Antenna Design With HFSS   Department of Engineering

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Worksheet 08 - Helix

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Recommended Citation

Worksheet: Helical antenna

Objectives:

In this session, you will

1. Create a helical antenna and observe its operation in the axial or the end-fire mode at 3GHz.

Part 1: setting up the variables

Step 1: open Ansys electronic desktop, go to HFSS - >HFSS

Step 2: go to the modeler tab ->units and change the units to cm.

Step 3: then go to the HFSS tab -> design properties and enter the following variables. Hit apply and then OK.

Name	Value	Unit	Evaluated V...	Type	Description	Read-only	Hidden
LoopRadius	1.6	cm	1.6cm	Design		☐	☐
wireRadius	0.15	mm	0.15mm	Design		☐	☐
Pitch	2	cm	2cm	Design		☐	☐
AntennaLength	12	cm	12cm	Design		☐	☐

Part 2: drawing the helix

Step 4: change the viewing plane to XZ.

Grid
XZ ▼
3D ▼
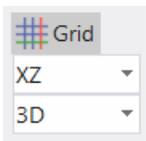
Step 5: draw a circle on the XZ plane. This will be the cross section of the helix.

Step 6: double click on CreateCircle and change its properties as follows;

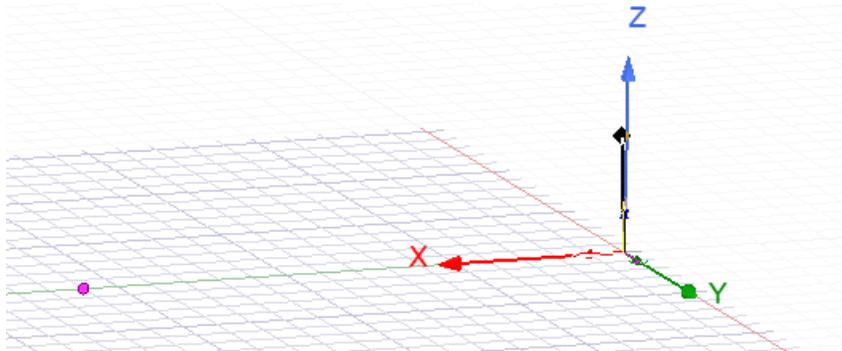| Name	Value	Unit	Evaluated Value	
Command	CreateCircle			
Coordinate System	Global			
Center Position	1.6 ,0 ,0	cm	1.6cm , 0cm , 0cm	
Axis	Y			
Radius	wireRadius		0.15mm	
Number of Segments	0		0	

Step 7: hit apply then OK.

Step 8: change the viewing plane back to XY. You may want to adjust the viewing plane manually as well.

| # Grid |
|--------|
| XY ▼ |
| 3D ▼ |
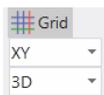
Step 9: click on the cross sectional circle that we drew right now. You may see that the draw helix feature is available now.

Step 10: click on draw helix then, click on the center of the coordinate system and draw the mouse around the z-axis.

Step 11: this will also open a pop-up window and for now hit OK on that with default settings.

Step 12: expand the unclassified model on the model pane.
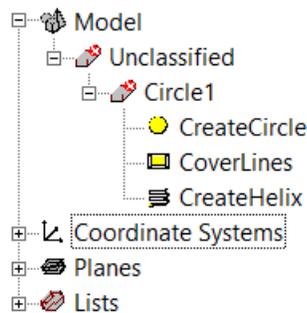
Step 13: double click on the CreateHelix and change its properties as follows;

Name	Value	Unit	Evaluated Value	
Command	CreateHelix			
Coordinate System	Global			
Center Position	0,0,0	cm	0cm , 0cm , 0cm	
Direction	0cm ,0cm ,AntennaLength		0cm , 0cm , 12cm	
Pitch	Pitch		2cm	
Radius Change Per Turn	0	cm	0cm	
Number of turns	6		6	
Right hand	✔			

Step 14: hit apply and then OK.

