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Worksheet 05 - Loop

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Worksheet: Loop antennas

Objectives:

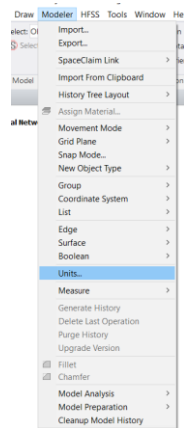
In this session, you will

1. Create a small loop that works at 10MHz.
2. Observe the radiation fields, gain and directivity

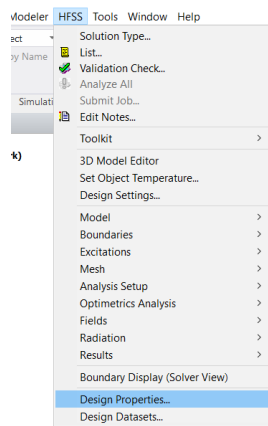
Part 1: setting up variables

Step 1: Ansys Electronics Desktop, go to HFSS tab->HFSS.

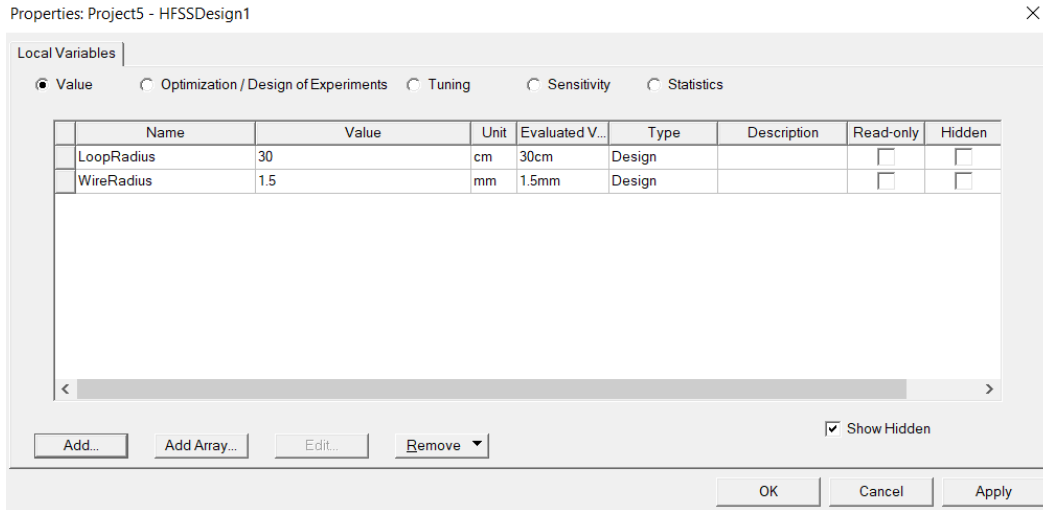
Step 2: go to the Modeler tab ->units and change the units to meters.



Step 3: go to the HFSS tab ->design properties.



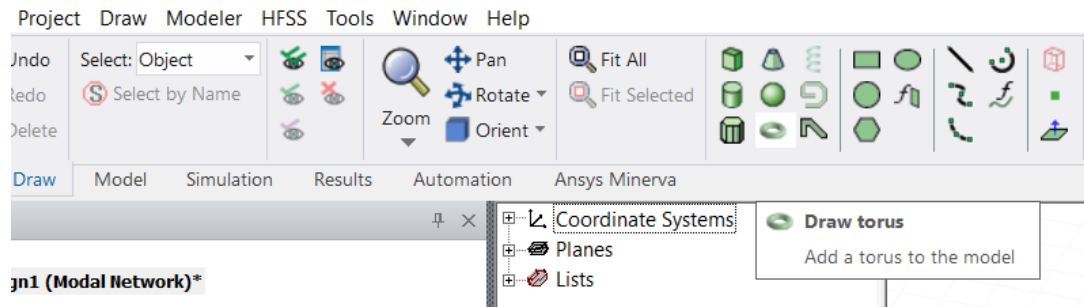
Step 4: in next pop-up window, hit the add button to add the following variables.



