newFASANT

Antennas coupling with multiple bounces

Benchmark: Antennas coupling with multiple bounces
Software Version: 6.2.7
Date: 17 de nov 15:57

Index

1. BENCHMARK DESCRIPTION AND OBJECTIVES 3

1.1. GEOMETRY CREATION 3
1.2. ANTENNA PLACEMENT 5

2. SET-UP DESCRIPTION 6

2.1. SIMULATION PARAMETERS 6
2.2. OUTPUT PARAMETERS 7
2.3. MESHING PARAMETERS 9

3. RESULTS 9

4. CPU RESOURCES 12

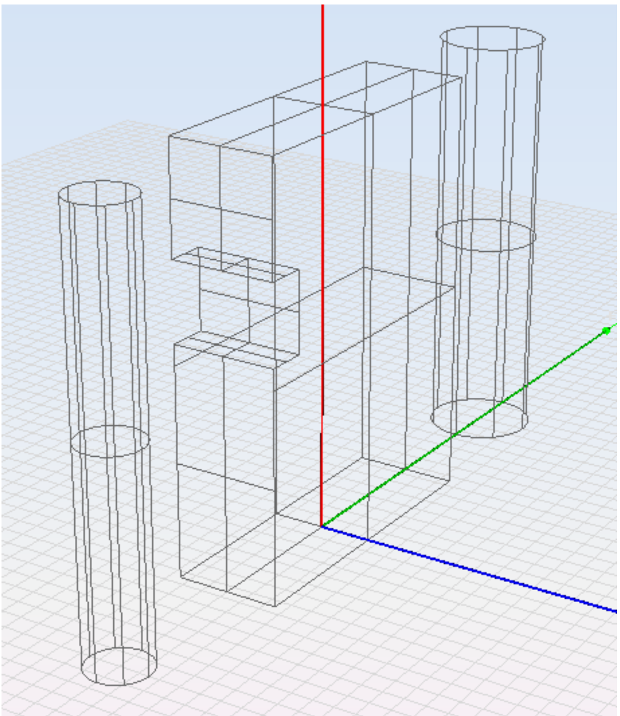
5. GEOMETRY AND PROJECT FILES 13

1. Benchmark description and objectives

This benchmark shows the creation of a parametrized model by using the existing primitives. Then, the coupling between two dipoles placed at each side of the geometry is computed at 15 GHz.

Explaining the recommended parameters for computing the coupling between antennas is the main aim of this tutorial, but most of them are also general for similar problems such as Near Field or even Far field simulations.

Canonical geometries have been chosen because most of ray tracing effects can be obtained by adjusting some of default parameters. In particular, the considered geometry is a box with a rectangular hole of parametric size edge, and two cylinders of parametric radius. The test case is shown in the figure below.



Test case geometry

Default parameters are kept unless otherwise is stated. Anyway, effects of changing most of parameters are briefly stated.

This example is generated using GTD module, so create a new GTD project by clicking on New Project button and selecting the GTD option.

1.1. Geometry creation

There are some important elements that should be taken into account for the geometric modelling:

- ***Units***: It is recommended to work with the Units that fit the most to the dimensions of the geometry, as some parameters are automatically set-up. The following functions are especially sensitive to the working Units.
  - ***Mouse functions***: such as zoom and selection functions. If any difficulty is found for these purposes, select the approximated elements on the desired area or from the Tree, click on Reset View button and the click on *Zoom Selected* button. Then, the camera functions are centered on the selection to improve the mouse functions near this region.
  - ***Boolean operations***: such as split or projection commands. It is recommended that the *Units* are similar to the smaller elements involved on boolean operations, as the accuracy may be improved.
  - ***Meshing process***: advanced meshing parameters such as the edges detection factors are predefined to the working *Units*.
- ***Reference Plane***: This utility is useful to place and orientate correctly any geometric element. If the reference plane local coordinates are enabled, every new command will generate the new object according to the reference system.

For starting with this example, the *default* ***Units*** and ***Reference Plane*** are valid.

Next, click on ***Geometry – Parameters – Define Parameters*** menu to create the list of parameters that are required for the geometry creation. The geometrical parameters are listed in next table.

