WIPL-D 2-D Solver

WIPL-D 2-D Electromagnetic Solver is indented for numerical electromagnetic analysis of cylindrical structures, theoretically infinitely long. The program works with 2-D cross-sections (cuts) of the analyzed structure.

Numerical engine is based on the surface integral equation formulation: electric field integral equations (EFIE) for metallic structures and PMCHWT formulation for dielectric and magnetic materials. It can handle arbitrary combinations of piecewise linear materials along with any combination of infinitely or finitely thin layers with distributed loadings. Every parameter, including material and distributed loading specifications can be frequency dependent.

WIPL-D 2-D Solver solves scattering problems. It calculates surface electric and magnetic currents at the material discontinuities, near electric and magnetic field, far (scattered) field and radar cross section (RCS). An example of a 2-D cross-section is shown in Fig. 1. An example of a near field in the vicinity of PEC elliptical scatterer is shown in Fig. 2. Finally, an example of radar cross-section (RCS) normalized to a wavelength in a free space is shown in Fig. 3.

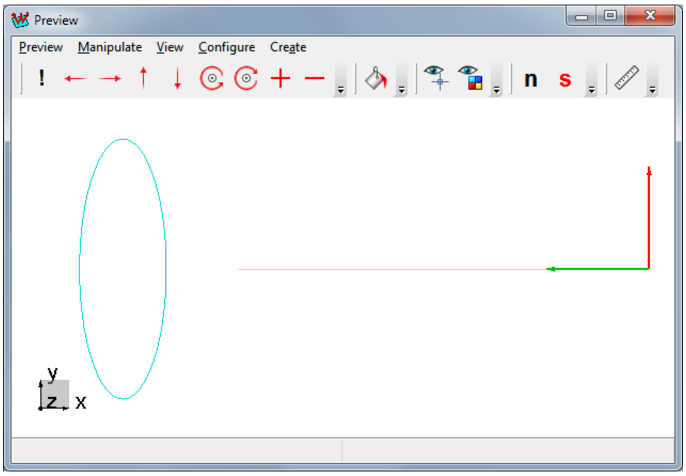

Fig 1. A 2-D cross-section of a structure.

WIPL-D 2-D Solver is integrated with WIPL-D Pro (3-D modeling tool) and WIPL-D CAD (3-D solid modeling tool), so that arbitrary cross-section from a 3D model with material specifications can be easily extracted for a 2-D electromagnetic analysis. An example of a complex 3-D structure with incorporated tool for extraction of cuts is shown in Fig. 4, while the corresponding imported cut in 2-D is show in Fig. 5.

WIPL-D 2-D Solver uses both, in-core (matrix in RAM) and out-of-core (matrix at hard disks), matrix factorization algorithms. For in-core solution with 32 GB of RAM, analysis of cross-sections up to 6,000 wavelengths can be done in matter of hours. State-of-the-art out-of-core solver accelerated with graphical processing units (GPUs) allows analysis of cross-sections up to 150,000 wavelengths in 24 hrs on a single desktop PC with up to 3 GPUs (for the further details of the supported hardware please contact WIPL-D).

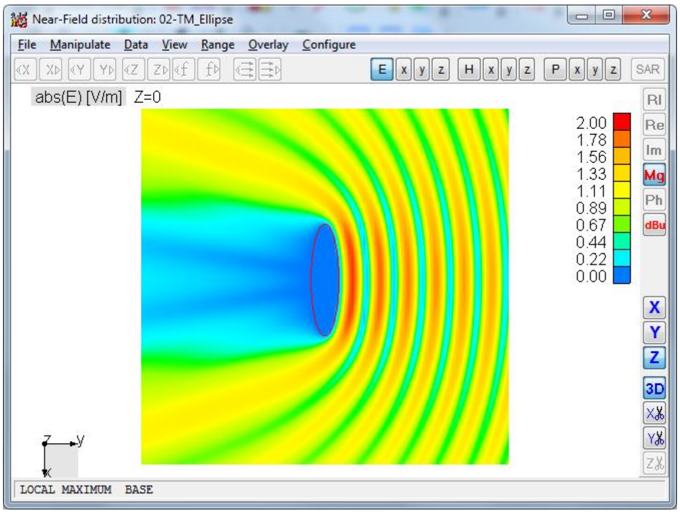

Fig 2. Near-field calculated with WIPL-D 2-D Solver.

