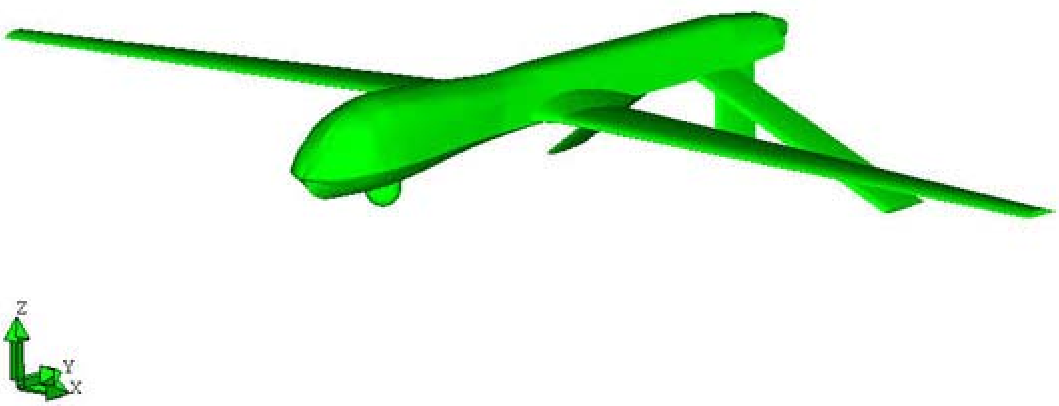
RCS SIMULATION OF THE PREDATOR UAV WITH EFIELD® MLFMM

Dimensions are:

- Length: 8.45 m
- Wing span: 15 m
- Height: 2.1 m



Aircraft model

Simulation

RCS results were computed for both monostatic and bistatic RCS.

Bistatic RCS:

- Frequency 1 GHz and 3 GHz
- Plane wave excitation at the front for θ = 90 degrees and φ = 270 degrees
- Bistatic RCS in the x-y plane for θ = 90 degrees and φ = 180 to 270 degrees
- Polarizations: VV (θθ) VH (θφ), HH(φφ) and HV(φθ)

Monostatic RCS:

- Frequency 3 GHz
- Monostatic RCS in the x-y plane for θ = 90 degrees and φ = 270 to 330 degrees with one degree step
- Polarizations: VV (θθ) VH (θφ), HH(φφ) and HV(φθ)
- Frequency 10 GHz (PO only)
- Monostatic RCS in the x-y plane for θ = 90 degrees and φ = 0 to 360 degrees with one degree step
- Polarizations: VV (θθ) VH (θφ), HH(φφ) and HV(φθ)

The problem was solved using the Efield parallelized MLFMM (Multi Level Fast Multipole Method) and PO (Physical Optics) solvers. For the MLFMM simulations a Combined Field Integral Equation (CFIE) was used to speed up the convergence. The CFIE is given as a linear combination of the EFIE and the MFIE according to

CFIE = α EFIE + (1- α) MFIE

The simulation was run on 4 processor on an AMD Dual Core Opteron 285 2.6 GHz with 16 Gb memory. In Table 1 and Table 2 model and simulation data is given for the bistatic and monostatic RCS computations using Efield MLFMM solver and in Table 3 for the monostatic RCS computation using Efield PO solver.

In Figure 1 to Figure 4 bistatic RCS results at 1 and 3 GHz obtained with Efield MLFMM are shown. In Figure 5 and Figure 6 monostatic RCS results at 3 GHz obtained with Efield MLFMM and Efield PO are shown. In Figure 7 the surface currents at 3GHz is shown. In Figure 8 the monostatic RCS results at 10 GHz obtained with Efield PO are shown and in Figure 9 the surface currents for plan wave excitation at the nose with vertical polarization are shown.

Table 1: Model and simulation data for the bistatic RCS computations with Efield MLFMM.

