REFLECTOR ANTENNA DESIGN WITH EFIELD® MLFMM AND MLFMM-PO

Efield® provides powerful tools for reflector antenna design. This example shows how to simulate a horizontal polarized L-Band Cassegrain reflector antenna for a satellite application using efield® MLFMM and MLFMM-PO solvers. The example shows the reduction in computational time that is achieved using the Efield MLFMM-PO solver for reflector antenna analysis. At the current date Efield is the only commercial software with a MLFMM-PO solver.

Geometry creation

The efield® macro tool was used for creating all shapes and surfaces in this example.

Antenna configuration	
Description	Parameter Value[m]
Diameter of the main reflector in azimuth	7.5
Diameter of the main reflector in elevation	5.0
Diameter of the sub reflector in azimuth	1.005
Diameter of the sub reflector in elevation	0.67
Focal length of main reflector	2.3
Focal length of sub reflector	0.625
Apex length of sub reflector	0.347

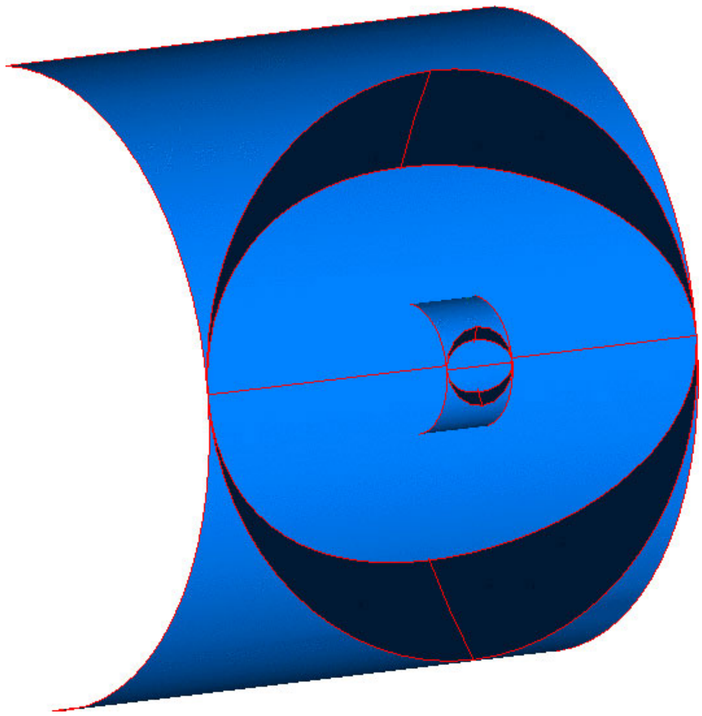

Figure 1: The starting geometrical structure generated by macros

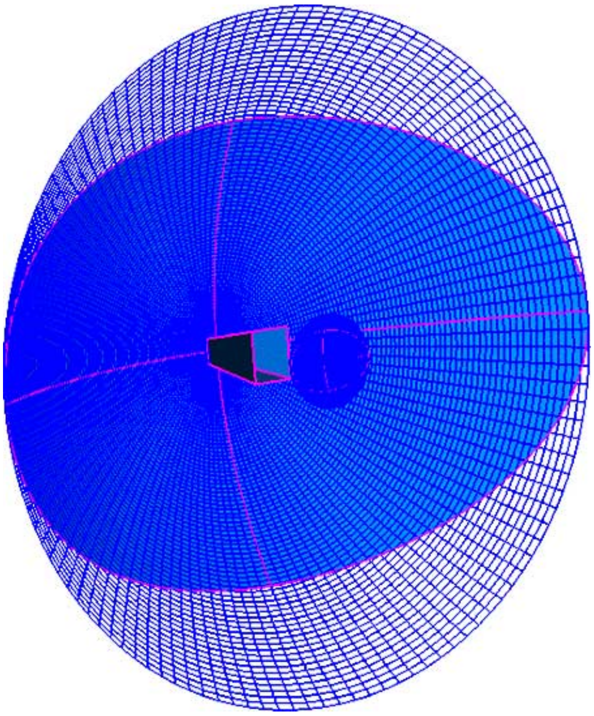

Figure 2: Surfaces and shapes

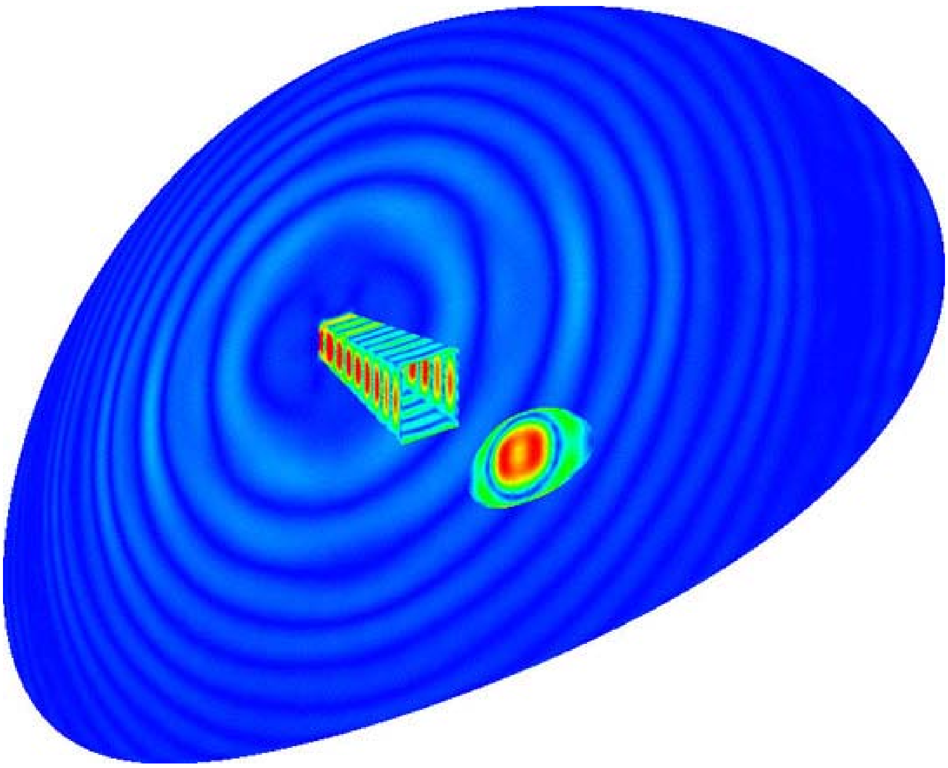