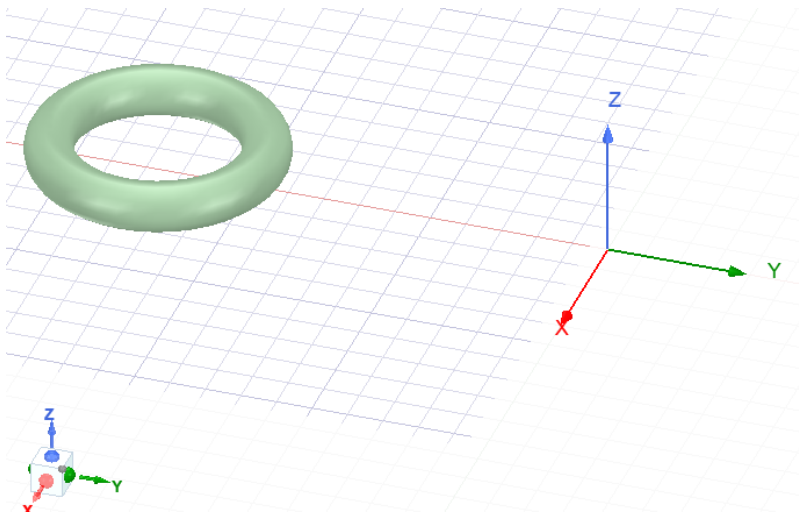
Step 5: hit apply then OK.

