Antenna and Radio Propagation

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Midterm Lab

Design & Analysis of UWB Patch Antenna

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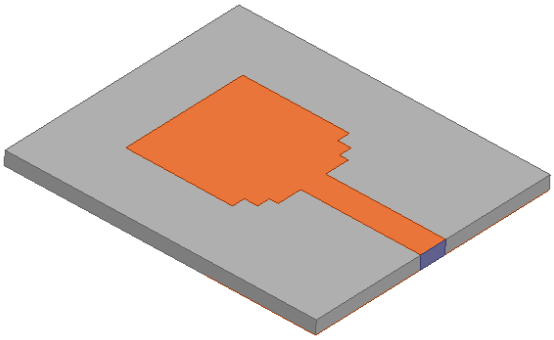
1 (a) Design & Analysis of a UWB Patch Antenna

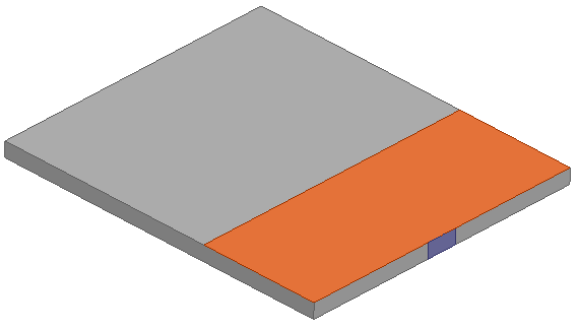
Design a UWB antenna according to the dimensions given in the figure below and complete the following tasks in HFSS:

- Draw a geometric model.
- Modify a model's design parameters.
- Assign variables to a model's design parameters.
- Specify solution settings for a design.
- Validate a design's setup.
- Run an HFSS simulation.
- Create a 2D x-y plot of S-parameter results.
- Create a 2D x-y plot of gain, efficiency results.
- Create a 2D Polar/Rectangular plot of radiation pattern.
- Create a 3D plot of radiation pattern.
- Create a field overlay plot of results.

1 (b) Project overview



(3D-Top view)



(3D-Bottom view)

2 Create the Model (All parameters are in 'mm')

Different Parameters

Name	Value	Unit	Evaluated Value	
lp	15	mm	15mm	Design
wp	14.5	mm	14.5mm	Design
hs	1.6	mm	1.6mm	Design
wf	3.2	mm	3.2mm	Design
lf	13.5	mm	13.5mm	Design
lsl1	3	mm	3mm	Design
wsl1	1	mm	1mm	Design
lsl2	1.5	mm	1.5mm	Design
wsl2	1.5	mm	1.5mm	Design
ls	30	mm	30mm	Design
ws	35	mm	35mm	Design
wg	12.5	mm	12.5mm	Design

The detail design procedure is shown in this YouTube video. You may check this link: https://www.youtube.com/watch?v=Q72F-uIB_ng&t=38s

Substrate:

1. 'Substarate'. Centre (-ls/2 ,-ws/2 ,0mm), X size = ls, Y size= ws, Z size = hs
2. Assign Material 'FR4' to Substrate.

Radiation Patch

3. Centre (-lp/2, ws/2-lf, hs), X size = lp, Y size= -wp

Slots on the Patch

4.'Slot1', Centre (lp/2, ws/2-lf, hs), X size = -lsl1, Y size= -wsl1

5.Slot1_2', Centre (lp/2, ws/2-lf-wsl1, hs), X size = -lsl2, Ysize=-wsl2

6.'Slot2', Centre (-lp/2, ws/2-lf, hs), X size = lsl1, Y size= -wsl1

7.'Slot2_2' Centre (-lp/2, ws/2-lf-wsl1, hs), X size = lsl2, Ysize=-wsl2

8. Select all slots (Slot1, Slot1_2, Slot2, Slot2_2) and Unite all.
9. Now Subtract the object created in Step 7, from Patch.
10. Assign 'Perfect E' Boundary to the object created in Step 8.