Figure 3: Surface currents on a Cassegrain antenna simulated with efield® MLFMM.

Simulation

The directivity at 1.3 GHz in the E-plane and H-plane was computed using MLFMM and MLFMM-PO. In total 2 x 361 far field angles vas computed. A waveguide mode port was used to excite the TE_{10} mode. In both MLFMM and MLFMM-PO the EFIE integral formulation with a SPAI preconditioner was used. The problem was solved to a residual of 10^{-3} in both the MLFMM and MLFMM-PO simulations. The total number of unknowns was 154 665. In the MLFMM-PO simulation these unknowns was decomposed into 141 139 PO and 13 526 MLFMM unknowns. The MLFMM was used for the horn and the sub reflector and PO for the main reflector as can be seen in Figure 4.

The resulting directivity in the E-plane and H-plane can be seen in Figure 5 and 6. As can be seen the accuracy of the MLFMM-PO simulation is very good.

MLFMM Simulation data:

- Convergence in 104 iterations
- Simulation time 1115 seconds
- Run on one core of an AMD Dual Core Opteron 285 2.6 GHz with 16 Gb memory

MLFMM-PO Simulation data:

- Convergence in 5 MLFMM-PO iterations
- Simulation time 307 seconds
- Run on one core of an AMD Dual Core Opteron 285 2.6 GHz with 16 Gb memory