Part 2: building the loop

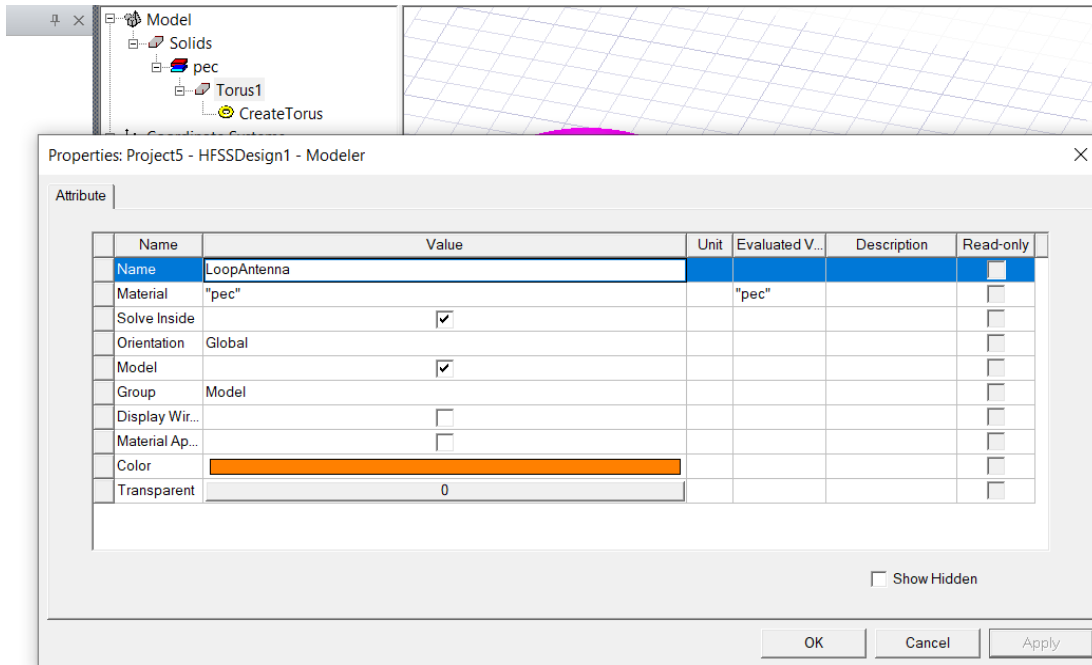
Step 6: go to the draw tab ->draw torus



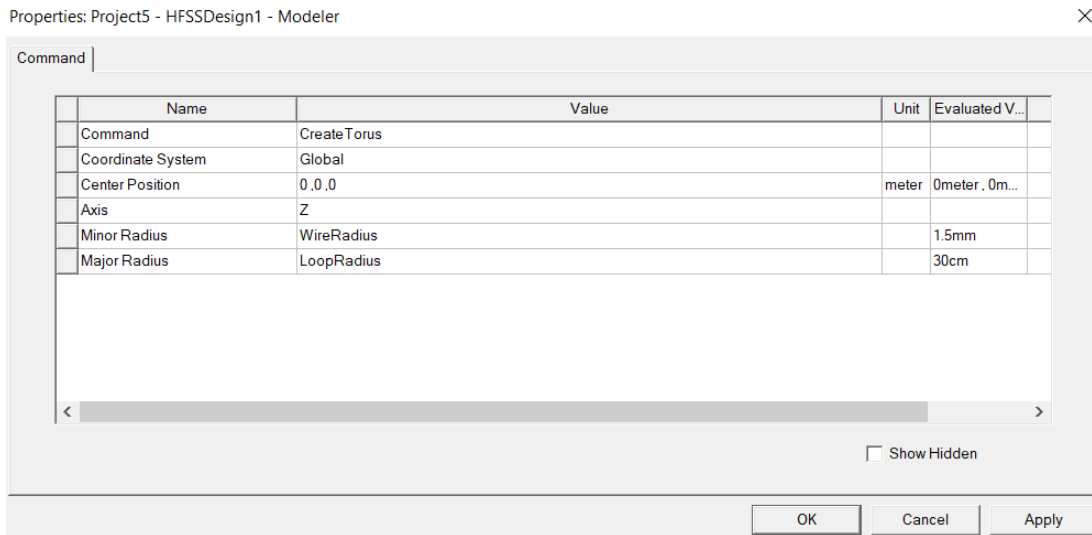
Step 7: draw a torus at a random location with arbitrary parameters.



Step 8: double click on Torus 1 in the model pane and change its properties as follows;



Step 9: now double click on create torus and change its properties as follows;

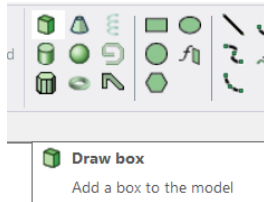


Step 10: hit apply then OK.

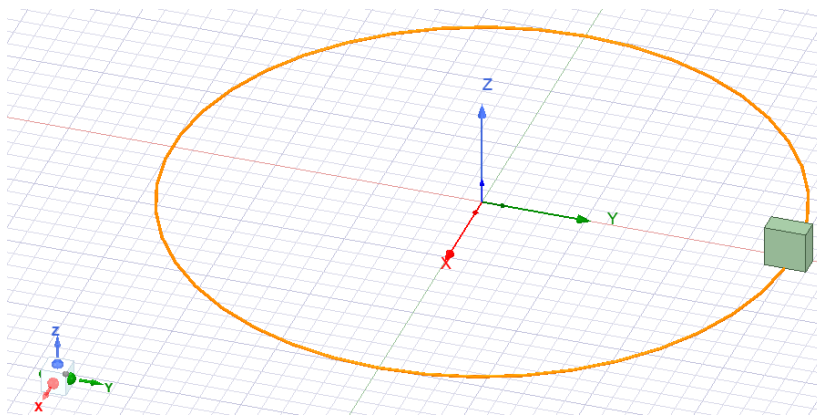
Step 11: hit fit all to see a zoomed view of the loop antenna.

Part 3: creating the feeder gap

Step 12: for this, go to the draw tab and ->draw box.

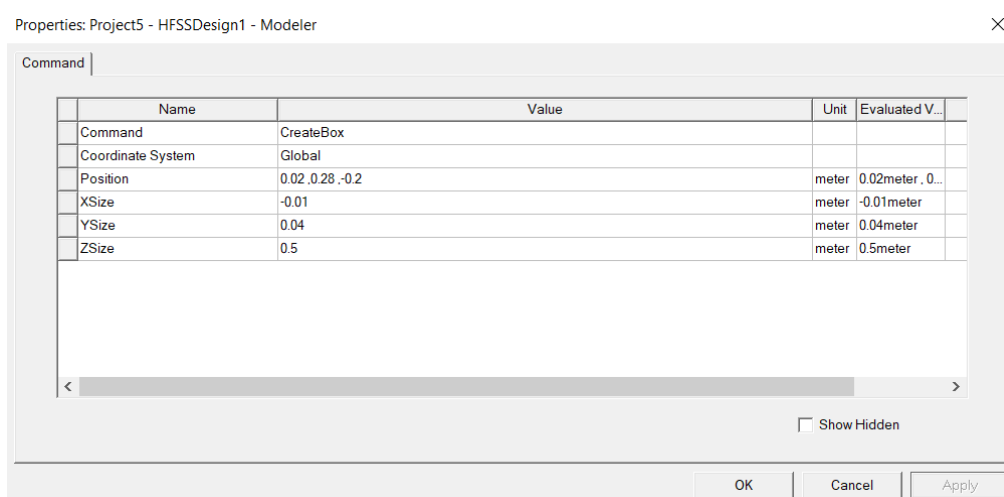


Step 13: instead of drawing the box at an arbitrary location, draw the box strategically on an axis, as shown in the figure below.