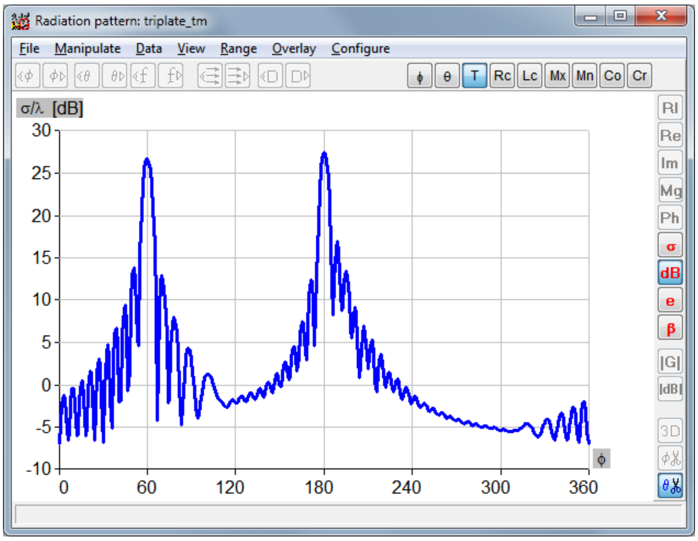

Fig 3. RCS calculated with WIPL-D 2-D Solver.

Simultaneous optimization of arbitrary number of the EM structure parameters in WIPL-D 2-D Solver can be done using WIPL-D Optimizer, which has different optimization algorithms (random search, systematic search, gradient algorithm, Nelder-Mead simplex, Genetic algorithm, Simulated annealing, Particle swarm optimization, multistage optimization, extraction of Pareto front for conflicting optimization criteria, estimation of local of the local optima, etc.).

WIPL-D 2-D Solver performs analysis in the frequency domain. However, time-domain response within WIPL-D 2-D Solver can be calculated using WIPL-D Time Domain Solver, based on frequency-domain analysis and inverse discrete Fourier transformation.

Each output result from WIPL-D 2-D Solver can be investigated as a function of arbitrary number of parameters of the analyzed 2-D structure, using WIPL-D Sweeper.

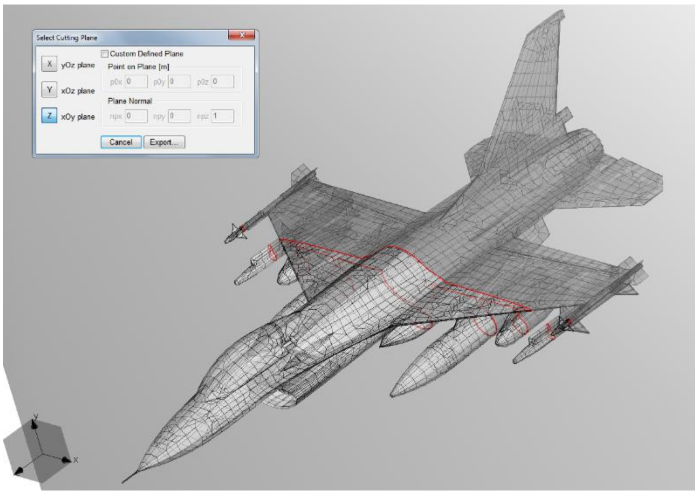

Fig 4. Example of cutting a cross-section from a 3-D model.

As an illustration of WIPL-D 2-D capabilities, a 12-decade frequency sweep of backscattered RCS from a perfectly conducting cylinder with circular cross-section of 1 m radius is shown in Fig. 6. The sweep is performed so that at the lowest frequency (~5 Hz) the circumference is λ/10,000,000, while at the highest frequency (~500 GHz) the circumference is 10,000 λ. The presented results are obtained with numerical MoM (in-core) analysis, on a computer with 32 GB RAM. The Rayleigh region, MIE region (zoomed-in) and the physical optic region can be all seen.

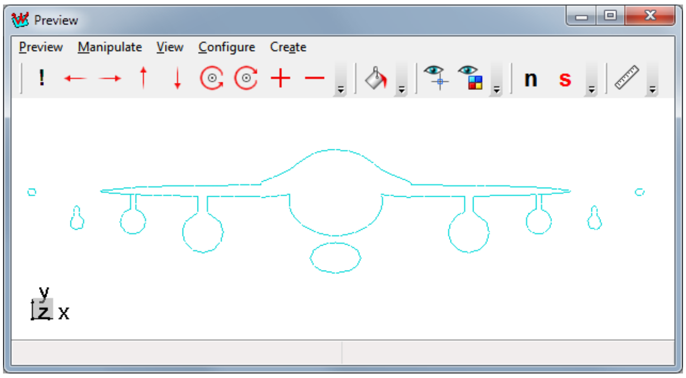

Fig 5. Example of a 2-D cross-section (cut) automatically obtained from complex 3-D geometry.