Frequency	Number of unknowns	Number of elements	CFIE alpha	Number of iterations	Memory	Time init (hours)	Time solve (hours)	Time total (hours)
1GHz	321259	214198	0.8	39/42	4.0Gb	0.34	0.08	0.42
1GHz	321259	214198	0.2	17/20	4.0Gb	0.34	0.04	0.38
3GHz	1309379	872970	0.8	175/148	10.0Gb	0.69	2.67	3.36
3GHz	1309379	872970	0.2	22/22	10.0Gb	0.72	0.39	1.11

Table 2: Model and simulation data for the monostatic RCS computations with Efield MLFMM.

Frequency	Number of unknowns	Number of elements	CFIE alpha	Time init (hours)	Time solve (hours)	Time solve per RHS(hours)	Time total (hours)
3GHz	1309379	872970	0.2	0.94	34.32	0.28	35.26

Table 3: Model and simulation data for the monostatic RCS computations with Efield PO.

Frequency	Number of unknowns	Number of elements	Time total (hours)
3GHz	1309379	872970	0.3
10GHz	13489101	-	0.78

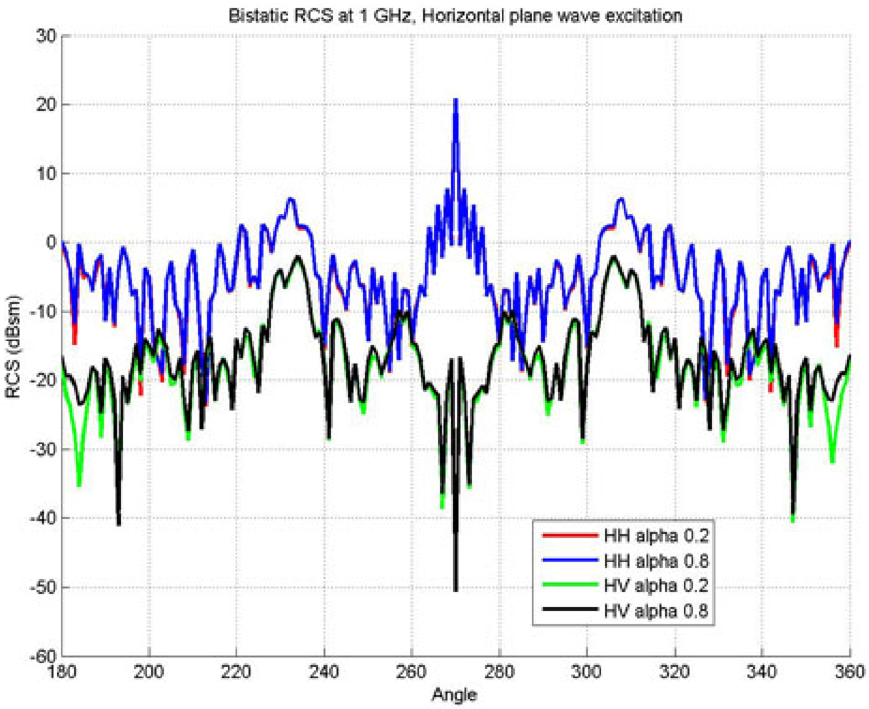