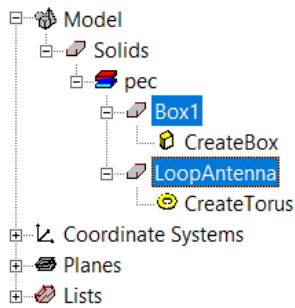
Step 14: now, double click on box 1 and change its material to pec.

Step 15: now, double click on create box and change its properties. Remember, here we are only interested in the x distance of the box (1cm) and that the box cuts through the loop. Other than that, you may use the default x and y position coordinates, and an arbitrary y size.

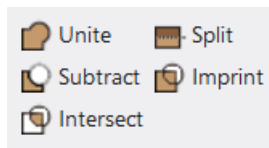


Step 16: hit apply then OK.

Step 17: now, while holding control select both box 1 and Loop antenna on the model pane.

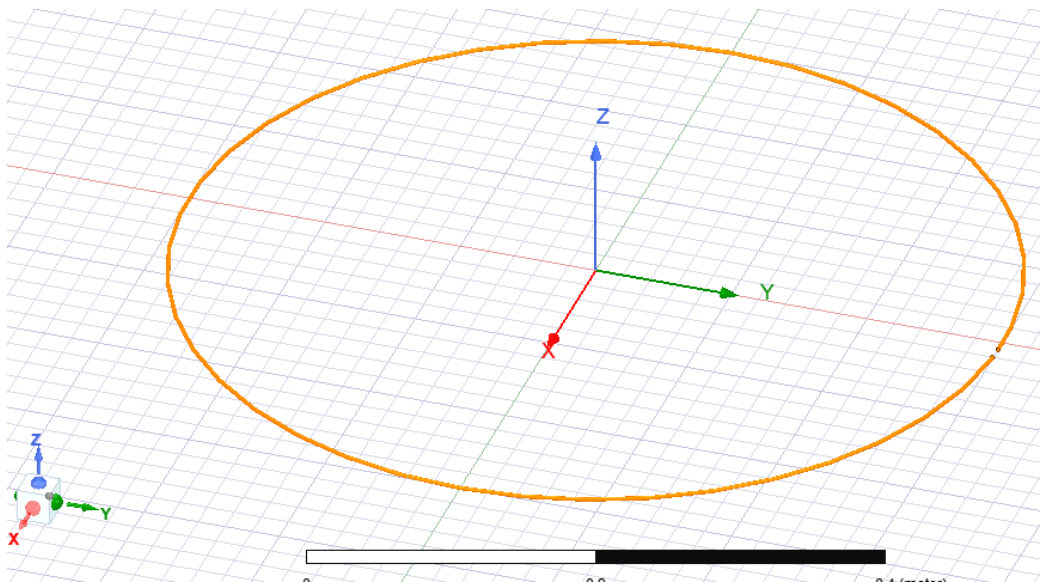


Step 18: then hit subtract



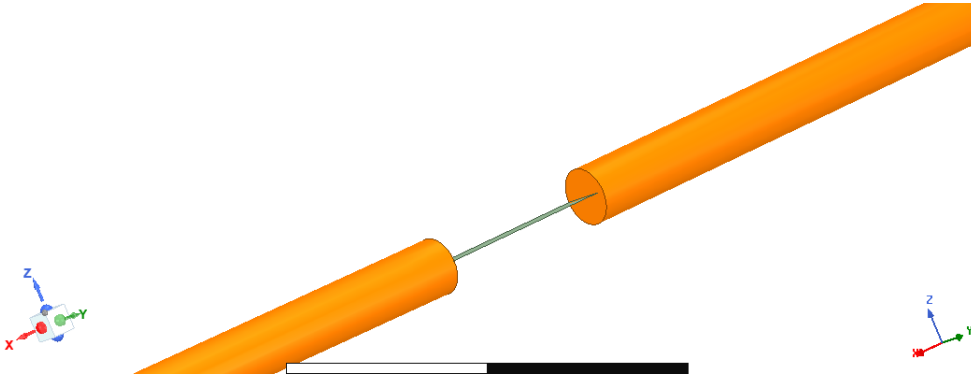
Step 19: in the next pop-up window make sure you have the loop antenna under blank parts and box 1 under tool parts. If not, select and use appropriate arrows to switch sides.

Step 20: after the proper subtract operation, you will see the following configuration with a small feeder gap.