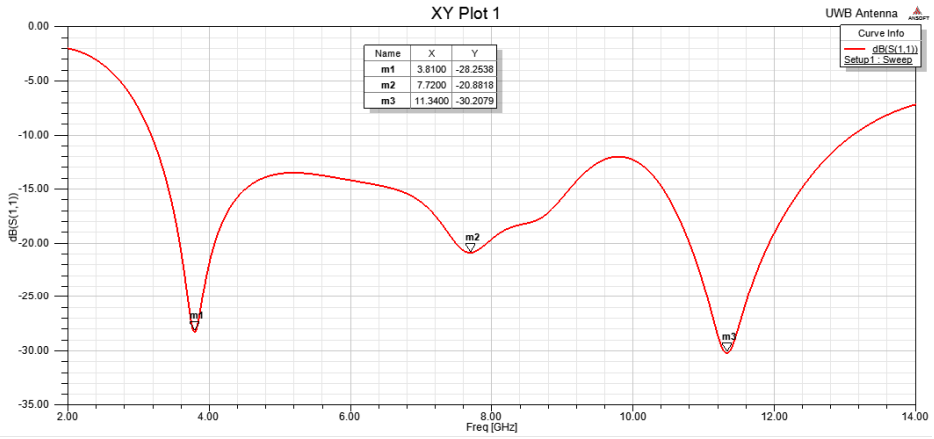
Feedline

11. 'Feed', Centre (-wf/2, ws/2, hs), X size = wf, Y size = -lf
12. Assign 'Perfect E' Boundary to Feed.

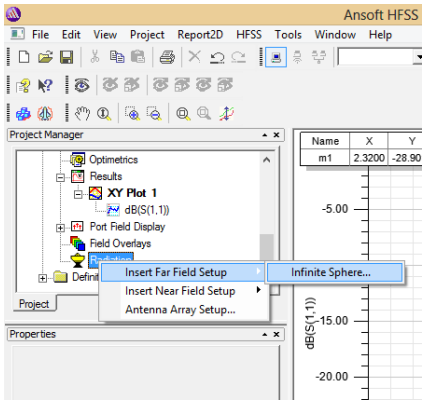
GroundPlane

13. Create Rectangular Sheet > Rename as 'Ground', Centre (-ls/2, ws/2, 0), X size = ls, Y size = -wg
14. Assign 'Perfect E' Boundary to Ground.
15. Create Rectangular Box > Rename as 'RadBox', Centre (-ls/2-15mm, -ws/2-15mm, -16 mm), X size = ls+30mm, Y size = +ws+30mm, Z size = 32 mm

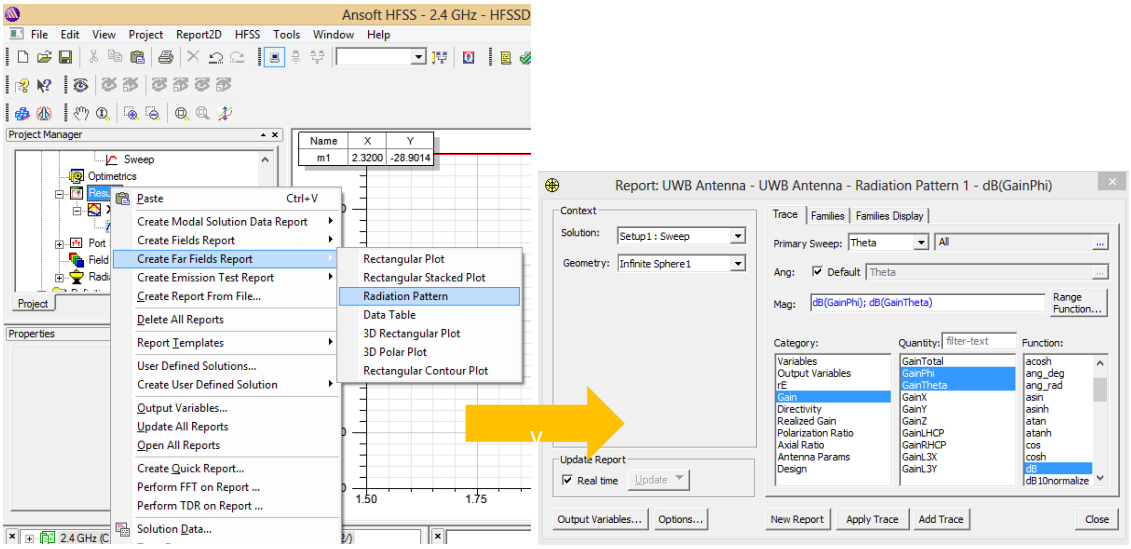
16. Assign Material ‘Air’ to RadBox.
17. Assign Radiation only Boundary to RadBox.
18. Change coordinate to > ZX
19. Create Rectangular Sheet > Rename as ‘Port’, Centre (-wf/2, ws/2, 0 mm), X size = wf, Z size = hs
20. Assign Lumped Port Excitation between the ground plane and feed line as shown below.
21. Right Click on analysis > Add solution setup → add 7.5 GHz > Ok
22. Click ‘+’ of the analysis → Right click on setup → Add frequency sweep → Edit frequency sweep (Sweep type Fast, Frequency range 2 GHz to 14 GHz, Step size 0.01 GHz) → Ok
23. Now Validate All > Analyze All (Simulation)
24. Right click on results > Do as follows…for $|S_{11}|$