Step 15: hit fit all to see the full model.

Step 16: now double click on Circle 1 and change its material property to pec (perfect electric conductor) and this will change the helix material to pec as well.

Step 17: also change the color of the helix to any color you prefer by changing the color property under Circle1 .

Part 3: setting up the ground plane

Step 18: draw a circle on the XY plane.
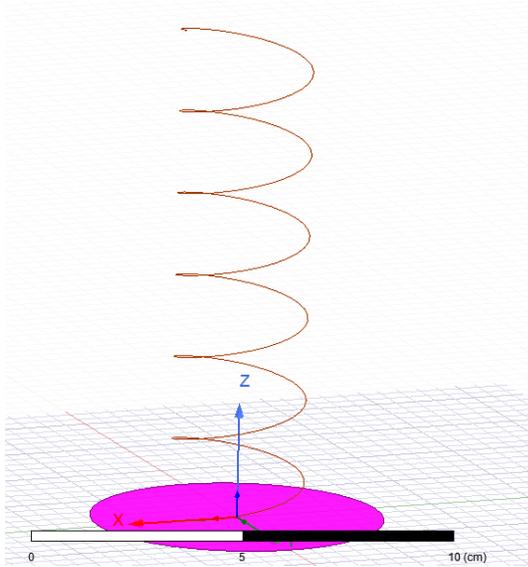
Step 19: double click on the Circle2 and change its properties as follows;

Name	Value	Unit	Evaluated V...	Description	Read-only
Name	GroundPlane				☐
Orientation	Global				☐
Model	✔				☐
Group	Model				☐
Display Wir...	☐				☐
Material Ap...	☐				☐
Color					☐
Transparent	0				☐

Step 20: hit apply then hit OK.

Step 21: double click on its create circle feature and change it properties as follows;

Name	Value	Unit	Evaluated Value	
Command	CreateCircle			
Coordinate System	Global			
Center Position	0,0,-2	cm	0cm , 0cm , -2cm	
Axis	Z			
Radius	3.75	cm	3.75cm	
Number of Segments	0		0	

Step 22: hit apply and then OK.

Step 23: right click on GroundPlane on model pane ->assign boundary ->perfect E. Leave the default name and hit OK.

Part 4: exciting the antenna

Step 24: change the viewing plane back to XZ.

Step 25: adjust the view and get a good view of the cross sectional area and the ground plane.

Step 26: draw a rectangle.

Step 27: double click on rectangle1 and change its name to excitation.

Step 28: double click on create rectangle feature and change its properties as follows;

| Name	Value	Unit	Evaluated Value
Command	CreateRectangle		
Coordinate System	Global		
Position	LoopRadius-wireRadius ,0 ,-2cm		15.85mm , 0 , -2cm
Axis	Y		
XSize	wireRadius*2		0.3mm
ZSize	2	cm	2cm

Step 29: hit apply then OK.

Step 30: now right click on Excitation on the model pane -> assign excitation -> port ->lumped port.
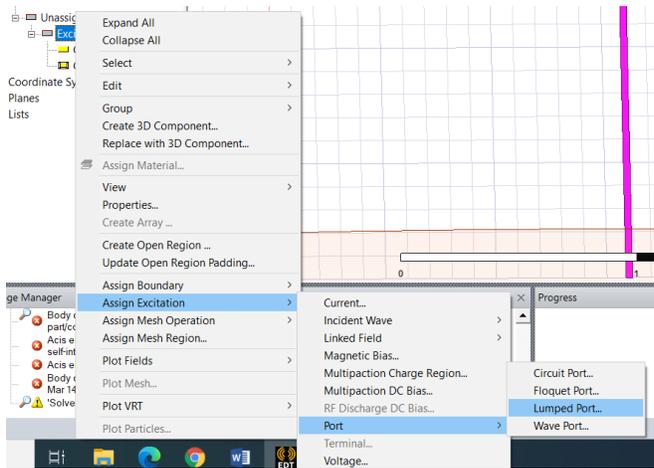
Step 31: leave the default setting on the first pop-up window and hit next.