Parameter	Description	Value
Height	Height of the box and the two cylinders	{2.0}
BoxCenterX	X coordinate of base center for the box	{0.0}
BoxCenterY	Y coordinate of base center for the box	{0.0}
BoxWidth	Width of the box (X size)	{0.5}
BoxDepth	Depth of the box (Y size)	{1.5}
t	Parametric auxiliary variable	[0 0.9] 5
R1	Parametric radius of left cylinder	0.15*(1+t/5.0)
R2	Parametric radius of right cylinder	0.25*(1+t/8.0)
HoleEdge	Size edge of the box hole	BoxDepth/4.0
HoleCenterY	Y coordinate of the center for the hole	t*BoxDepth
HoleCenterZ	Z coordinate of the center for the hole	{1.1}

Geometrical parameters defined

Use the previously defined commands to create the geometry with the existing primitives. Two cylinders and two boxes must be created. Then, the booleanDifference between the two boxes is required. The geometry creation is detailed in the table and figure above.

Command	Parameters	Values
box	X corner base	BoxCenterX-BoxWidth/2.0
	Y corner base	BoxCenterY-BoxDepth/2.0
	Z corner base	0.0
	Width	BoxWidth
	Depth	BoxDepth

	Height	Height
cylinder	X center	0.0
	Y center	-BoxDepth
	Z center	0.0
	Radius	R1
	Height	Height
cylinder	X center	0.0
	Y center	BoxDepth
	Z center	0.0
	Radius	R2
	Height	Height
box	Xcorner base	BoxCenterX-BoxWidth/2.0
	Y corner base	(BoxCenterY-BoxDepth/2.0)+HoleCenterY-(HoleEdge/2.0)
	Z corner base	HoleCenterZ
	Width	BoxWidth
	Depth	HoleEdge
	Height	HoleEdge
booleanDifference	Object A	Box 1
	Object B	Box 2

Commands parameters description

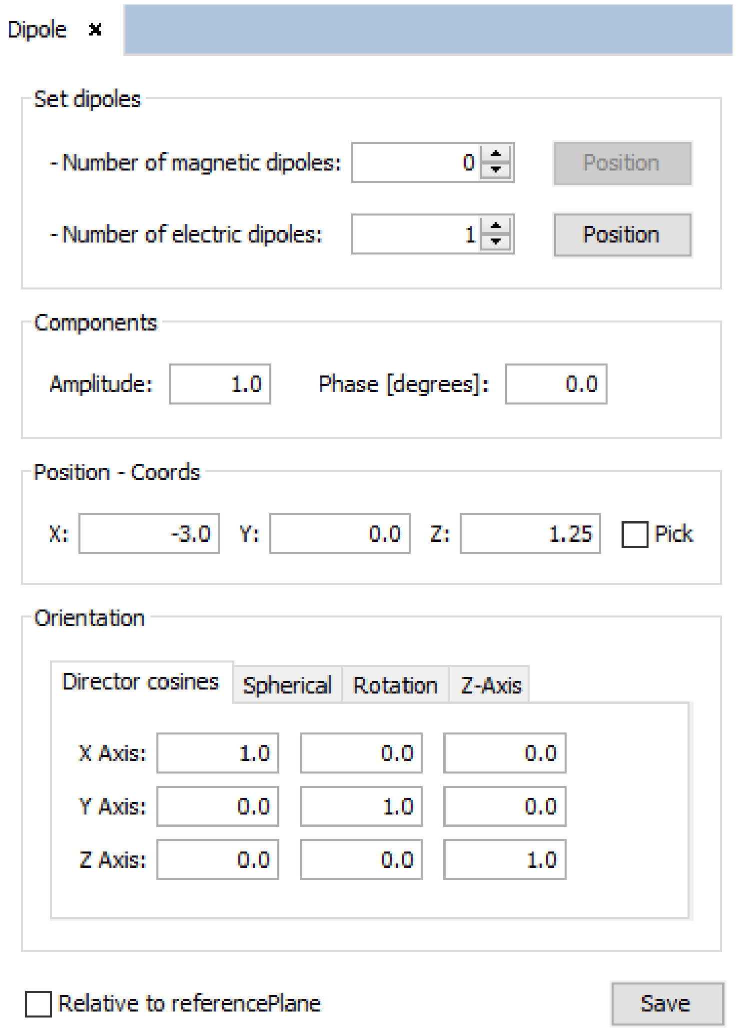
```
command> box
First corner of base [x y z]: BoxCenterX-BoxWidth/2.0 BoxCenterY-BoxDepth/2.0 0.0
Base size [width depth]: BoxWidth BoxDepth
Height [double]: Height
command> cylinder
Select center [x y z]: 0.0 -BoxDepth 0.0
Radius [double]: R1
Height [double]: Height
command> cylinder
Select center [x y z]: 0.0 BoxDepth 0.0
Radius [double]: R2
Height [double]: Height
command> box
First corner of base [x y z]: BoxCenterX-BoxWidth/2.0 (BoxCenterY-BoxDepth/2.0)+HoleCenterY-(HoleEdge/2.0) HoleCenterZ
Base size [width depth]: BoxWidth HoleEdge
Height [double]: HoleEdge
command> booleanDifference
Select the surfaces of the 'objectA' on screen (Press enter when done):
Select the surfaces of the 'objectB' on screen (Press enter when done):
Please Wait...
command>
```

