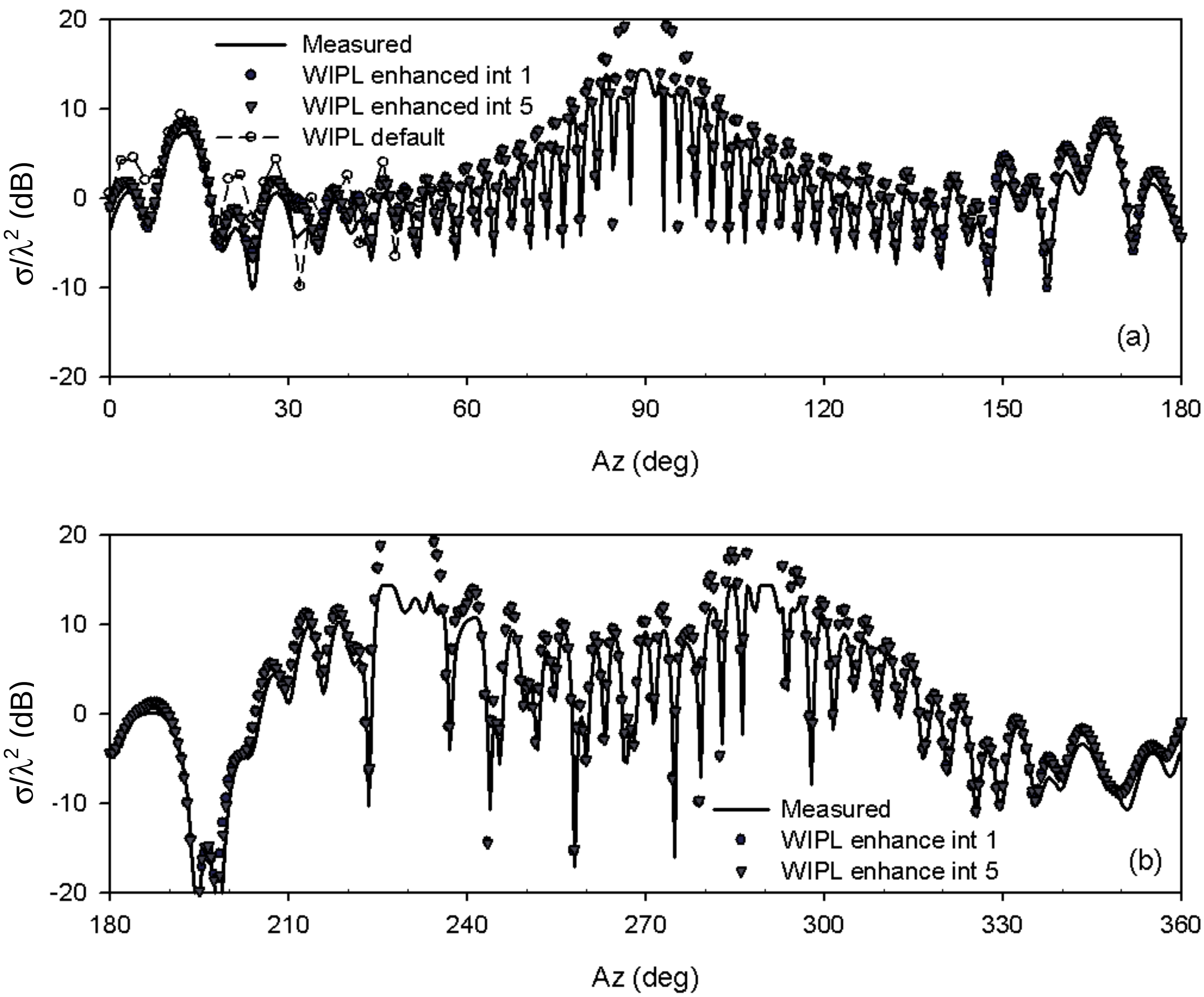


Figure 4. Measured and computed RCS for the prism, 1300 MHz, HH polarization;
(a) 0-180°, (b) 180-360°.

 