Step 32: in the next pop-up window, select new line for the integration line. Click the center of the bottom edge of the excitation rectangle and click on the bottom center of the top edge.

Step 33: this will show the source integration line as follows and hit next.
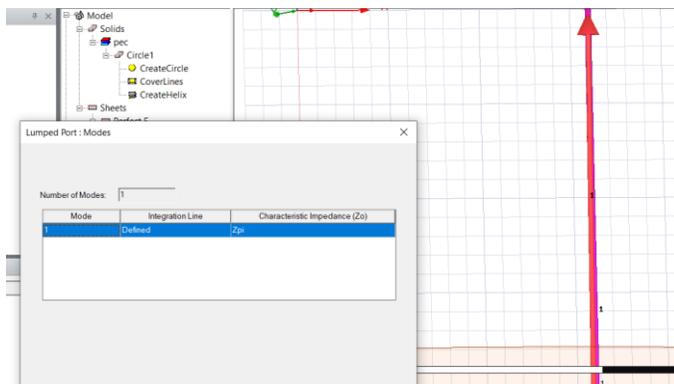
Step 34: hit do not renormalize and hit finish.

Step 35: hit fit all and change the viewing plane back to XY.

Part 5: setting up the radiation space

Step 36: draw a cylinder and double click on cylinder 1 to change its properties as follows;

| Name	Value	Unit	Evaluated V...	Description	Read-only
Name	RadiationSpace				☐
Material	"air"		"air"		☐
Solve Inside	✔				☐
Orientation	Global				☐
Model	✔				☐
Group	Model				☐
Display Wir...	☐				☐
Material Ap...	☐				☐
Color					☐
Transparent	0.76				☐

Step 37: hit apply and then OK.

Step 38: double click on the create cylinder feature and change its properties as follows;

Name	Value	Unit	Evaluated Value
Command	CreateCylinder		
Coordinate System	Global		
Center Position	0,0,-3	cm	0cm , 0cm , -3cm
Axis	Z		
Radius	5	cm	5cm
Height	20	cm	20cm
Number of Segments	0		0

Step 39: hit apply and then OK.

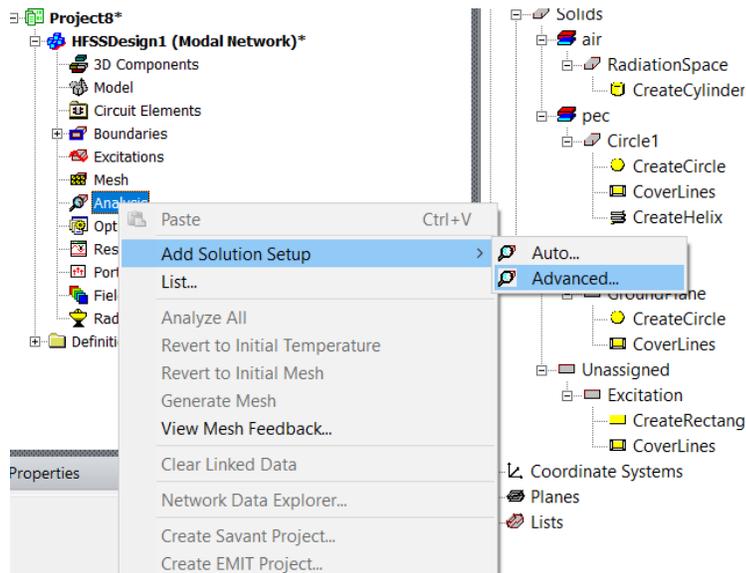Step 40: hit fit all to see the full model.
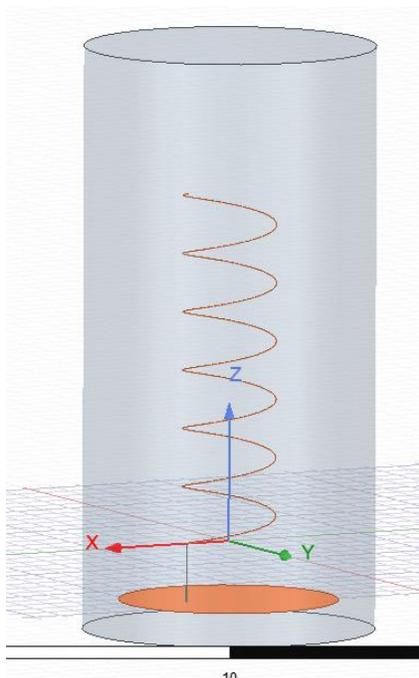
Step 41: right click on Radiation space in the model pane ->assign boundary ->radiation.
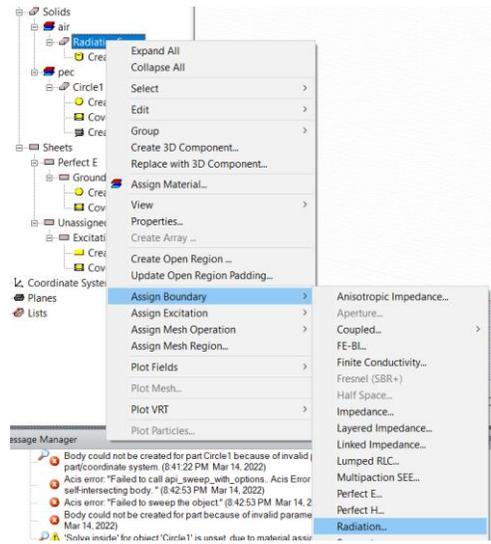
Step 42: leave the default name in the pop-up window and hit OK.

