

## WIPL-D Pro CAD: What is New in v2014?

Improvements/new features introduced in v2014 are:

1. Automatic healing tools:
2. Direct mesh algorithm improvements:
  - a. improved meshing of very complex faces,
  - b. increasing of quad mesh Q-factor, i.e. reduction of number of unknowns
3. Hybrid algorithm - a new mesh algorithm
4. New type of primitive called point
5. New curve primitives:
  - a. analytical curve
  - b. curve from edge
6. Improvement of the existing primitives
  - a. curve primitives
  - b. Helix & Spiral primitives (non-wire types)
7. Export of CAD models (wire or geometry planar intersection) to 2D Solver
8. Local settings for current expansion and current calculation
9. Manipulation of a 3D model with a 3D mouse
10. Minor options/improvements
  - a. Enhanced functionality of Boolean operations
  - b. Removal/deletion and copying of the coordinate system
  - c. Ability to run more projects in batch mode
  - d. "Set as read-only" option for project
  - e. The ability to simply disable/enable near filed and radiation pattern calculations via button
  - f. Option to close all open projects together

### 1. Automatic healing tools

Using CAD models created in other software packages (especially mechanical engineering tools) is important part of EM modeling. Very often it is necessary to export the CAD model from one tool and properly convert it into another. Imported models usually contain geometric irregularities and details which are irrelevant for electromagnetic simulation. This often leads to irregular models after the meshing process, or models which yield much higher hardware and software requirements for simulation. WIPL-D Pro CAD 2014 offers a reach set of tools for recognition and healing of geometry irregularities.

Geometry irregularities are automatically recognized in WIPL-D Pro CAD:

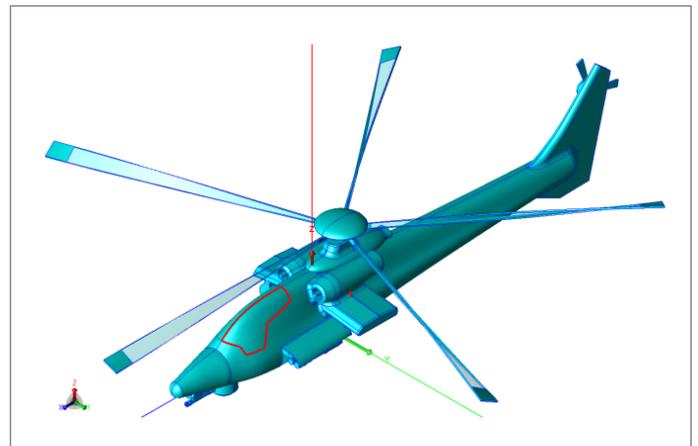
- Entities with faults are drawn as transparent and marked in project tree
- Open edges, which indicate places where faces are not regularly sewed, are drawn in red color

Two basic types of healing tools are:

- Repair tools used for
  - Repair geometry, and
  - Sew Simplify geometry
- Rebuild tools used for
  - Fill hole
  - Remove hole, feature or blend

### a) Recognition and repair of geometry irregularities

Model of helicopter imported in WIPL-D Pro CAD is shown in Fig.1.



**Fig. 1. Model of helicopter immediately after importing.**

Faces with faults in this model are faces forming propeller of the helicopter. All these faces are drawn as transparent and they are also marked with an exclamation mark in the project tree. After placing the mouse cursor over one of these faces, the error description will be given in the status bar. Healing of entities with faults can be performed by using Repair Geometry option or option Simplify Geometry.

To ease visualization of faces that are not properly connected together, option Mark Open Edges should be invoked. After activating the option, all Open Edges belonging to non-wire bodies will be marked by thick red line. Open Edge is an edge belonging to a closed loop of a face not belonging to any other face. In order to sew these faces together, faces should be selected and Sew Faces option should be applied.

Model of the helicopter after applying Repair Geometry and Sew Faces options is shown in Fig. 2.



Fig. 2. Model of helicopter after healing.

### b) Rebuild tools

Parts of geometry which are irrelevant for EM analysis can be easily de-featured by applying WIPL-D Pro CAD options Remove Feature, Remove Hole and Remove Blend. These options also existed in the previous versions of WIPL-D CAD tool.

The new option introduced in v2014 is Fill Hole option. This option can be used to close holes in a body of any type (Wire, Sheet, Solid or General). Different methods could be set for filling the hole. Some of them are illustrated in Fig. 3.

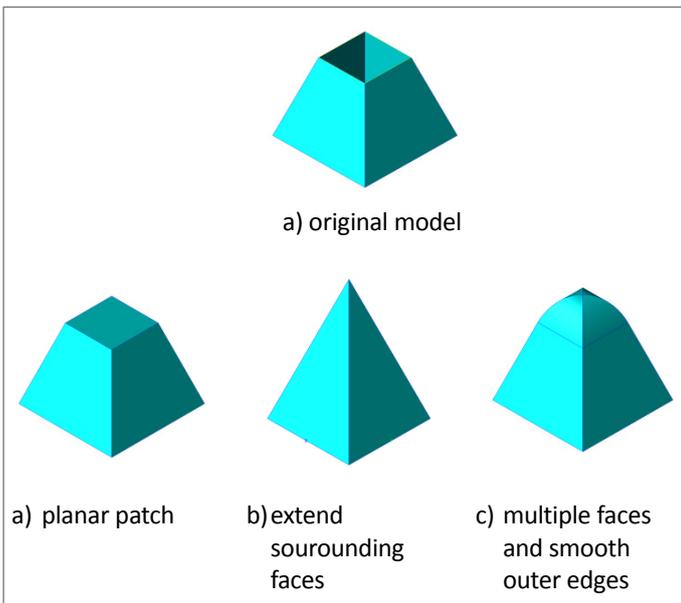


Fig. 3. Fill Hole option.