Geometry creation by using console commands

1.2. Antenna placement

An electrical dipole is considered as active antenna. Click on Antenna – Dipole Antenna menu to open the panel for placing the active antenna. The only parameter modified is the position – cords that is set to (***-3.0, 0.0, 1.25***), as shown in figure below. Further parameters such as the ***Orientation*** or the ***Field Components*** may be specified.

Multiple dipole or different antenna types such as *Mutipole* or *Pattern File* may be considered.



Active dipole

2. Set-up description

The main parameters recommended for solving this benchmark are presented in this section.

Every parameter value is justified and also a brief resume about the benefits and inconvenient of setting-up the recommended value or changing it are also included.

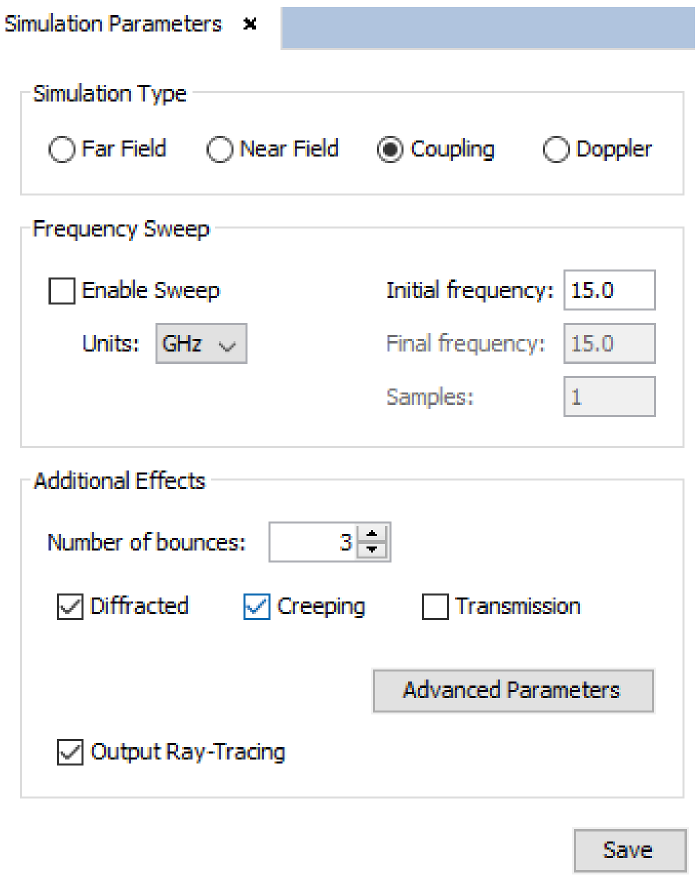
Critical parameters are highlighted and also justified.

2.1. Simulation Parameters

The main simulation parameters are resumed in this section, such as the information about the units, materials and observation points/directions.

Regarding the *Units*, the default units (meters) are appropriate for the current example, as it is the magnitude of the primitives considered. Every *Units* would be similarly valid for this example, but note that the axis and reference plane sizes should be scaled to the selected units. In case of changing the current *Units*, remember to click on *YES* button to the message that asks you for scaling the geometry.

Click on ***Simulation – Parameters*** to open the *Simulation panel*. The *Initial frequency* is set to ***15 GHz***. The simulation type is set as ***Coupling*** and the ***Output Ray-Tracing*** option is selected, so the coupling and ray tracing results will be available after the simulation. Also ***3 bounces*** have been set, and both ***Diffracted*** and ***Creeping*** *effects* are selected.