Part 6: setting up the analysis set-up

Step 43: right click on analysis on the project manager pane -> add solution setup ->advanced

Step 44: change the frequency to 3GHz and the number of passes to 20. Hit OK.

Step 45: in the next pop-up window change the sweep type to fast and the linear count to 101.

Step 46: go to the simulation tab and hit validate. Everything should be checked green.

Step 47: hit analyze all. This will run the simulation.

Part 7: observing the results

Step 48: right click on radiation in the project manager pane -> insert far field setup ->infinite sphere.

Step 49: leave the default settings in the pop-up window and hit ok.

Step 50: go to the results tab -> far field report -> 3D polar
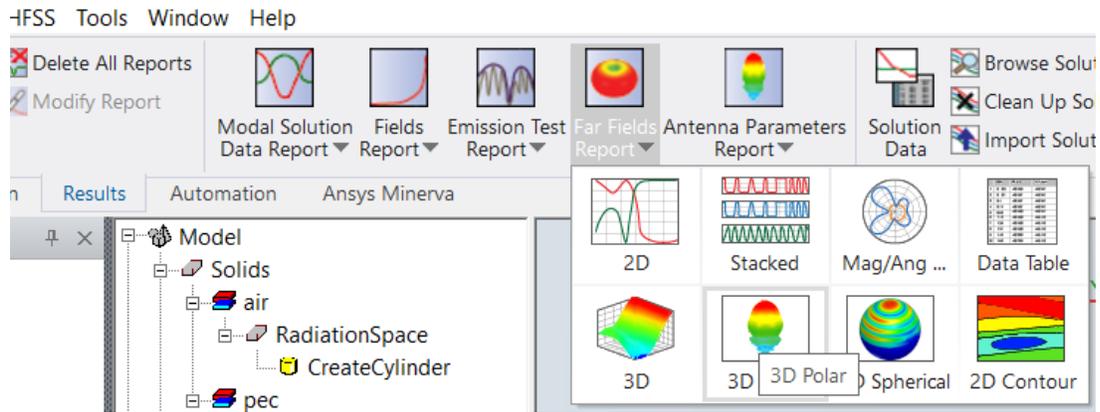
Step 51: from the pop up window select rE, rE total, abs, and hit new report. This will plot the radiating electric field. It will plot the following figure which you can upload to the learning management system;