### Direct mesh algorithm

Direct mesh algorithm, which is default meshing algorithm in WIPL-D Pro CAD is improved in two directions:

- Meshing of very complex faces is significantly improved. After these improvements meshing is not just more robust, but also results in lower number of unknowns.

- Mesh quality factor is increased, resulting in up to 30% lower number of unknowns. Furthermore, thanks to regular shape of mesh elements matrix fill-in time is dramatically reduced, while accuracy of simulation results is improved.

Two meshes of a reflector antenna are shown in Fig. 4. Diameter of reflector is equal to 20 wavelengths.

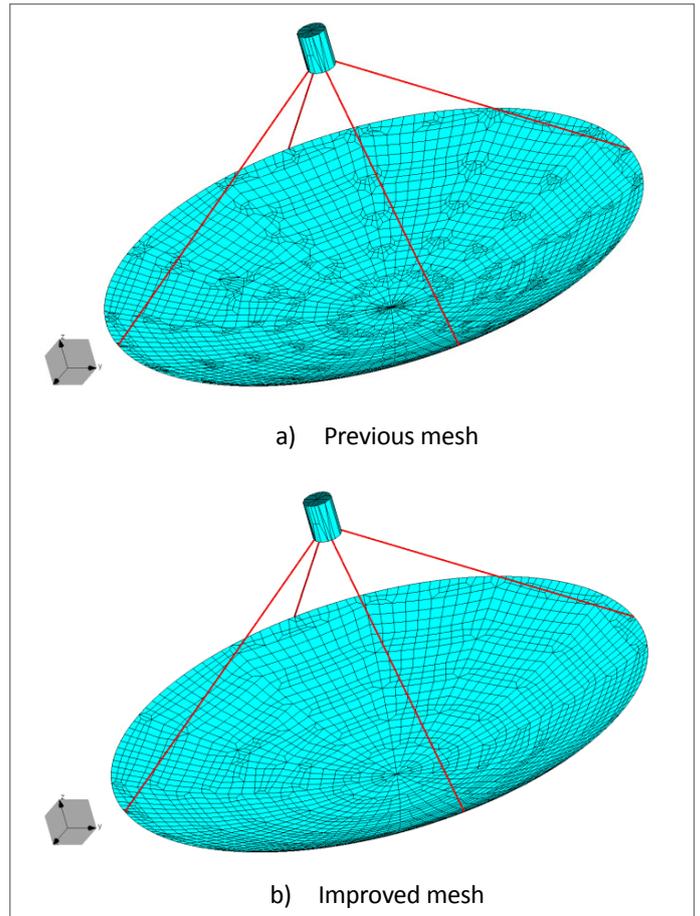


Fig. 4. Mesh of a reflector antenna.

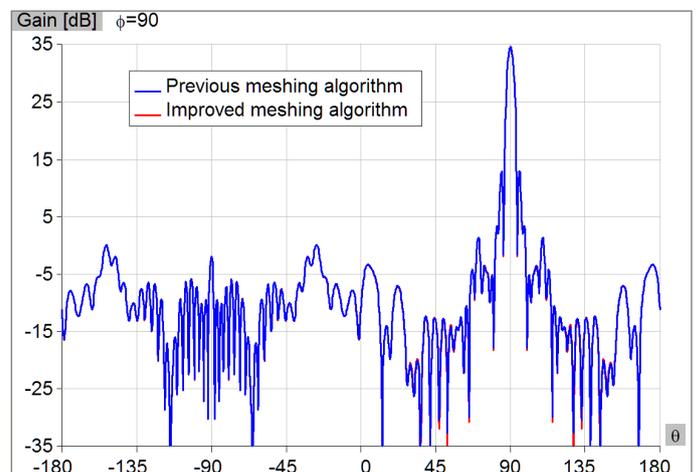


Fig. 5. Radiation pattern of reflector antenna.

Mean Q-factor for the improved meshing algorithm is 1.2 times higher than mean Q-factor obtained with the previous mesher version. That results in 4862 unknowns, comparing to 6315 unknowns obtained with previous meshing algorithm.

Simulation results are almost identical, as it is illustrated in Fig. 5, where radiation pattern in x0z plane is shown.

### 3. Hybrid algorithm - a new mesh algorithm

Hybrid algorithm is developed as a new mesh algorithm - it combines the best features of both, direct and uniform mesh algorithm in order to achieve the best appropriate mesh for planar structures with extended (long and thin) parts and with huge number of details.