Simulation parameters

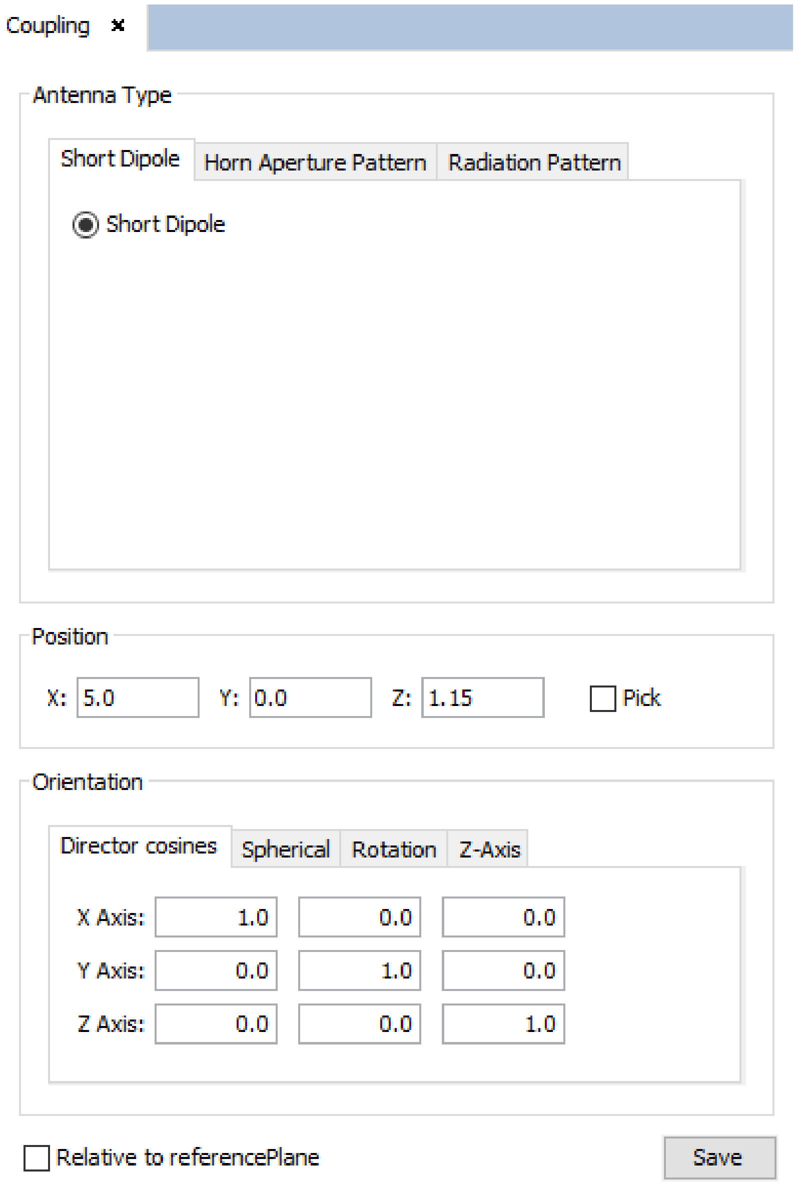
No materials are required for this example, as both the box and the cylinders are full metallic structures.

2.2. Output Parameters

When the simulation type is set to *Coupling*, the only option available in ***Output*** menu is the Coupling one.

This example has been with a ***Short Dipole*** placed in ***Position*** (***5.0,0.0,1.15***), as shown in figure below. Anyway, the most important parameters within the *Output – Coupling* panel are listed:

- ***Antenna Type***: The passive antenna may be defined by three different ways: a *Short Dipole*, a *Radiation Pattern* file and a *Horn Aperture Pattern* that is a particular case of the previous one. The two last options only can be used whenever at least a *DIA* file has been imported by using the *Antenna – Import DIA file* option.
- ***Position***: To set the point where the passive antenna is placed on.
- ***Orientation***: The passive antenna may be rotated by using the *Orientation* options in different ways: *director cosines*, *Spherical* coordinates, *Rotation* angles or *Z-Axis* direction.
- ***Relative to referencePlane***: Select this option to place the antenna relative to the Reference Plane coordinate system or unselect it to specify absolute coordinates.



