Compact Multi-band Antenna for Wireless Applications

The aim of this application note is to demonstrate the possibilities of WIPL-D Pro 3D EM Solver regarding simulation of complex printed antennas in a wide-band. Also, the aim is to illustrate the simplicity of creating models of this type of antennas in the specialized tool, AW Modeler. The software takes into account the influence of a finite-size ground plane backing the antenna. The antenna is simulated in the frequency range between 0.5 and 3 GHz and is modeled as being printed on a dielectric substrate with ε_r = 4.4 and thickness of 1.6 mm.

Antenna Model

The antenna is fully modeled using **AW Modeler**, an add-on tool for easy general 3D EM modeling and quadrilateral meshing. To obtain satisfactory results for printed structures techniques like edging and total imaging have to be applied. Total imaging, otherwise a lengthy process, is performed automatically by AW Modeler.

The model (Fig. 1) is made according to specifications from the Microwave Journal published in May 2008 [1]. Final dimensions are used, listed in Table 1 in [1] and repeated here for clarity in Tab.1.

The complete process of fully-parametric model creation and transfer to WIPL-D Pro lasts a bit more than one hour.

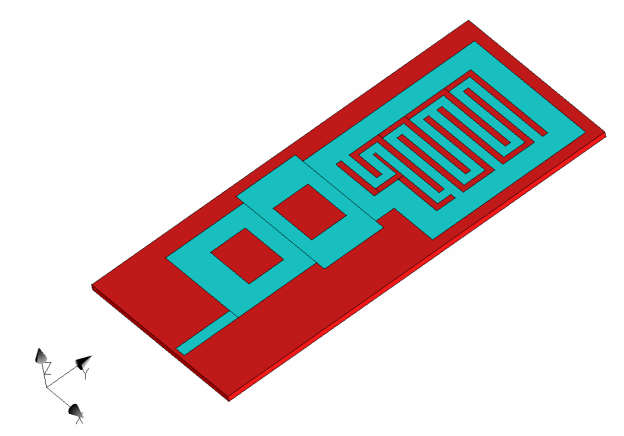

Figure 1. Antenna with finite ground plane

Table 1. Antenna dimensions in mm, according to [1]

xf	0	Wf	3
W1	6	W2	13.5
W3	2.75	W4	13.5
L1	8	L2	10
L3	17	L4	5.5
M	2.3	S	1.5

Final WIPL-D model is obtained after performing export from AW Modeler, with Total Imaging enabled for the meshing stage (Fig. 2).

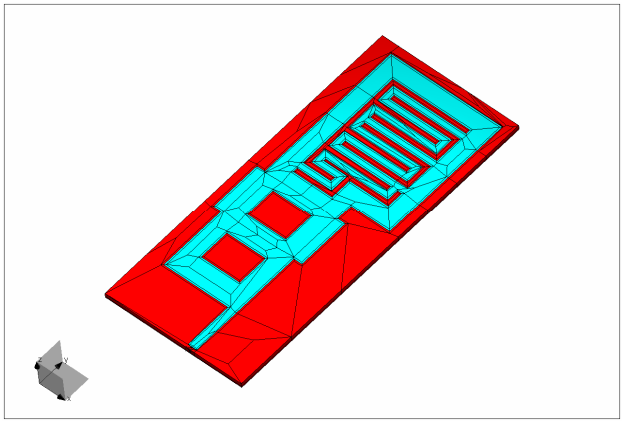

Figure 2. WIPL-D model

Simulation of Antenna

The created antenna model was simulated using WIPL-D Pro v6.4. The S11 parameter is ploted in the frequency range from 0.5 to 3 GHz (Fig. 3). The observed resonances were identified with simulation and measurements [1] as in Tab. 2. Corresponding radiation patterns were obtained for the operating frequencies of f=0.9 GHz (Figs. 4 and 5), f=1.9 GHz (Figs. 6 and 7), and f=2.4 GHz (Figs. 8 and 9).

Table 2. Simulated and measured [1] resonances

sim	0.89	1.09	1.32	1.38	1.66	1.8	1.92	2.13	2.4	2.63
meas	0.89	1.09	1.32	1.38	1.66	1.8	1.91	2.15	2.4	2.61

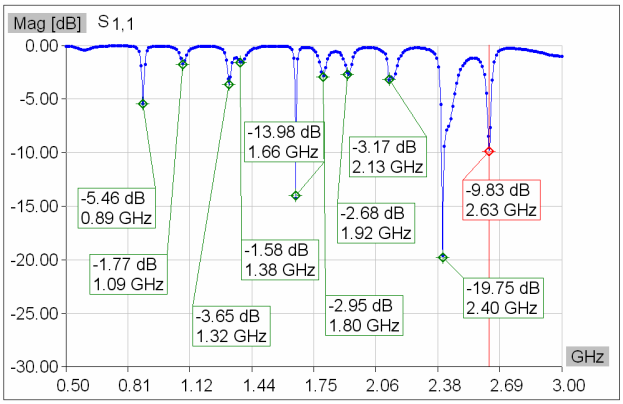

Figure 3. S11 parameter (0.5-3 GHz)

