

PC Case as EMC Cavity

WIPL-D EM Simulation

WIPL-D Software suite offers a remarkable variety of tools and features for efficient simulation of electromagnetic compatibility (EMC) problems. Extremely **efficient simulation kernel** allows solving electrically large and complex scenarios quickly, with minimum amount of computer resources required. **GPU enabled** numerical analyses can be performed on inexpensive platforms faster than on traditional CPU workstations. For complex geometries, WIPL-D Pro CAD offers import of native CAD files (from IGES to CATIA). In house meshing algorithm yields simulation models adapted for WIPL-D EM simulation (with both large and small-scale details included). Short simulation time means that EMC simulations can be run in large number of frequency points, often required for time domain analysis.

PC Case Simulation

EMC simulation capabilities of WIPL-D software suite will be demonstrated by using an EM simulation of PC case tower (Figure 1). The realistic model of the metallic case is **easily built of available primitives and Boolean operations** applied on such in **WIPL-D Pro CAD** (the tool offers full modeling capabilities and built in quadrilateral mesher). The PC case dimensions are 45 x 40 x 18 cm. Meshed model is shown in Figure 2. The meshed model has large regular quads on flat surfaces without details (for example, small holes represent the details), while it has small quads around details which are significant for EM simulation. This way of meshing enables precisely capturing geometry of the problem. Also, single model of the case offers large-to-small scale details included.

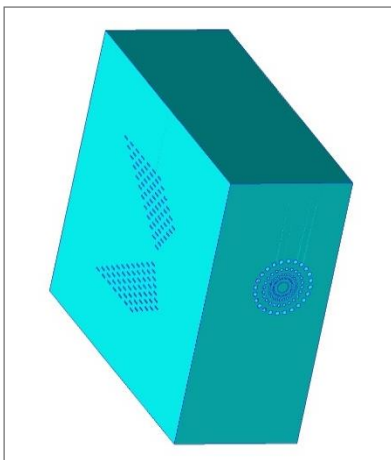


Figure 1: PC case tower. WIPL-D Pro CAD model

The first scenario is meant to illustrate the complexity of EM simulation in the cavity. We place a wire dipole inside of the PC case (Figure 3) and inspect its input impedance (Figure 4). It reveals us a resonance for each of the mode of the cavity. The simulation is performed on a regular desktop PC: Intel® Core™ i7-

7700 CPU@3.60 GHz and Nvidia GeForce GTX 1080 (in each scenario, GPU card was used for matrix inversion). It requires **9,951 unknown coefficients** in the MoM system matrix and simulation time is **10.2 seconds per frequency**.