### 4. Point - new type of primitive

New type of primitive called point is introduced – it is a vertex that can be defined either numerically or through symbolic mechanism and can be used in modeling as a stand-alone primitive.

### 5. New curve primitives

New curve primitives are introduced in order to simplify the model creation.

#### a) Analytical curve

Definition of parametric curve by specification of the curve parameter range and x, y and z curve coordinates in a form of analytical function.

A four arm sinuous antenna created using this primitive is shown in Fig. 6. Each arm composed of 6 cells, where each cell is scaled version of its predecessor. Cells are defined by following equation:

$$\varphi = (-1)^p \alpha_p \sin \frac{180 \ln(r/R_p)}{\ln(\tau_p)}$$

where r and  $\phi$  are polar coordinates of the curve,  $R_p$  is radius of p-th sector.  $\tau_p$  is radius grown rate and  $\alpha_p$  is sweep angle.



Fig. 6. Four arm sinuous antenna.

#### b) Curve from edge

In the new version of WIPL-D Pro CAD a curve can be created from the selected edge(s). These curves could be used, as any other curve, for creation of wire bodies or used as auxiliary objects during further modeling.

### 6. Improvement of the existing primitives

Beside the introduction of the new primitives, some existing primitives are improved.

#### a) Curve primitives

Fitted spline, NURBS and polyline are creating by specifying a set of control points. In previous versions of WIPL-D Pro CAD the only way to input these points was to type one by one in appropriate edit field or by mouse click in 3D view window. Starting from version 2014, control points could be imported from an ASCII file. Format of the file is very simple and it can be easily created.

#### b) Helix & Spiral primitives (non-wire types)

It is possible to choose the type of an end for strip. In the previous version only sharp ends of the strip existed. Starting from version 2014 helix and spiral primitives with flat ends are also supported.

With this option for helix/spiral ends and with direct meshing algorithm it is possible to obtain mesh which is exactly the same as mesh obtained by using WIPL-D Pro helix/Spiral Objects.

Two helixes with flat ends are shown in Fig. 7.

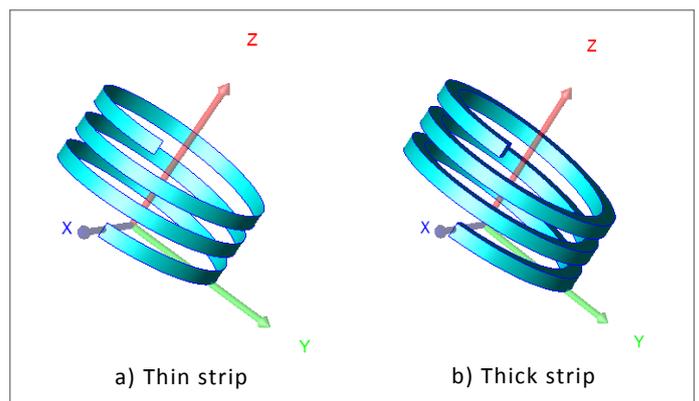


Fig. Helixes with flat ends.

### 7. Export of CAD models to 2D Solver

WIPL-D Pro CAD allows the export of geometry to the WIPL-D 2D Solver format. Since WIPL-D 2D solver uses structures with a constant cross section, the geometry being exported must be planar. The geometry being exported is obtained as a cross section of the (3D) model geometry and a cutting plane. The

cutting plane can be one of the three basic coordinate planes or a custom defined plane.

## 8. Expansion order for entities can be manually specified

Current calculation points and current expansion order can be set locally on selected faces, wires and edges of wire objects.

Thanks to these options order of approximation can be increased/decreased on desired parts of the model. Also, instead of uniform density of currents calculation points this density can be changed on the model parts selected by user.

## 9. Manipulation of a 3D model with a 3D mouse

In order to make 3D modeling even more efficient, using of 3D mouse for manipulations over the model, including Rotation, Pan and Zoom manipulations, is supported. This option is available in any structure manipulation mode, such as Orbit or Pan, in any Selection mode, or when a Draw mode is active.

## 10. Minor options/improvements

### a) Enhanced functionality of Boolean operations

Boolean operations are improved in sense of more robust functionality, as well as better domain inheritance for entities involved in Boolean operations.

### b) Removal/deletion and copying of the coordinate system

In addition to existing manipulation over working coordinate system, deletion and copying of coordinate system are introduced.

### c) Ability to run more projects in batch mode

Multiple projects could be selected and added into the Batch queue. Once the batch run is started, project from the queue will be meshed and simulated successively.

### d) "Set as read-only" option for project

The project can be set as "read-only", so that the project cannot be accidentally modified and run, i.e., the project (geometry, excitation, results, etc.) is preserved as is.

### e) The ability to simply disable/enable near field and radiation pattern calculations via button

Once the grid of near field points and/or far field directions is specified, user can enable/disable calculation of near

field/radiation pattern simply by checking appropriate check box.

### f) Option to close all open projects together

WIPL-D Pro CAD is Multiple Document Interface (MDI) application, meaning that multiple projects could be opened simultaneously. All opened projects could be closed in single click, by selecting option close all open projects together.