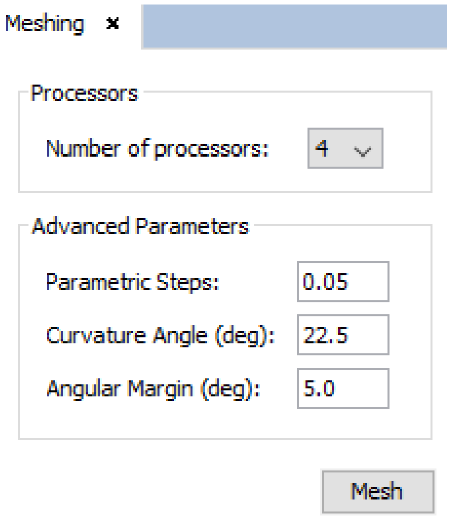
Coupling Parameters – Short Dipole

2.3. Meshing Parameters

The most of parameters are set-up by default within this section. The only parameter that have been modified for this example is the ***number of processors*** that has been set to ***4***.

According to the estimated resources, this example may be solved in the ***Silver Version***.

This example has been meshed in a personal computer by using 4 processors and requiring about 90 MB of RAM and 10 seconds to obtain all meshes (one mesh per parametric step is generated).

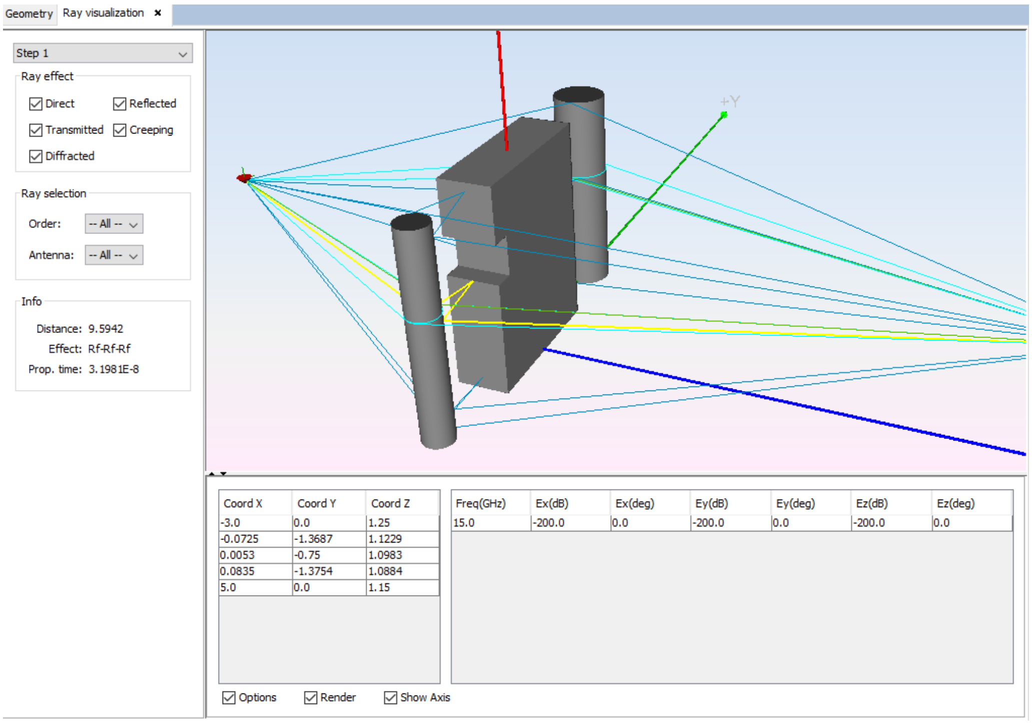