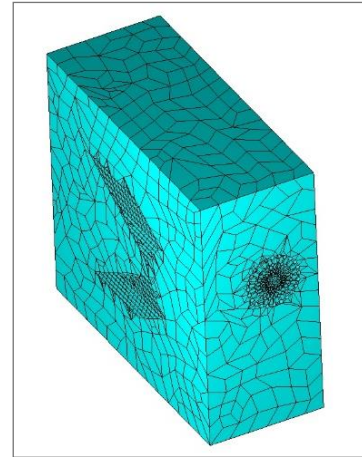


Figure 2: PC case tower. Meshed model in WIPL-D Pro

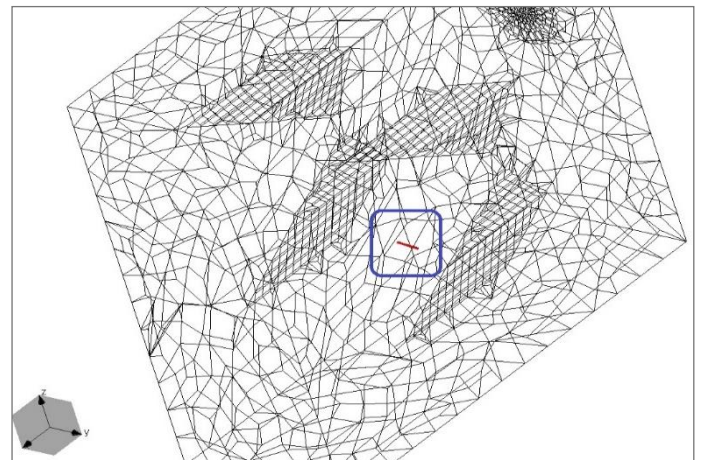


Figure 3: Wire dipole inside case

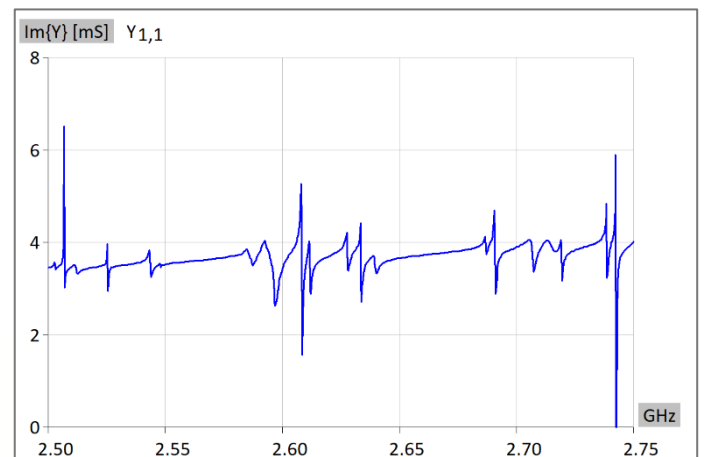


Figure 4: Resonances inside case

EMC Compatibility Scenario

A more complex compatibility scenario involves placing two microstrip filters into PC case and observing the S-parameters.

The filter is shown in the Figure 5. The filter itself requires **1022 unknown coefficients**, while the simulation of the filter lasts **3 seconds per frequency**. Return loss of the filter in free space is shown in Figure 6.

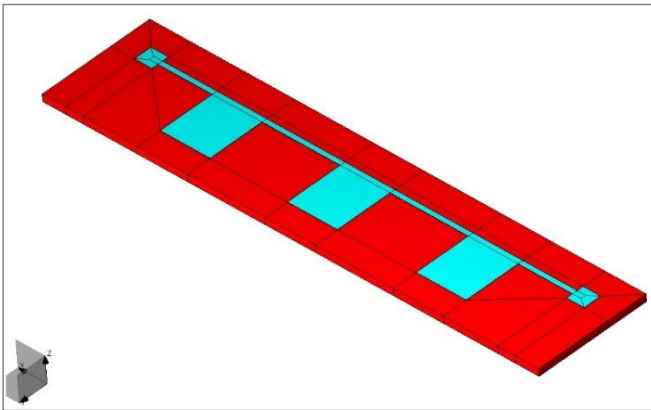


Figure 5: Microstrip stub filter

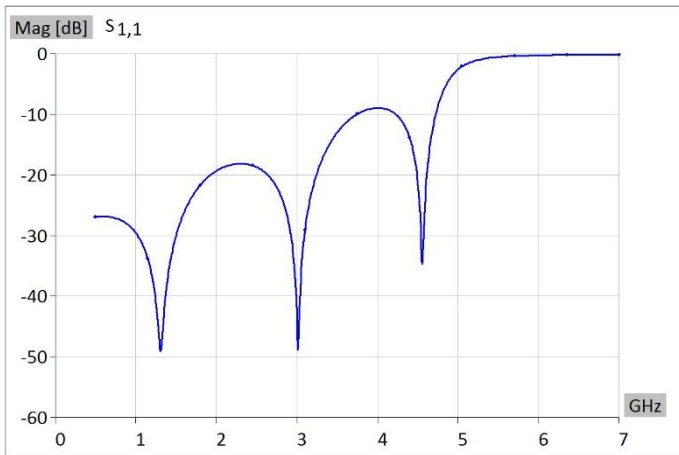


Figure 6: Filter return loss

Additional simulated scenario represents two filters in free space. As mentioned, the most complex scenario encompasses two such filters placed in the PC case (Figure 7). The results obtained after simulating these models are displayed in Figures 8-9. Simulation of the two filters inside the PC case requires **15,441 unknown coefficients**. The simulation lasts around **58 seconds per frequency**.