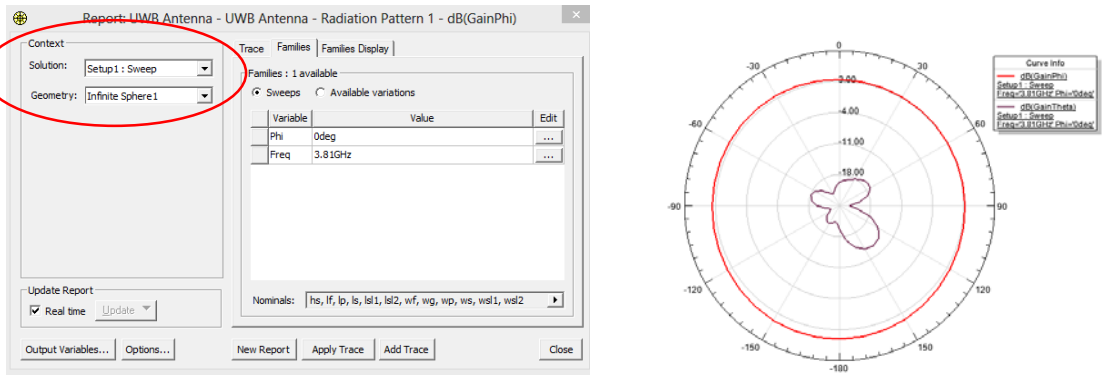
25. Right click on Radiation > Do as follows…for radiation pattern