Meshing parameters

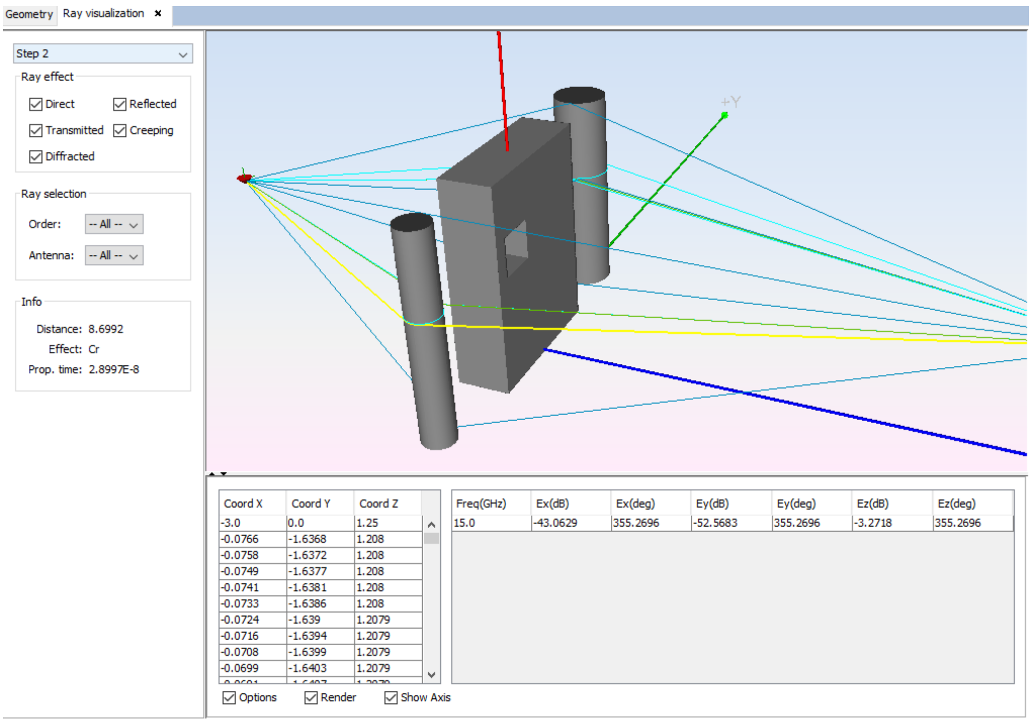
3. Results

Results obtained in this benchmark are included within this section. This example has been run in a personal computer by using ***4 processors*** and requiring about 400 MB of RAM and 10 minutes to obtain all results (one simulation per parametric step is required).

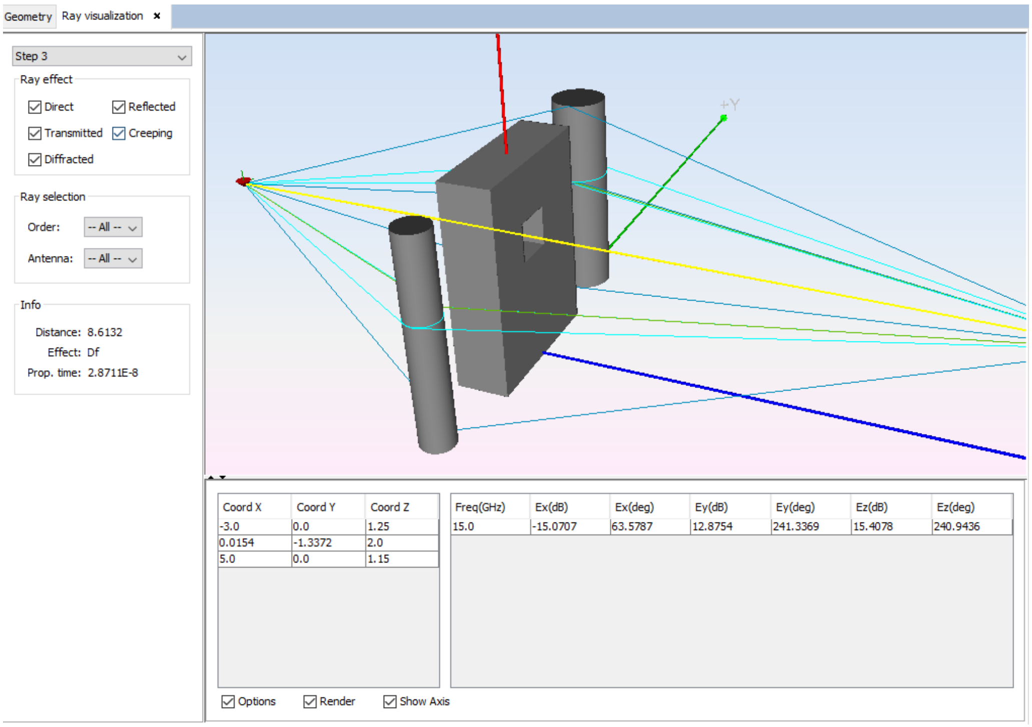
As the *Simulation – Parameters – Output-Ray Tracing* option has been selected, the ray representation may be visualized by clicking on ***Show Results – View Ray*** menu. This results are included for every parametric step in next figures.