Part 4: adding excitation

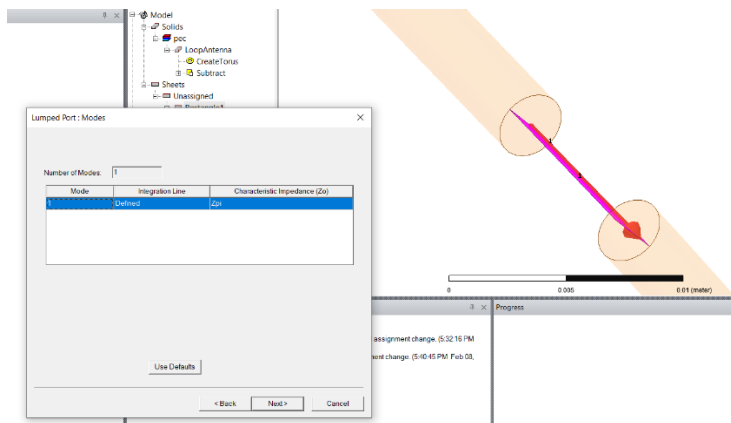
Step 21: for this zoom into the gap. If it helps adjust the viewing plane and the movement mode. Then draw a rectangular sheet between the gap. For this case, the movement mode was set to along Y axis.



Step 22: now right click on rectangle 1 on the model pane ->assign excitation ->port -> lumped port.

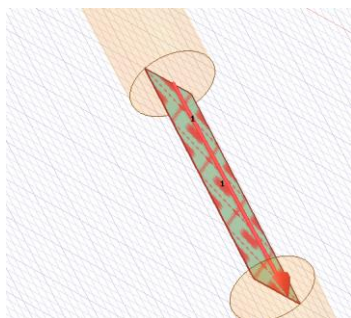
Step 23: leave the default value of 50 Ohms in the next window and hit next.

Step 24: in the second pop-up window set the integration line along the rectangle by clicking the at the center of one short edge and then on the center of the other short edge.



Step 25: check do not renormalize in the next window and hit finish.

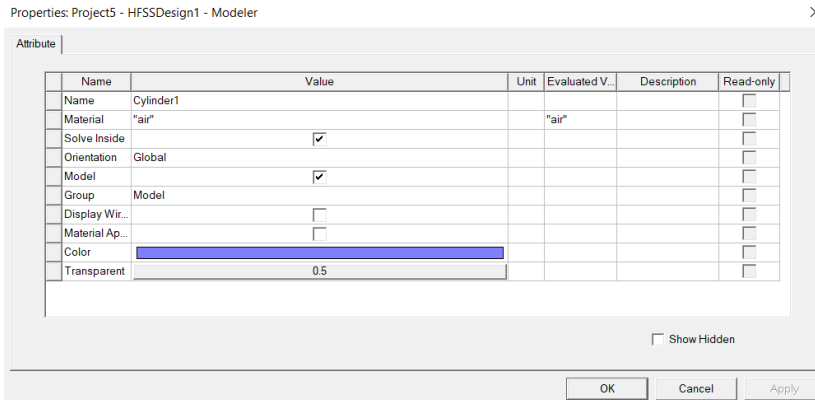
Step 26: to check whether excitation was set properly, go to the project manger pane, expand excitation and click on the source symbol. This will highlight the excited area.



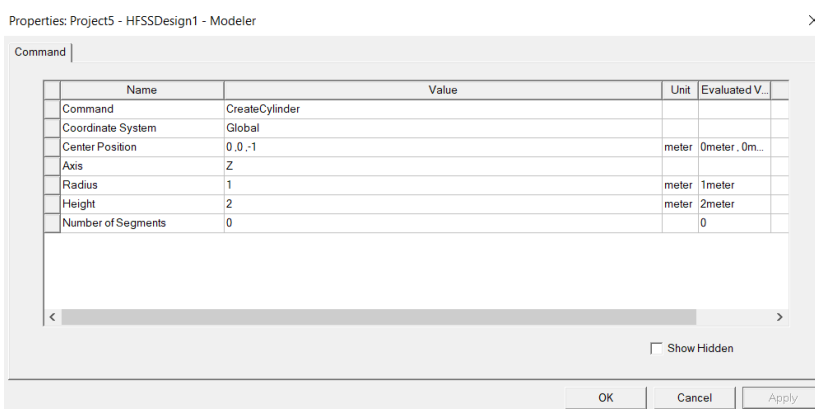
Part 5: adding the radiation space

Step 27: For this draw a cylinder at a random location with arbitrary parameters.

