What's New in XFDTD v6.1

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This document contains a brief summary of the new features in XFDTD version 6.1. Detailed information may be found in the XFDTD v6.1 User's and Reference manuals.

Adaptive Mesh

As with other computational EM software, XFDTD represents the geometry as a set of locations at which the appropriate fields or flux are computed. For most time-domain software this *mesh* takes the form of one or more grids of *cells* containing field locations. In earlier versions of XFDTD, the size of the cells in the main FDTD mesh was the same at all locations within the problem space, ie. a uniform rectangular mesh. In XFDTD v6.1 the mesh cell size may vary with location so that more cells may be concentrated in regions of the geometry requiring finer spatial resolution, ie. an adaptive mesh.

Adaptive mesh is illustrated in the following two figures. Figure 1 shows a portion of the feed of a horn antenna meshed with a constant cell size in XFDTD v6.0. Figure 2, the same geometry is meshed adaptively in XFDTD v6.1. Both figures show approximately the same portion of the geometry and contain approximately the same number of mesh locations or unknowns. However, the adaptive mesh is a significantly better representation of the geometry.

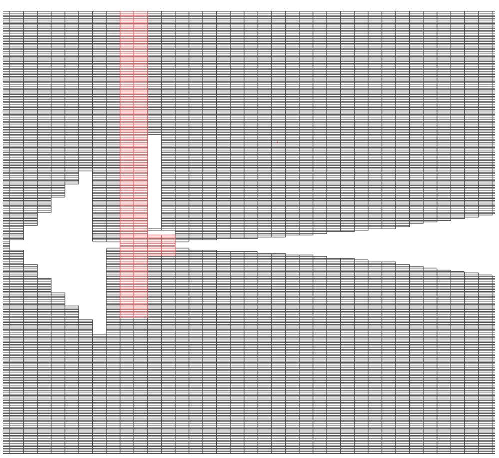

Figure 1: Portion of a Horn Antenna with Uniform Mesh

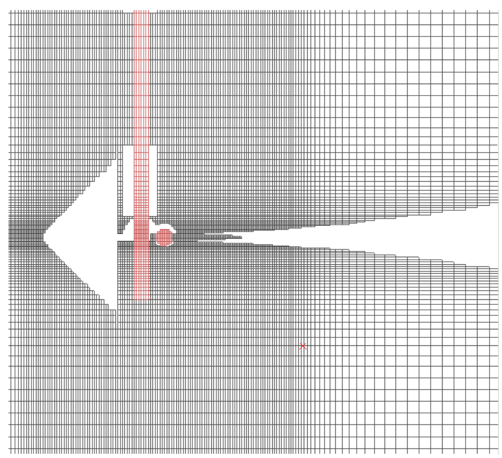

Figure 2: Portion of a Horn Antenna with Adaptive Mesh

The user may select to have XFDTD automatically determine the locations of the adaptive mesh regions globally, by geometry group, and by individual object. In addition the user may also manually specify where adaptive mesh regions are located. Automatic- and manually-specified regions may be intermixed in the same geometry.

Adaptive meshing helps ensure that the unknowns to be solved for a given geometry are optimally distributed so that computer resources are used efficiently. More information about adaptive meshing is available in Chapter 5 of the XFDTD v6.1 Reference manual.

Geometry Creation and Editing

Several new features add capabilities to creating geometries and increase the ease of use of geometry editing in XFDTD. More information about these new editing features is contained in Chapter 5 of the XFDTD v6.1 Reference manual. They are summarized as follows:

View-based Selection and Object Faces When editing the geometry in XFDTD v6.0, selection of objects is limited to clicking on the object in the geometry tree. In XFDTD v6.1 objects and faces of objects may be selected directly with the mouse by clicking on the object in the Solid View. The  button on the Geometry View tab enables the user to select an object by clicking on it in the view and the  button enables the user to select the face of an object by clicking on it in the view. Face selection may also be made from the geometry tree similar to object selection.

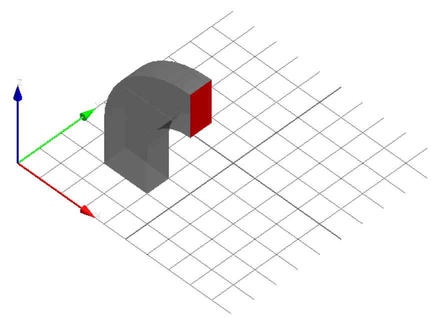

Figure 3: Selected Face Shown Red

Sweep/Revolve/Flare Selected faces of solid objects, as well as objects created in the 2D editor, may be translated through space in various ways to create 3D solids. They may be swept linearly, rotated about a line, or follow complicated paths and scaling functions. Remcom has added an extensive set of the sweeping features found in many CAD drawing programs to XFDTD.

In Figures 4 and 5 a rectangular plate is selected and swept with a *draft angle* (expansion) to create a solid in the shape of a flared horn antenna.