Figure 1: Bistatic RCS at 1GHz. Polarization **φφ**

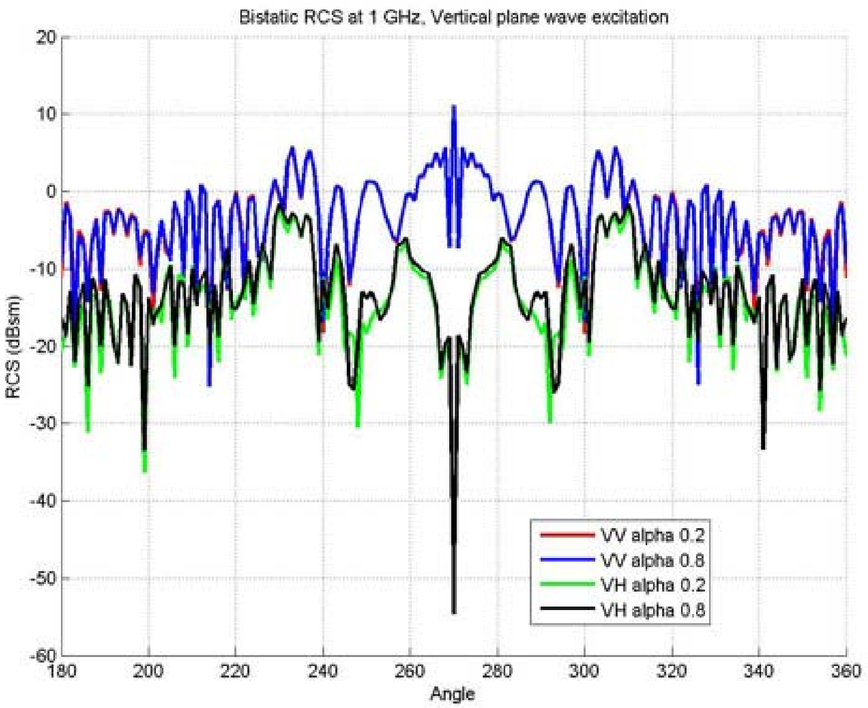


Figure 2: Bistatic RCS at 1GHz. Polarization **θθ**

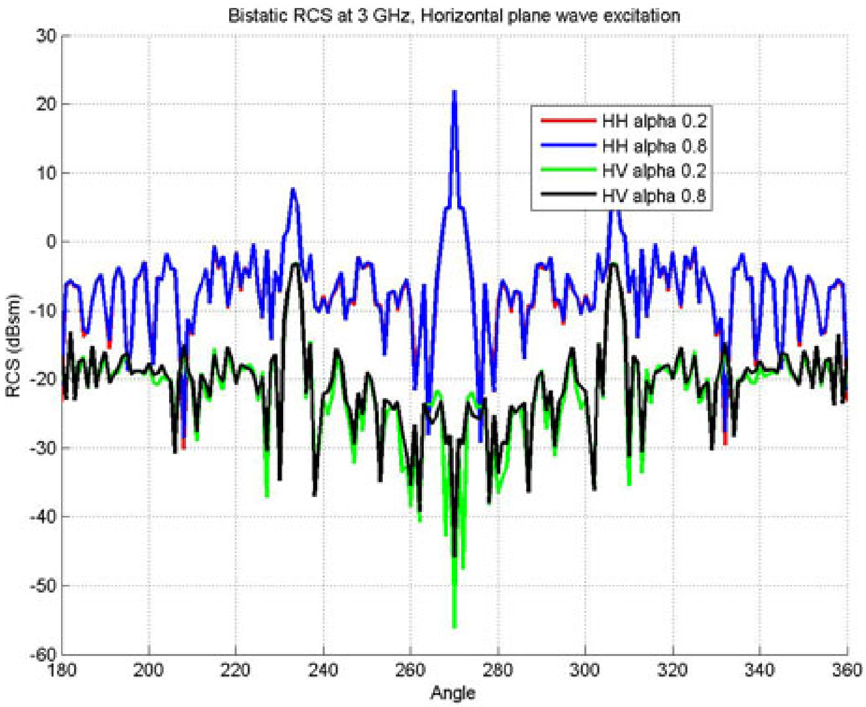


Figure 3: Bistatic RCS at 3GHz. Polarization φφ

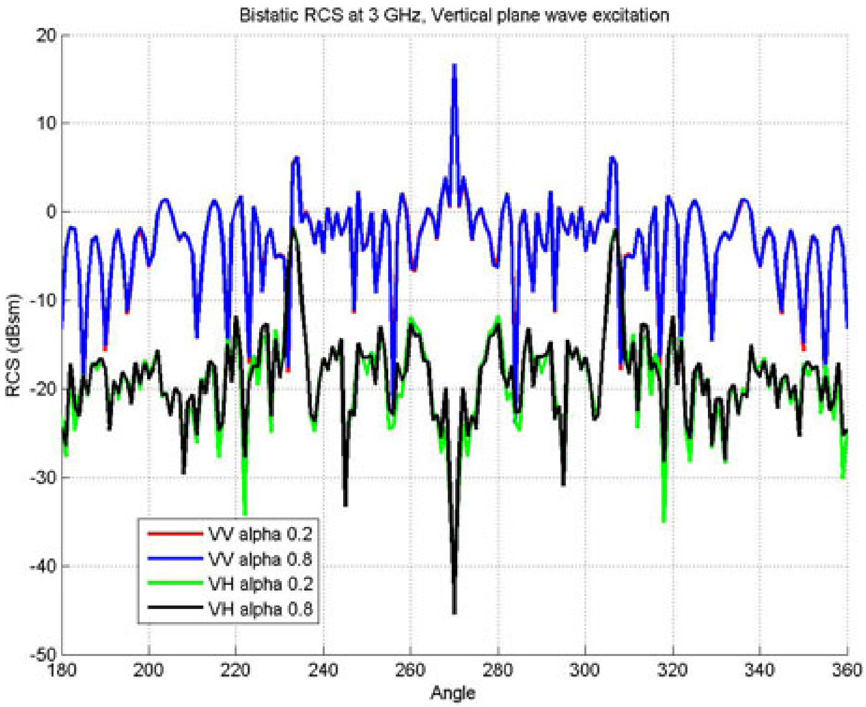


Figure 4: Bistatic RCS at 3GHz. Polarization θθ

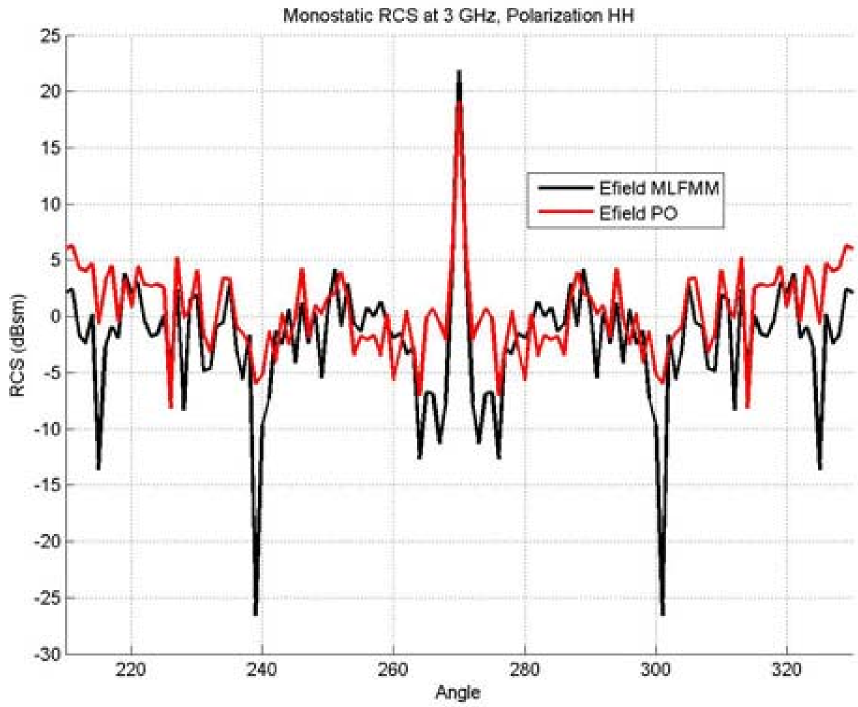


Figure 5: Monostatic RCS at 3GHz. Polarization HH. Comparison of Efield MLFMM, and the Efield PO.