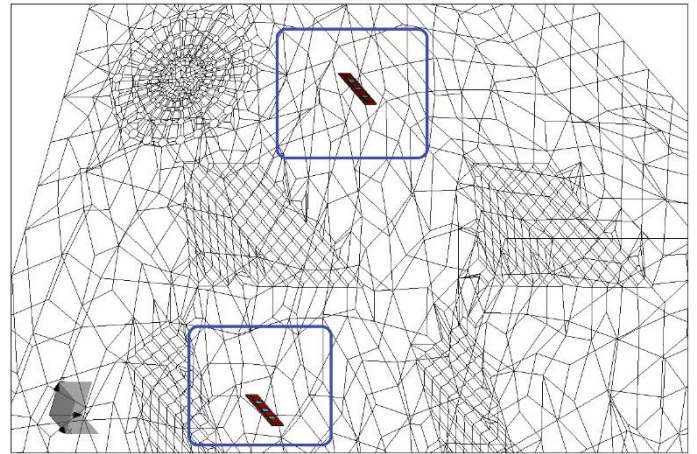


Figure 7: Two filters inside the case

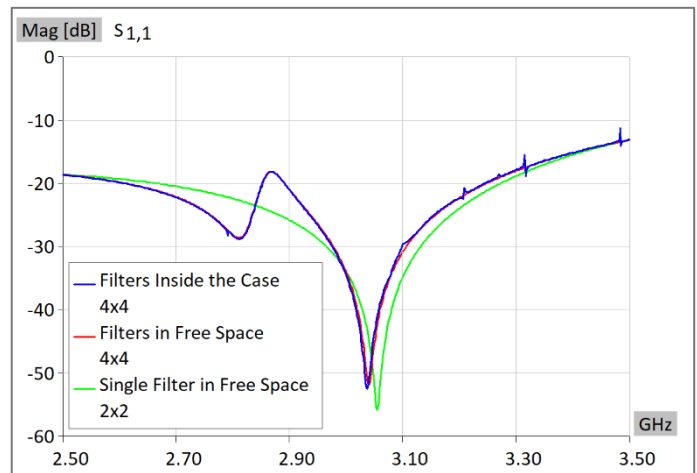


Figure 8: Filter return loss - various scenarios

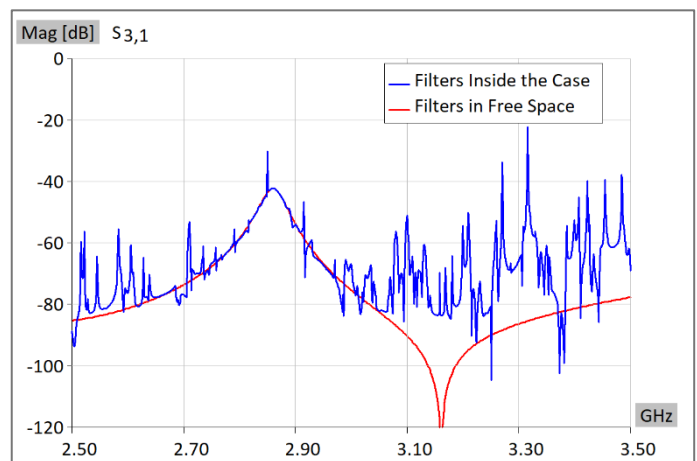


Figure 9: Coupling between filter ports