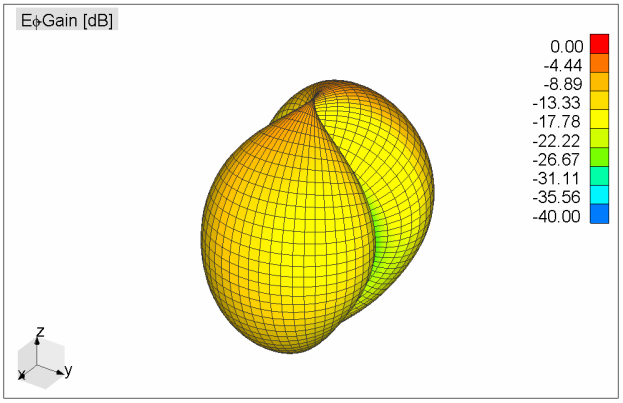

Figure 4. Eφ – 3D diagram at 0.9 GHz

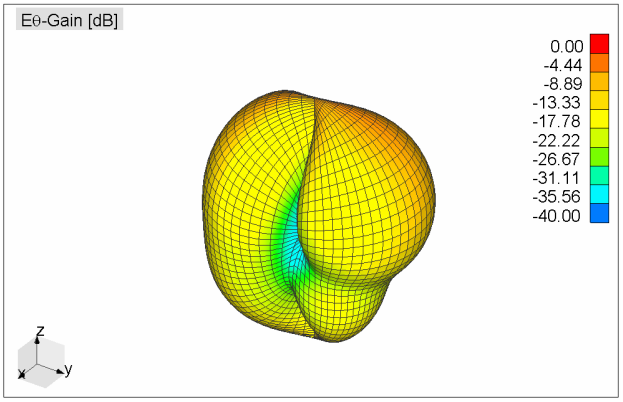

Figure 5. Eθ – 3D diagram at 0.9 GHz

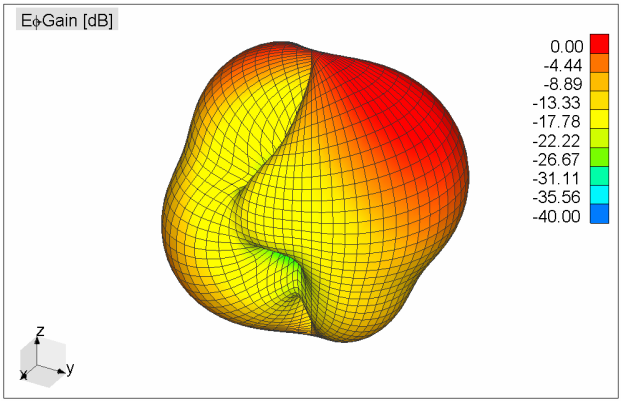

Figure 6. Eφ – 3D diagram at 1.9 GHz

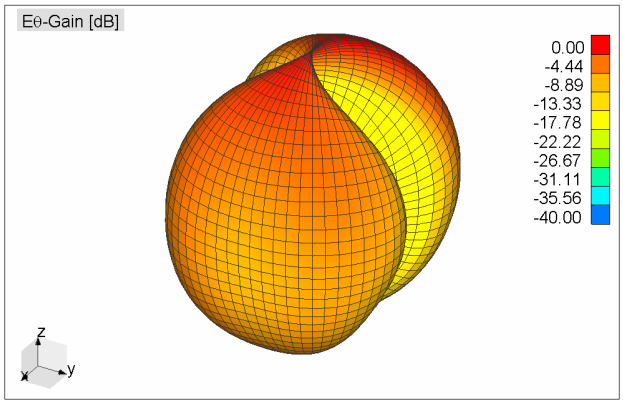

Figure 7. Eθ – 3D diagram at 1.9 GHz

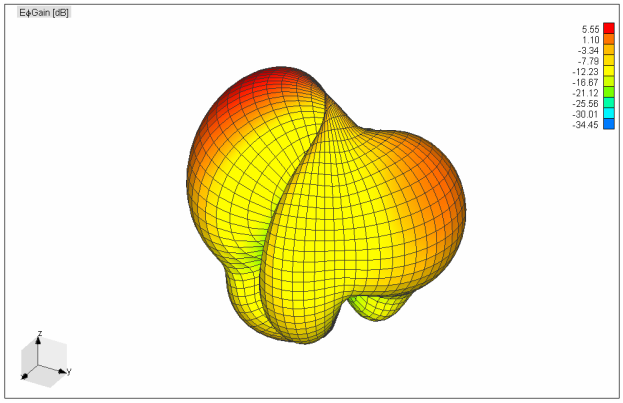

Figure 8. Eφ – 3D diagram at 2.4 GHz

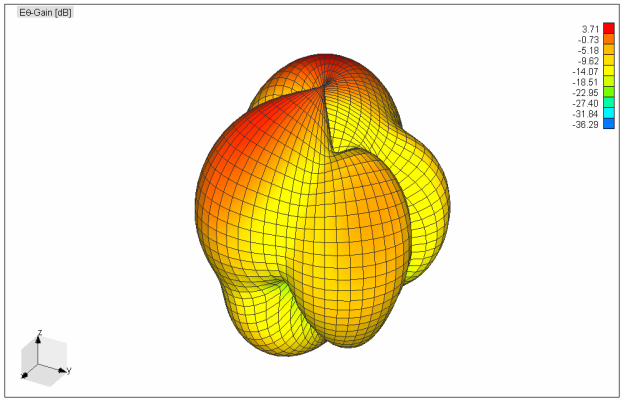

Figure 9. Eθ – 3D diagram at 2.4 GHz

The simulation at a single frequency lasts 1 minute on a Intel Core2 Duo CPU with 2.66 GHz clock rate. The memory requirements are 87 MB.

[1] A. A. Eldek, "Analysis and Design of a Compact Multi-band Antenna for Wireless Communications Applications", Microwave Journal, vol. 51, no. 5, pp. 218-230, May 2008.