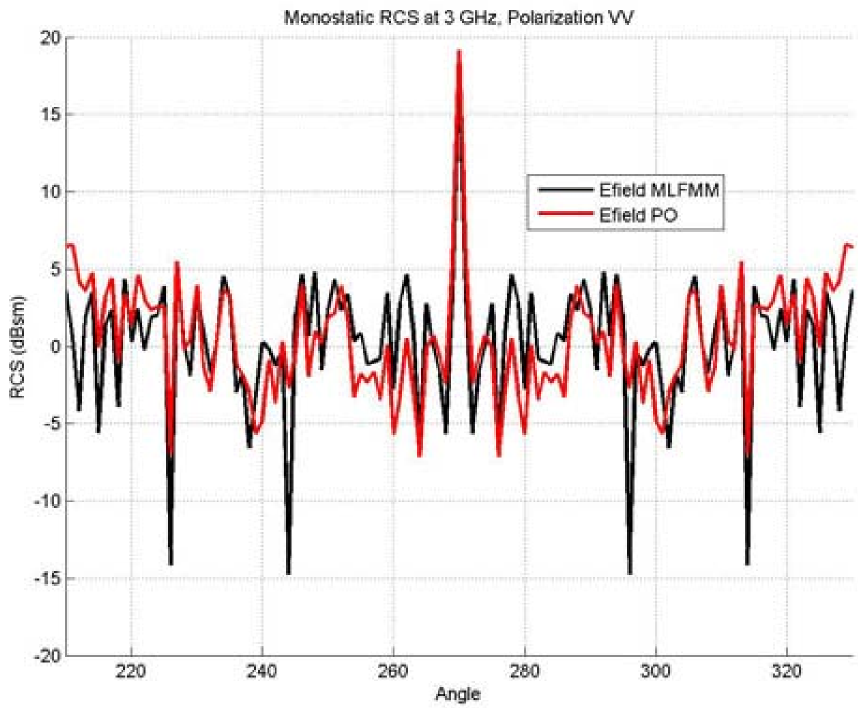


Figure 6: Monostatic RCS at 3GHz. Polarization VV. Comparison of Efield MLFMM, and the Efield PO.

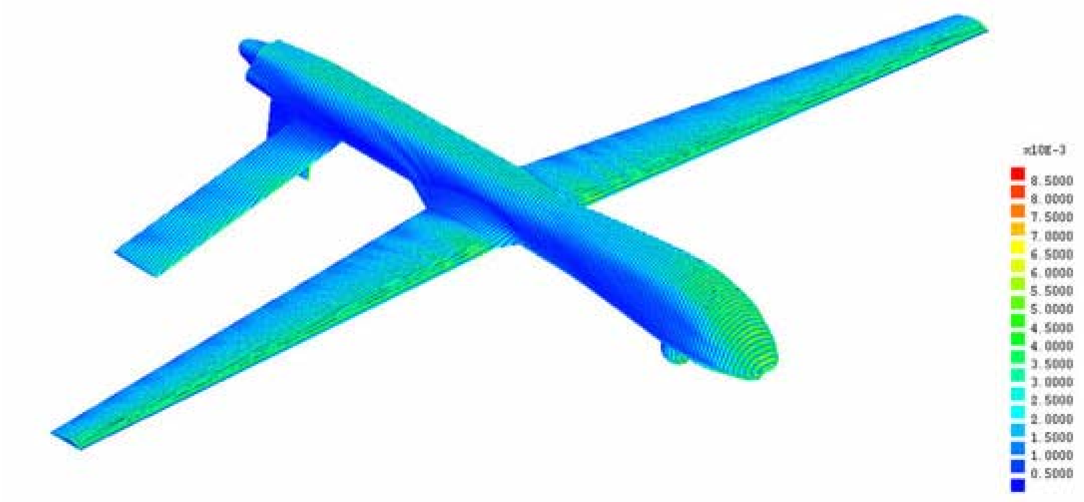


Figure 7: Surface currents for plane wave excitation with horizontal polarization at 3 GHz.

