Waveguide Slot Array 20x20

The aim of this application note is presenting efficient simulation of antenna array using WIPL-D Software. WIPL-D Pro, full wave 3D EM Method-of-Moments (MoM) based solver, will be used both for modelling and simulating the antenna array. The results of interest will be near field distribution and radiation pattern.

WIPL-D Model

The waveguide slot antenna array with 400 elements (800 slots in total) is modeled using WIPL-D Pro built-in entities and performing appropriate manipulations with these entities. Each radiating element consists of two shifted slots. The radiating elements are staggered into squared area creating 20x20 slots array. In order to save computational resources, two symmetry planes are applied. This means that only quarter of the array is simulated. Simulated antenna array is shown in Figure 1.

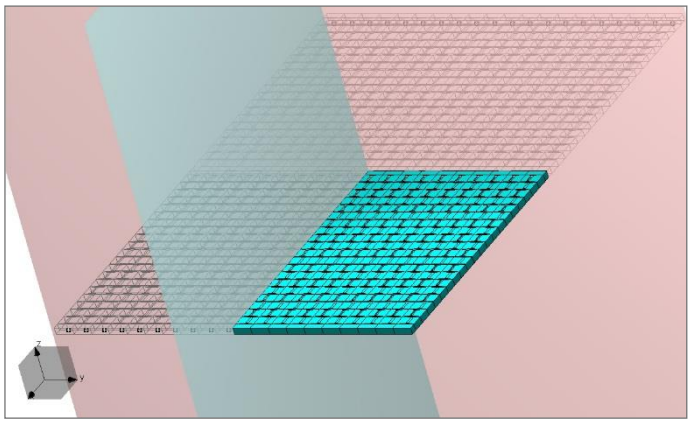

Figure 1. Antenna array with 2 symmetry planes

Results and Simulations

Antenna array was simulated at 34 GHz. Near field is calculated 0.85 meters above the bottom of the antenna. Calculated magnitude of near field is shown in Figure 2.

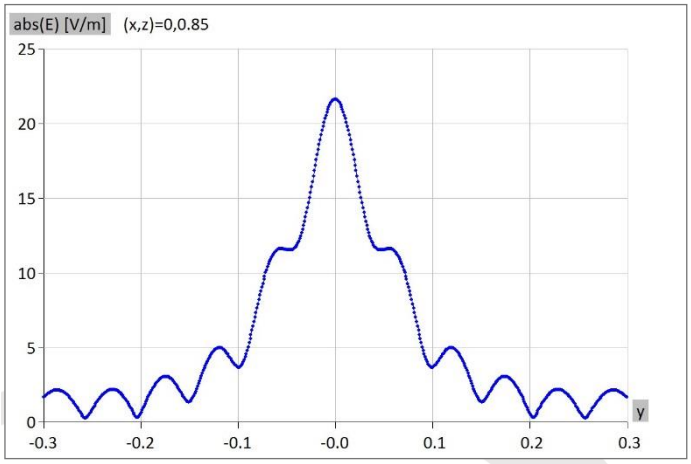

Figure 2. Calculated near field at z = 0.85 meters

Radiation pattern is calculated in two phi-cuts. The first phi-cut is obtained for phi = 90 Degrees, while the other phi-cut is obtained for phi = 0 Degrees. Radiation patterns are presented in Figure 3.

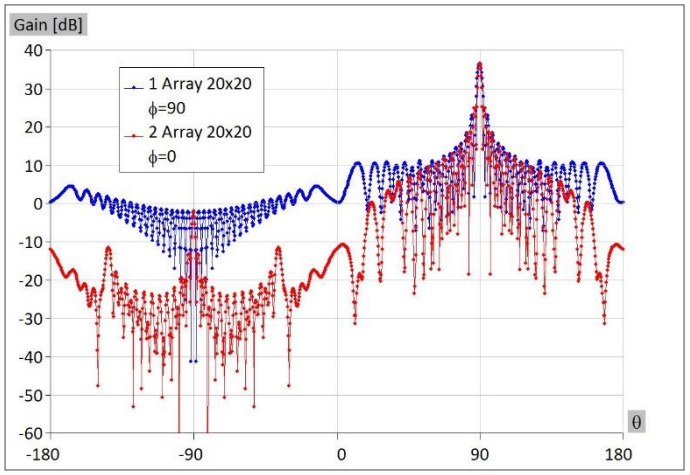

Figure 3. Radiation patterns – two phi-cuts

3D radiation pattern is calculated, also. It is shown in Figure 4.

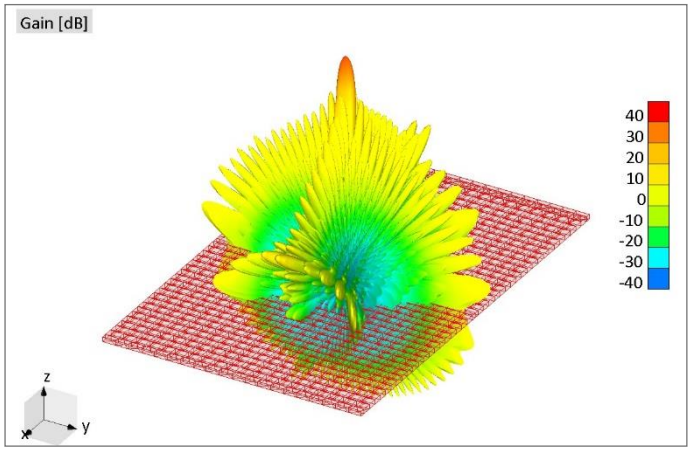

Figure 4. 3D radiation pattern

The simulation was performed on standard desktop PC: Intel® Core™ i7-7700 CPU @ 3.60 GHz. The configuration was enhanced with single low-end GPU card (NVIDIA GeForce GTX 1080). Total simulation time and number of unknowns are presented in Table 1. Simulation time presented in Table 1 does not include time required for calculation of 3D radiation pattern. Matrix fill-in was done at CPU, while matrix inversion was done both on CPU and GPU. The average array element consisting of two slots requires only around 200 unknowns.

Table 1. Total simulation time and number of unknowns

Model	Number of unknowns	CPU Simulation time [sec]	GPU Simulation time [sec]
Array 20x20	19,220	90	47