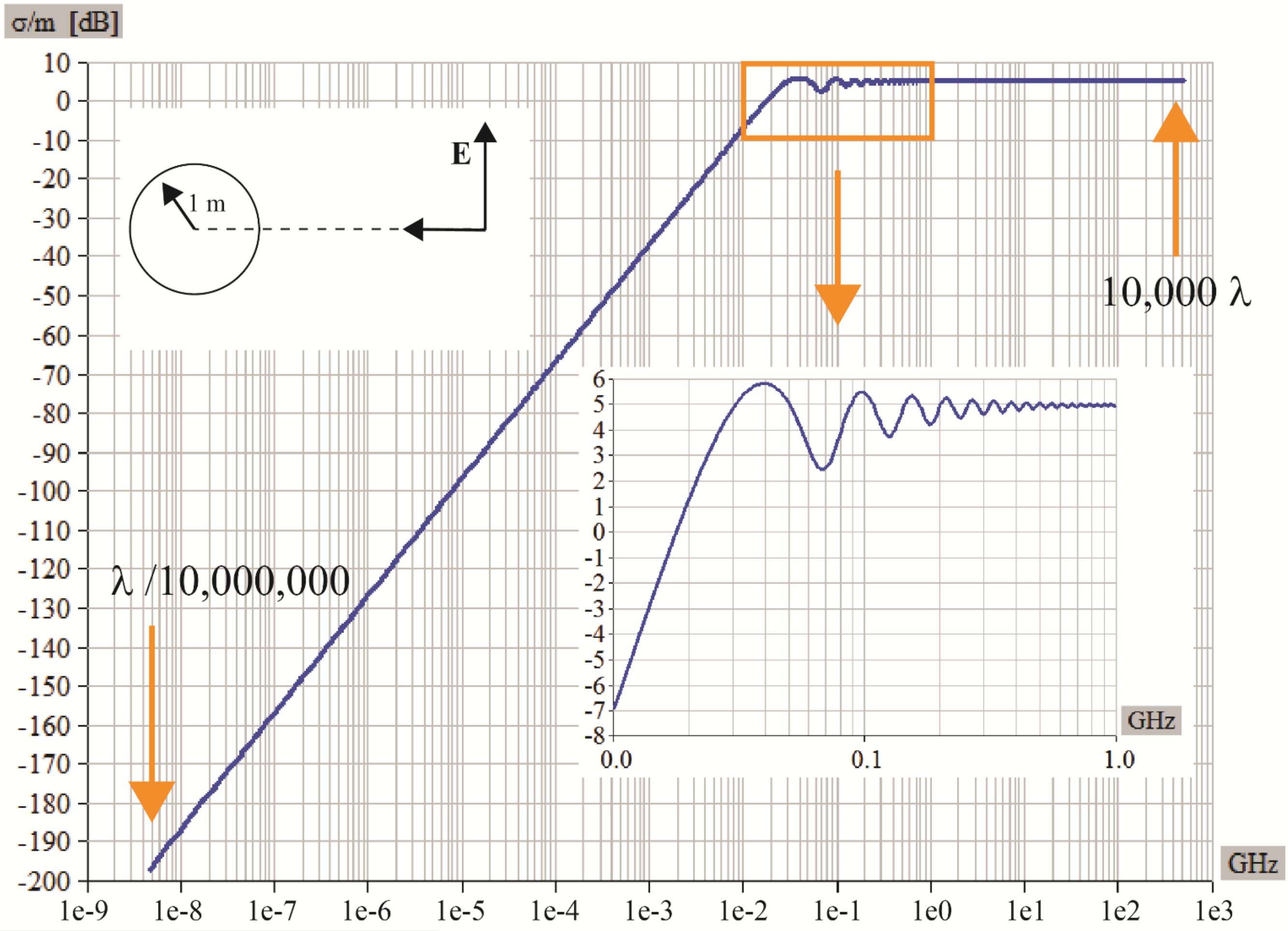

Fig 6. Back-scattering from circular cylinder of radius 1 m: sweep from electrically small (λ/10,000,000) to electrically large cross-section (10,000 λ).