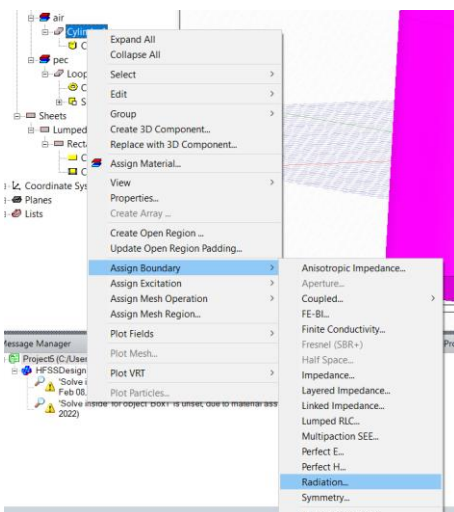
Step 28: double click on cylinder 1 and change its properties as follows; the hit apply and OK.



Step 29: now double click on create cylinder and change the dimensions.

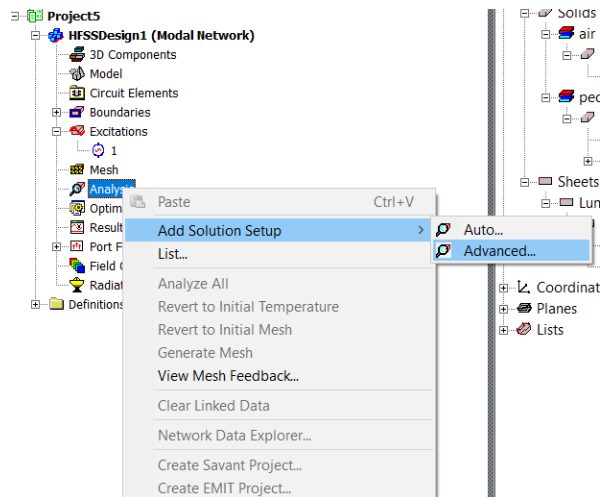


Step 30: right click on cylinder 1 ->assign boundary- radiation. In the pop-up window leave the default name and hit OK.



Part 6: setting up the solution

Step 31: right click on analysis -> add solution set up ->advanced



Step 32: in the next pop up window set the frequency to 10 MHz, and the number of passes to 20.

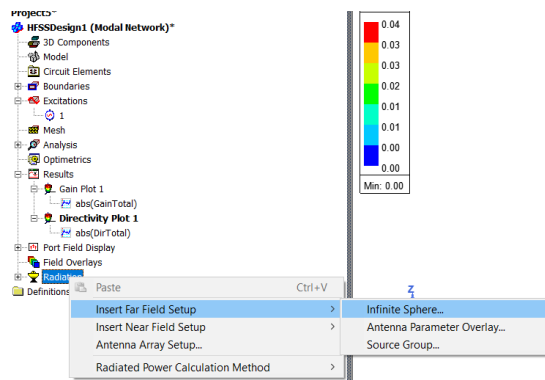
Step 33: in the next one, set the mode to fast and the count to 101. Then hit OK.

Part 7: simulating the loop antenna

Step 34: go to simulation tab ->validation and make sure all aspects are covered.

Step 35: go to simulation -> analyze all.

Step 36: once the simulation is complete, right click on radiation in the project manager pane - >insert far field set up - >infinite sphere

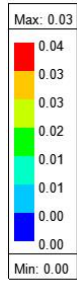


Step 37: leave the default settings for the far field parameters and hit OK.

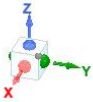
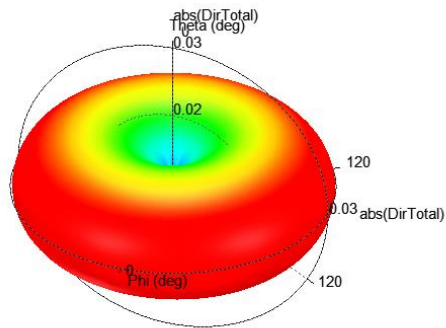
Step 38: go to results ->far field reports -> 3D polar

Step 39: in the parameter selection window, select directivity, directivity total, abs

Step 40: you will get a plot similar to this. Why the directivity is so low? Upload this plot to the learning management system.



Directivity Plot 1



Step 41: go to HFSS 3D model editor and increase the loop radius. You may also want to increase the dimensions of the radiation space and the excitation sheet. What happens to the gain now? Upload the new directivity plot to the learning management system.

Step 42: discuss why the gain is very low for the loop antenna and how to increase it.