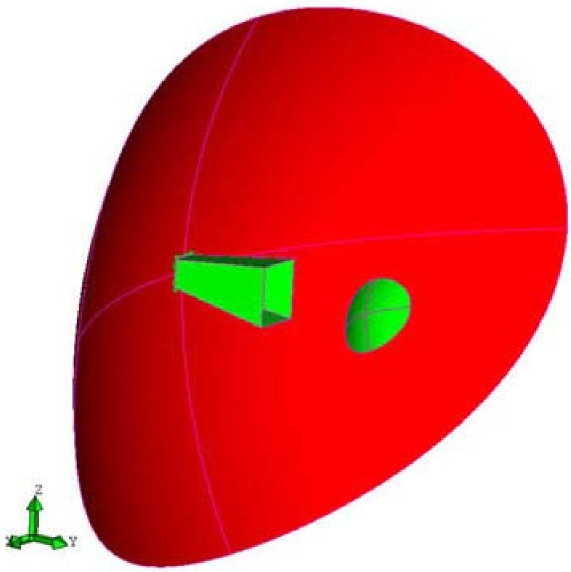

Figure 4: MLFMM-PO decomposition

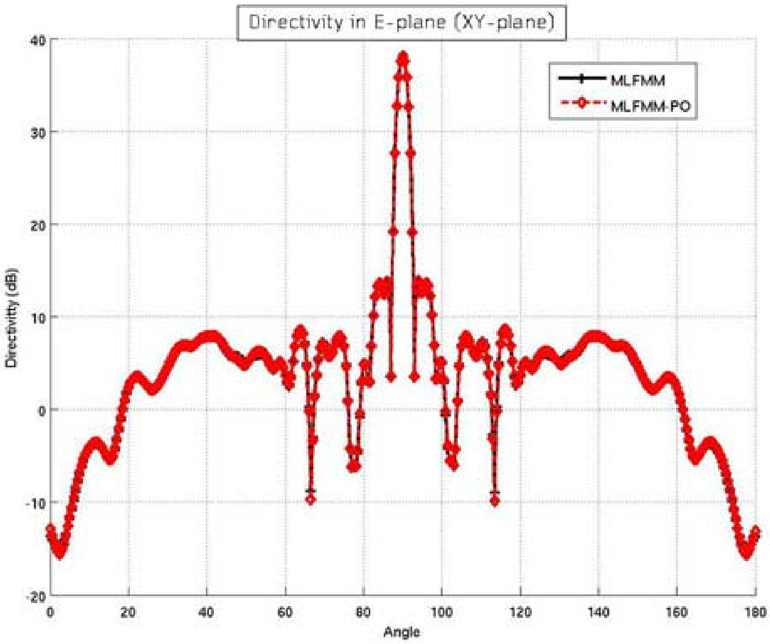

Figure 5: Directivity E-plane

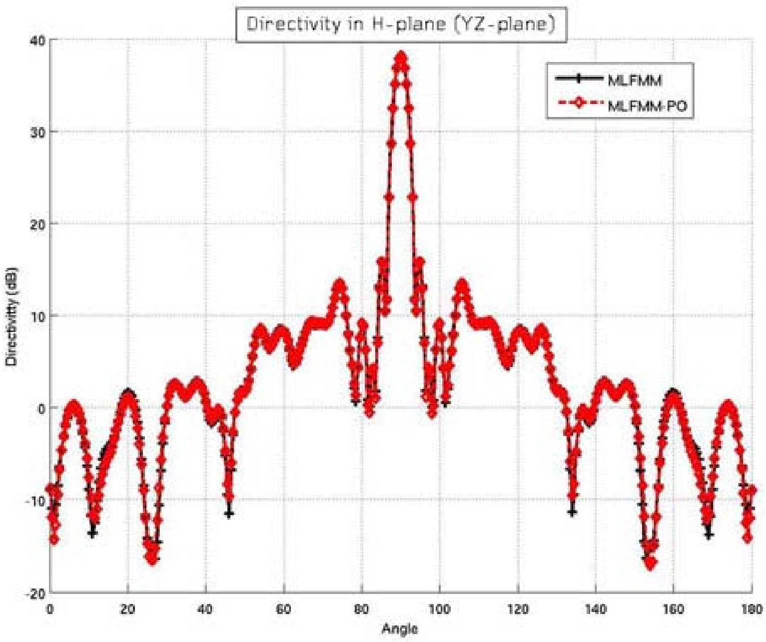

Figure 6: Directivity H-plane

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