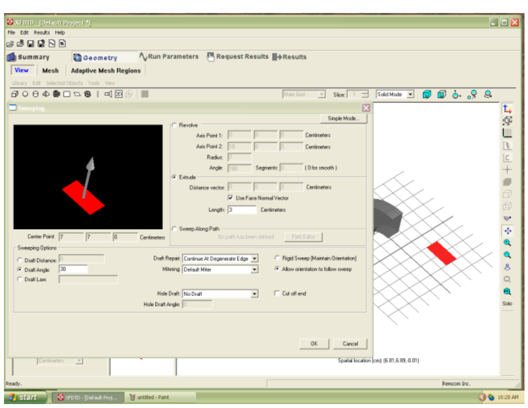

Figure 4: Sweep with Draft Angle a 2D Object

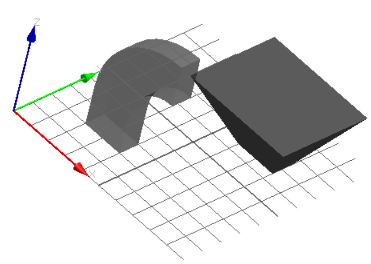

Figure 5: Flared Horn Shape from Sweep/Draft

With this feature XFDTD's 2D and 3D geometry editors are able to create many geometries that might previously have had to be generated in an external CAD program. In addition, externally generated CAD files may be edited from within XFDTD.

Shelling of Solid Objects 3D objects created in XFDTD or imported from CAD files may be *shelled*, which means that the objects are "hollowed out" leaving a specified shell thickness. Selected faces of the object may optionally be removed during the shelling operation. Consider the flared horn object and 90° bend of a rectangular face that were created from sweeping and revolving simple 2D surfaces. Figure 6 shows these two objects after being shelled by XFDTD with the end faces removed, creating a horn antenna and 90° waveguide bend.

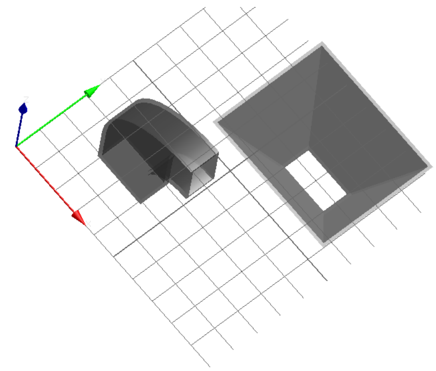

Figure 6: Guide and Horn after Shelling

Move/Rotate/Scale Objects with the Mouse, Nonuniform Scaling XFDTD v6.0 provides control over the positioning of objects within the geometry via dialogs where movement, rotation, and scaling may be entered numerically. To complement this, XFDTD v6.1 has the added capability to move , rotate , and scale objects using the mouse. This provides for more interactive control of placement. Combined with numerical placement, it is an effective way to quickly integrate newly created or imported objects within an existing geometry. Figure 7 shows the horn in process of being rotated and figure 8 shows the horn in its new position.

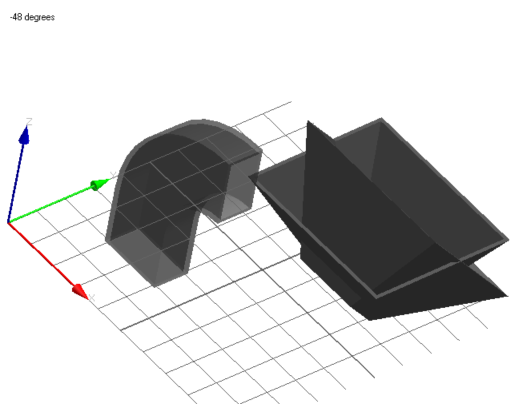

Figure 7: Horn Antenna Being Rotated with the Mouse

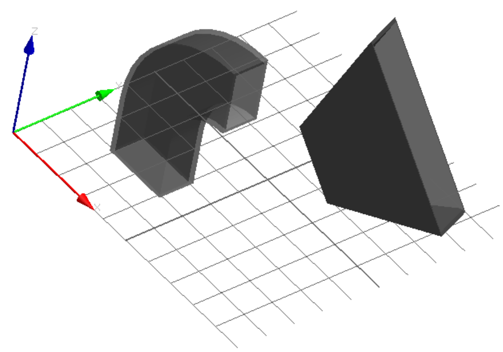

Figure 8: New Position of Horn Antenna

Also, objects may now be scaled independantly in (x, y, z) to create, for example, an elliptical cylinder out of a circular cylinder.

Alignment of Object Faces Sometimes two objects need to be aligned or connected precisely in ways that are not convenient to accomplish with moves and rotations. An example of this is when two objects need to be joined such that a face of one object is against the face of another object, but the faces are not aligned with the coordinate system. This may be accomplished by determining the location of the face of the fixed object and moving and rotating the second object until it aligns with this face. In XFDTD v6.1 a new feature allows objects to be aligned or joined quickly by selecting the two faces to be joined, and indicating which object is to be moved. The object to be moved will be repositioned so that the select faces are joined at their midpoints. Figures 9 and 10 illustrate this with our simple waveguide and horn geometry. In figure 9 the two faces to be joined are selected and the join/align dialog is selected from the solid operations portion of the right-click menu. After selecting the 90° guide as the fixed object and pressing "Ok", the horn is automatically repositioned as shown in Figure 10.

