Antenna Placement on Airbus A320

Numerous 3D modeling tools are being used in engineering. Despite the obstacles of proprietary file formats and limited support for open formats, the interoperability of different modeling tools becomes increasingly important due to overall optimization of design and production processes. WIPL-D Pro CAD introduces wide support for transferring various models created in third-party tools into WIPL-D Pro 3D EM Solver.

The Airbus A320 model, shown in Figure 1 was imported from an IGES file. The airplane length is 37.6 m, wing span is 34.1 m. The model contains details such as windows and jet engine parts. No model repair was needed after import. Using an adaptive meshing algorithm, an all-quad mesh was created (Figure 2) that adequately represented all the details and yet created larger quads on the fuselage and wings to use the speed of higher order MoM to full extent.

Figure 1. Imported model of Airbus A320

Figure 2. Mesh of Airbus A320 – Full model, no defeaturing

Using the cropping and defeaturing techniques in WIPL D Pro CAD, the model was split in half and simplified by removing all windows (Figure 3). Quarter wavelength monopole was then placed on the fuselage and the gain of the system was calculated at 833 MHz, with the airplane being 104λ long at this frequency.
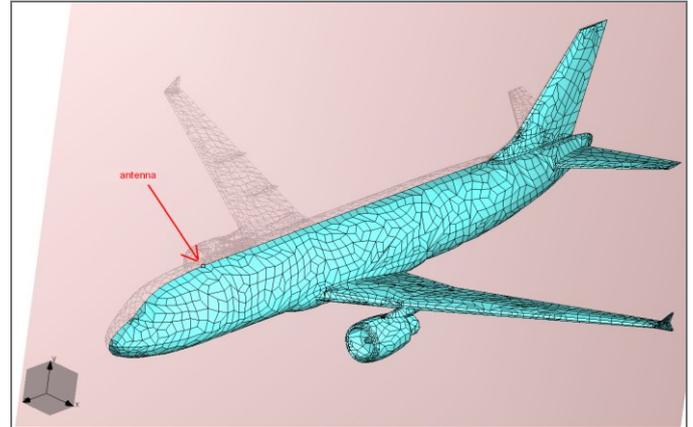

Figure 3. Mesh of Airbus A320 – Half model, windows removed

Rigorous higher order MoM in combination with adaptive expansion order reduction and the GPU accelerated out-of-core solver results in:

Table 1. Number of unknowns, memory and simulation times – airplane at 833 MHz

Frequency	Number of unknowns	Disc space used	CPU simulation time	GPU Simulation time
833 MHz	67,957	34.4 GB	4.9 h	37 min

The resulting radiation pattern in the symmetry plane is shown in Figure 4.
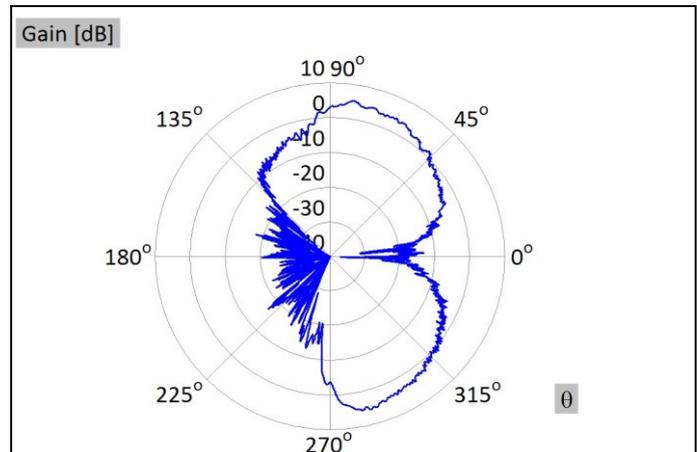

Figure 4. Gain in the symmetry plane at 833 MHz of a monopole placed on top of the fuselage, close to the nose

Placement of a small antenna on three different positions on the aircraft was investigated next in order to establish the influence of the wings and the tail on the radiation pattern. A half-wavelength dipole was placed above the airplane fuselage at midpoint between the wings and the nose, at wings, and at
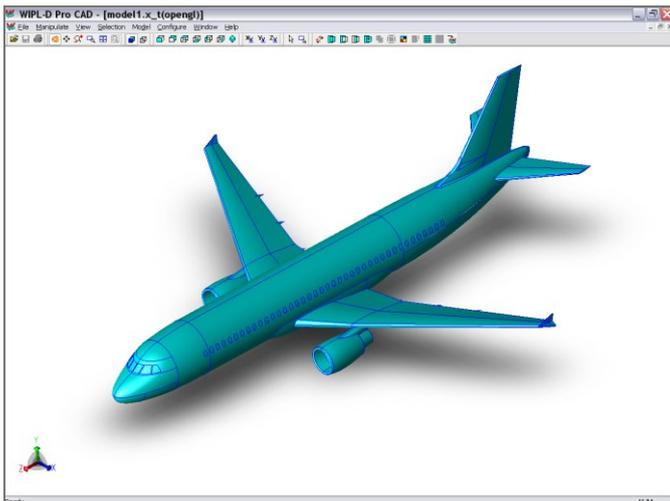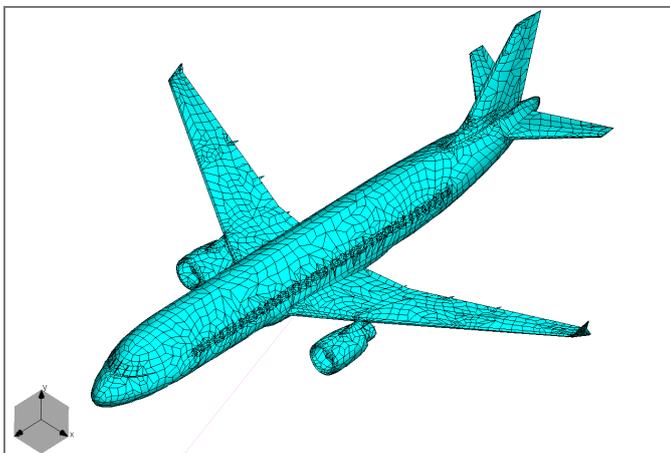
midpoint between the wings and the tail (Figure 5). The simulation frequency was 1.53 GHz which meant the airplane was about 190λ long.
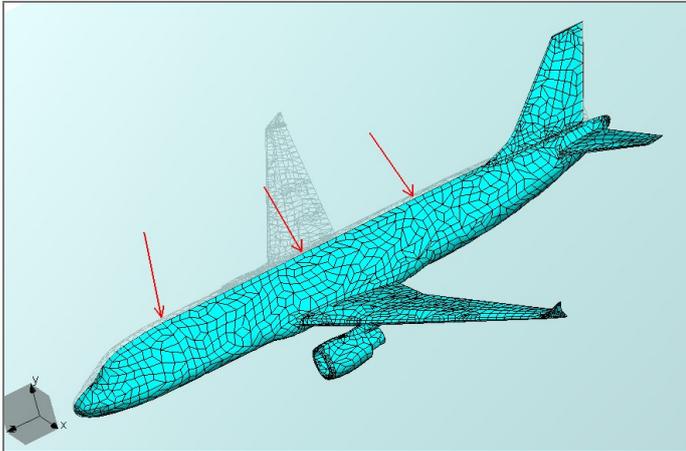