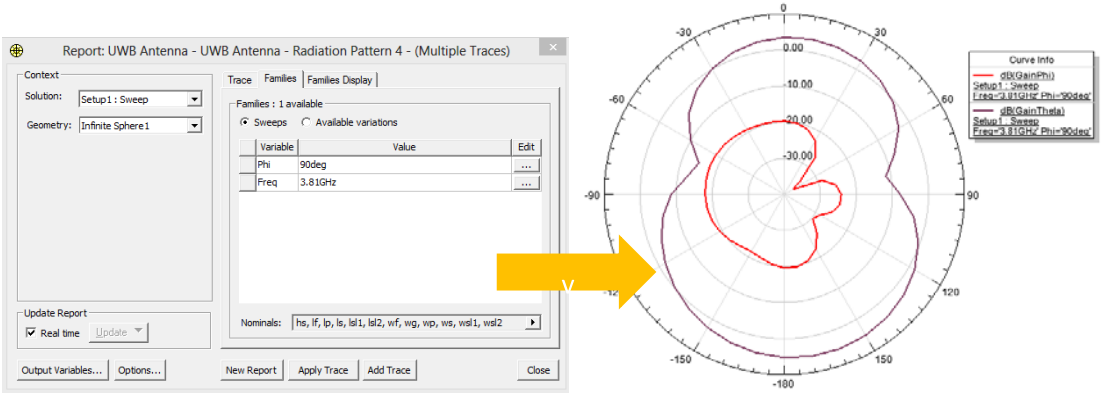
For Example: at 3.81 GHz



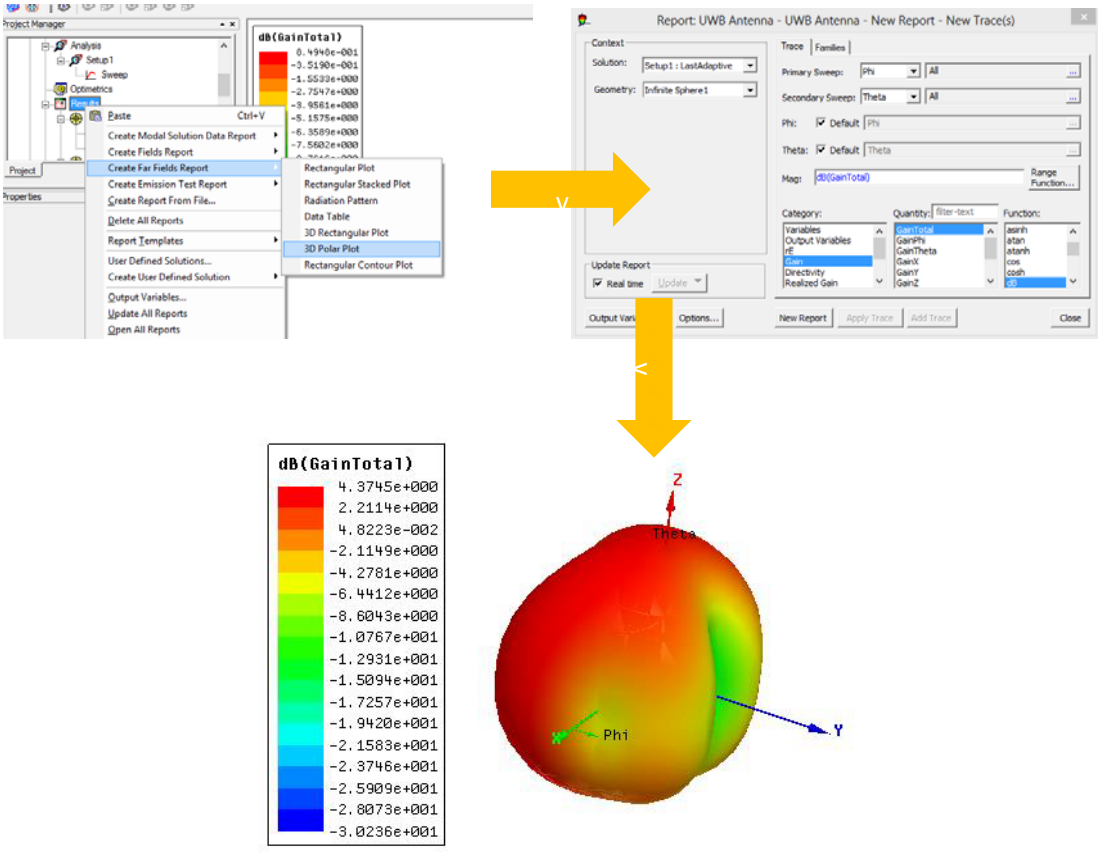
Select Solution type: Sweep
Then go to Families and do as follows for Phi = 0 Degree



Then go to Families and do as follows for Phi = 90 Degree



27. Draw 3D polar plot. Follow the below procedure:



完成要求：

1. 完成建模
2. 仿真S11参数
3. 仿真3.8GHz 和 11.3GHz phi=0 degree 和 phi=90 degree 的方向图.
4. 仿真3D方向图 Total Gain @7.7GHz.
5. 完成一个报告上交并提交文件。