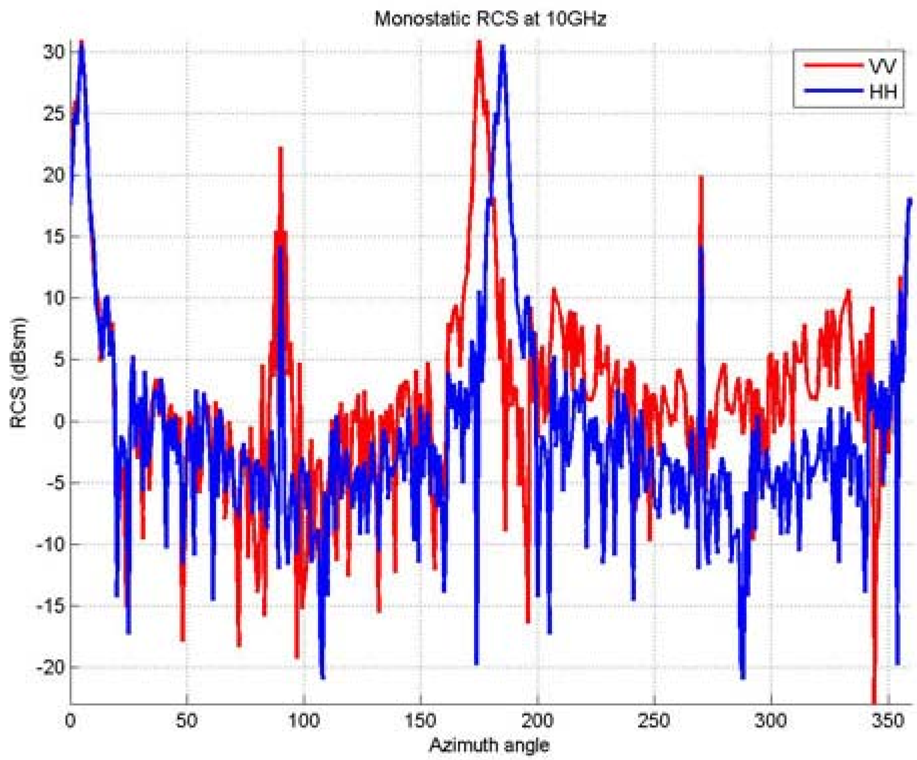


Figure 9: Surface currents for plane wave excitation with vertical polarization at 10 GHz.

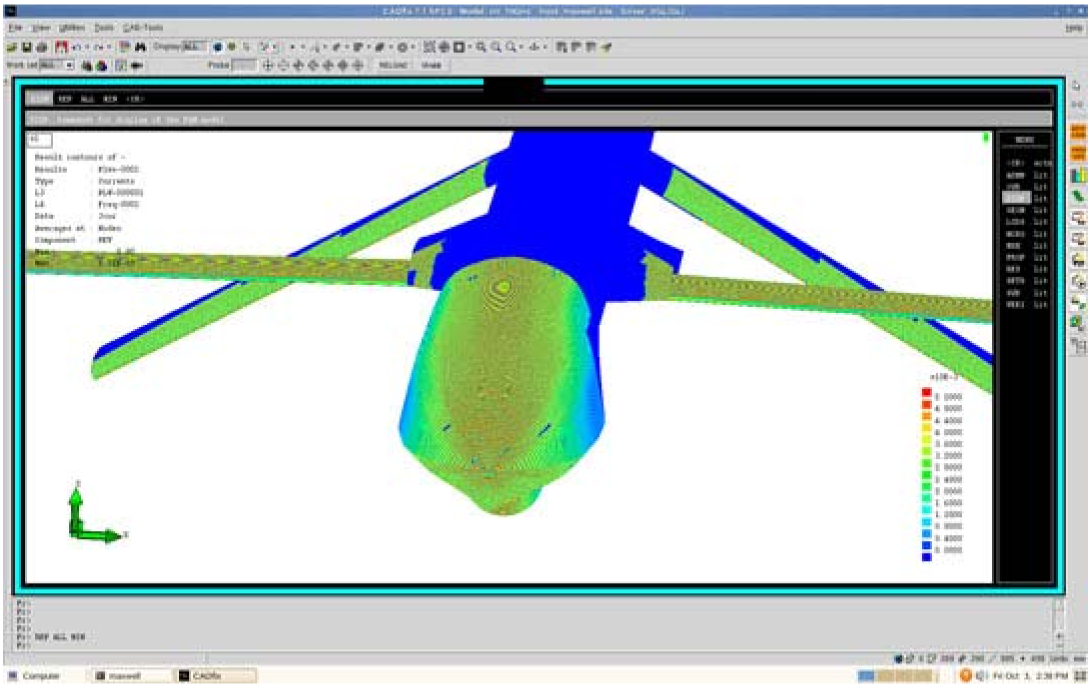


Figure 10: Surface currents for plane wave excitation with vertical polarization at 10 GHz.

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