Figure 5. Three positions for placing a dipole

Rigorous higher order MoM in combination with adaptive expansion order reduction and the GPU accelerated out-of-core solver results in:

Table 2. Number of unknowns, memory and simulation times – airplane at 1.53 GHz

Frequency	Number of unknowns	Disc space used	CPU simulation time	GPU Simulation time
1.53 GHz	95,077	67.4 GB	13.5 h	88 min

The radiation patterns in the symmetry plane for three different positions of the dipole are shown in Figure 6.
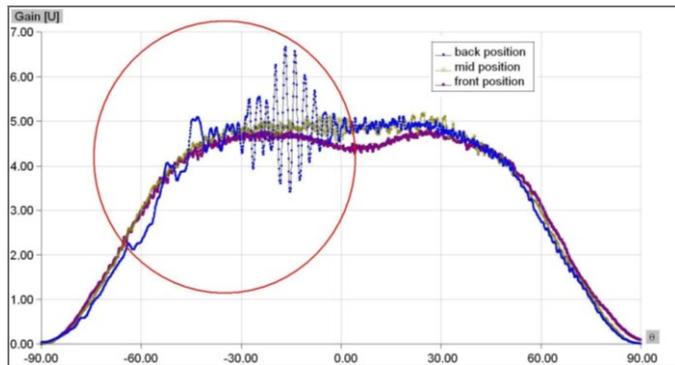

Fig 6. Radiation patterns for three positions of the dipole

The influence of the tail is clearly visible in case when the dipole is placed at the back (the encircled disturbances in Figure 6).

A comparison of the three radiation patterns with a radiation pattern of a dipole above infinite PEC plane is given in Figure 7. This can give us a hint as to how large of a difference is between the airplane fuselage and an infinite flat PEC plate at the frequency of interest. The diagram shows that the position of the placed antenna does not make a significant influence to the overall radiation pattern and that hemispherical coverage of the space above the airplane is possible even from a position near the tail (Figure 8 gives the radiation pattern in dB).
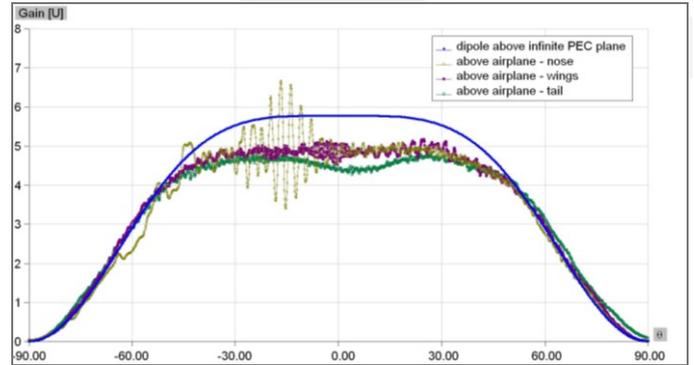

Figure 7. Comparison of radiation pattern for three dipole positions with the radiation pattern of a dipole above infinite PEC plane
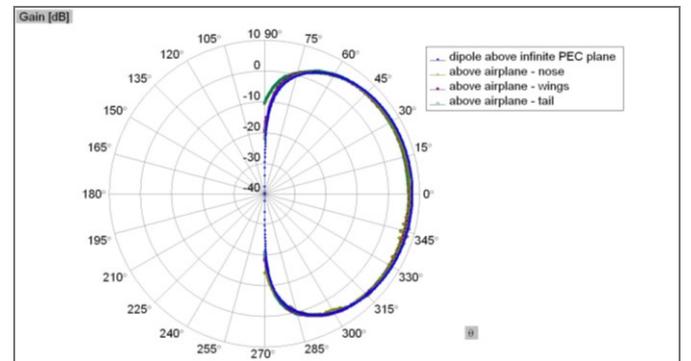

Figure 8. Comparison of radiation pattern for three dipole positions with the radiation pattern of a dipole above infinite PEC plane – in dB

The simulations were done on the PC with following configuration: Intel® Core(TM) i7 CPU 950 @3.07 GHz, 24 GB RAM, 1 GPU Nvidia GeForce GTX 590.