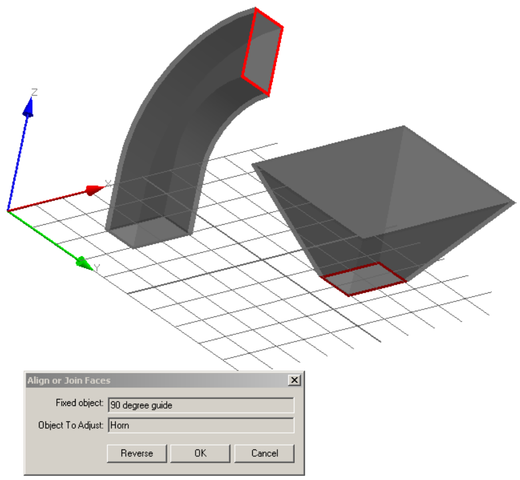

Figure 9: A Face on Each Object is Selected

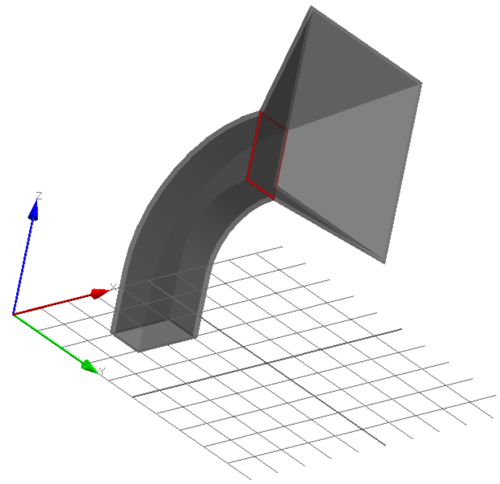

Figure 10: Second Object is Moved so Selected Faces are Joined

Improved Undo/Redo Functionality

Most operations that can be performed in the geometry editor of XFDTD may be reversed by using the new Undo/Redo feature. This means that, for instance, if you make a mistake while changing the parameters of an object, performing a boolean operation, or repositioning an object, the operation may be undone by pressing `ctrl-z`. Undone commands may be redone just as easily. The number of commands remembered is a preference so that the user may select the best tradeoff of memory used and levels of undo available.

SAR Averaging Improvements

Remcom is a leader in providing standards-compliant computation of SAR statistics, including 1g and 10g averages, with the BioPro version of XFDTD. For many problems the computation of SAR averages may be the most time-consuming part of the computation. XFDTD's SAR averaging has been streamlined for v6.1 to provide for increased computation efficiency. In tests using the Specific Anthropomorphic Mannequin (SAM) head with 1mm cells, the computation of SAR 10g averages in XFDTD v6.1 took less than 20% of the time of the same computation in XFDTD v6.0. In addition, SAR averaging capability has been added to the MPM version of XFDTD v6.1 so that very complex biological problems can take full advantage of the speed improvements of multiple processor computers.

Nonlinear Dielectric

Diagonalized anisotropic nonlinear dielectric material has been added for v6.1 to the advanced materials supported by XFDTD.

Component, Near-Zone, Field Planes Referenced to CAD Space

In earlier versions of XFDTD, parameters specified by referencing cell locations in the mesh would be lost if the geometry were remeshed with a different cell size. In XFDTD v6.1 these values are translated into cell locations in the new mesh. This provides for a close estimate of these values in the new mesh

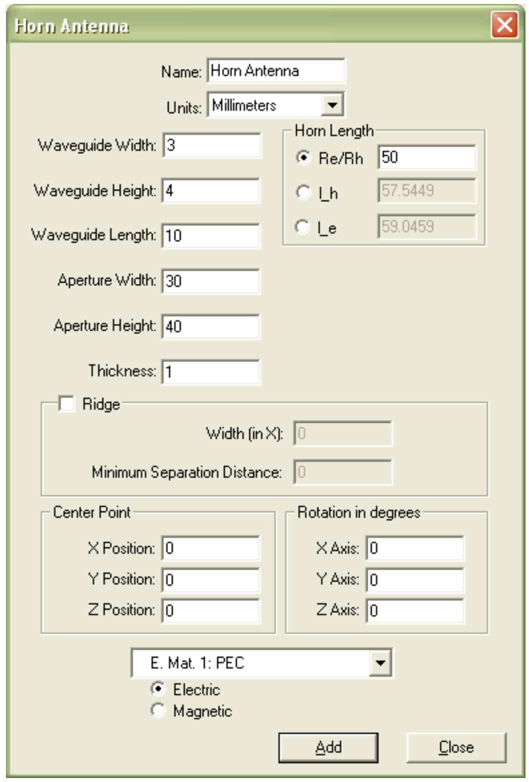

Figure 11: Horn Antenna Primative

and allows them to remained defined across a mesh change. The effected parameters are: disscrete components (voltage and current sources, R, L, C, etc.), near-zone points to save, and planar fields to save.

Horn Antenna Primative

There is now a dialog specifically for creating horn antennas, shown in figure 11. This primative creates a horn antenna with an optional ridge and rectangular waveguide section at the feed.