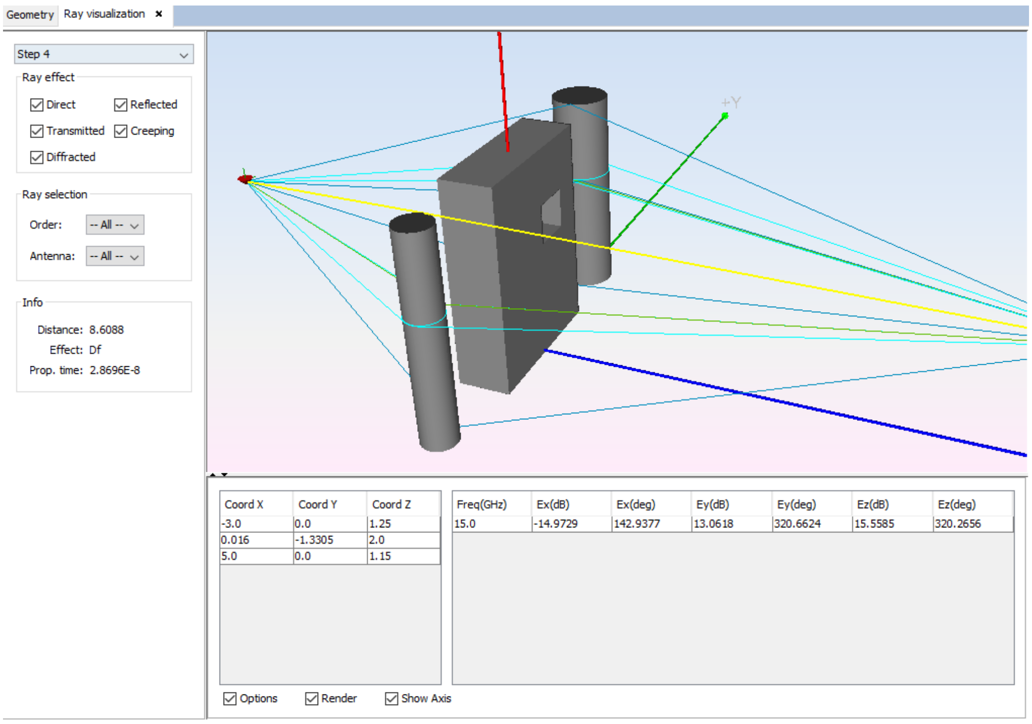
Ray tracing for geometric step 1



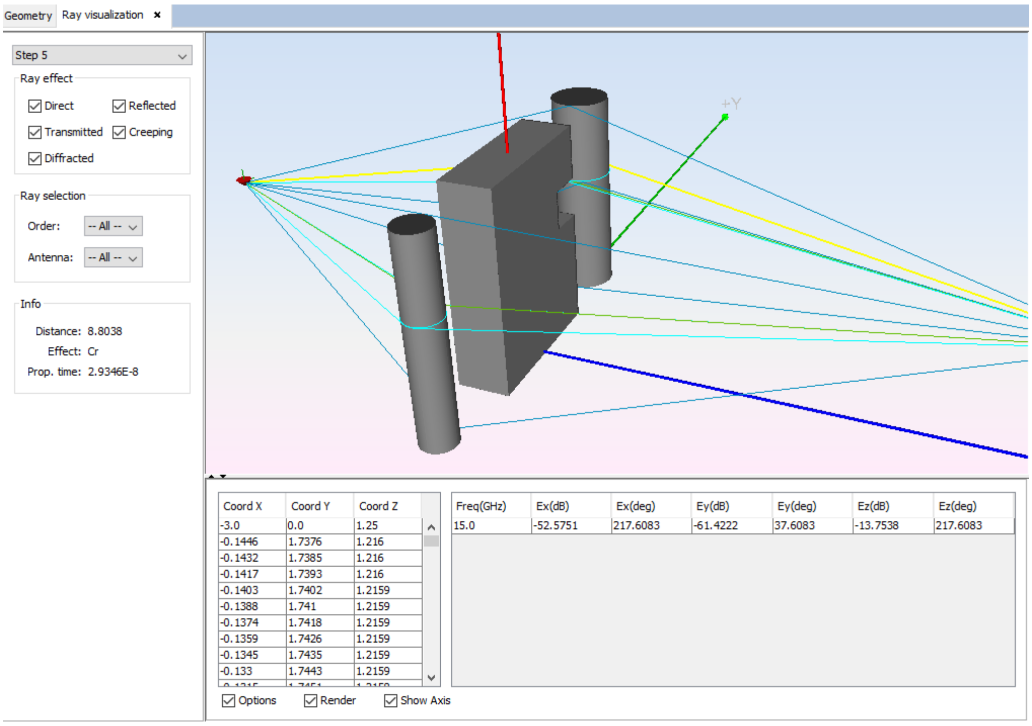
Ray tracing for geometric step 2



Ray tracing for geometric step 3



Ray tracing for geometric step 4



Ray tracing for geometric step 5

Finally, the *Coupling* results are compared in the below table.

Step	Coupling (dB)
1	-86.529124
2	-86.212910
3	-72.324066
4	-85.673293
5	-85.432255

Coupling results

4. CPU resources

The benchmark include a resume of the computational resources required for achieving the provided results step by step.

CPU type		Workstation / Personal Computer / Laptop	
Resources	Number of processors	RAM required (MB)	Time required (mm : ss)
Step 1	4	400	2 : 15
Step 2	4	400	2 : 11
Step 3	4	400	2 : 13

Step 4	4	400	2 : 15
Step 5	4	400	2 : 09

Resources resume

5. Geometry and project files

The geometry file (or script) and the newFASANT project are included whenever the considered cases are distributable.

The script shown in next figure is included as “GTD-Coupling.nfs”.

```
#
#  newFASANT script file
#
# Creates the geometry considered in "newFASANT - GTD - Coupling" example
# that has a box with its base centred at the origin and a rectangular hole
# and two cylinders at each side along the Y axis.
# The geometry has the following specifications:
#  BoxCenterX: X coordinate of the base box centre
#  BoxCenterY: Y coordinate of the base box centre
#  Heigth: height of the box and cylinders, in Z dimension
#  BoxWidth: Width of the box, in Y dimension
#  BoxDepth: Depth of the box, in X dimension
#  HoleCenterY: Y coordinate where the box hole is centred
#  HoleCenterZ: lower Z coordinate of the box hole
#  HoleEdge: Size edge of the box hole, in Y and Z dimensions
#  R1: Radius of the thinnest cylinder, in XY dimensions
#  R2: Radius of the width cylinder, in XY dimensions
#  t: Auxiliary parameter to parametrize the hole Y coordinate
#     and the cylinders radii
#
# Parameters with fixed values
#
set BoxCenterX {0.0}
set BoxCenterY {0.0}
set Height {2.0}
set BoxWidth {0.5}
set BoxDepth {1.5}
set HoleCenterZ {1.1}
set HoleEdge  = BoxDepth/4.0
#
# Parameters with variable values
#
set t [0.0,0.9] 5
set HoleCenterY  = t*BoxDepth
set R1  = 0.15*(1+t/5.0)
set R2  = 0.25*(1+t/8.0)#
#
# Auxiliary parameters defined automatically
#
set $1  = BoxCenterX-BoxWidth/2.0
```

```
set $2  = BoxCenterY-BoxDepth/2.0
set $3  = -BoxDepth
set $4  = (BoxCenterY-BoxDepth/2.0)-(HoleCenterY/2.0)
set $5  = (BoxCenterY-BoxDepth/2.0)-(HoleEdge/2.0)
set $6  = (BoxCenterY-BoxDepth/2.0)+HoleCenterY-(HoleEdge/2.0)
#
# Create the geometry
#
box -n mainBox -p $1 $2 0.0 BoxWidth BoxDepth Height
cylinder  -n leftCylinder -p 0.0 $3 0.0 R1 Height
cylinder  -n rightCylinder -p 0.0 BoxDepth 0.0 R2 Height
box -n holeBox -p $1 $6 HoleCenterZ BoxWidth HoleEdge HoleEdge
booleanDifference -s -objectA mainBox -objectB holeBox -n boxWithHole
```

newFASANT script

The project is also included with the name "GTD-Coupling.nfp".