Lab4 Introduction to CST Software for transmission simulation

Name _____ Student ID _____

TA _____ Score _____

Objectives

1. To learn to use 3D electromagnetic simulation software CST;
2. To master the basic setting of electromagnetic simulation and how to draw graphics;
3. To master the test method of simulation results;
4. To master the method of simulating reflection coefficient and refraction coefficient with CST.

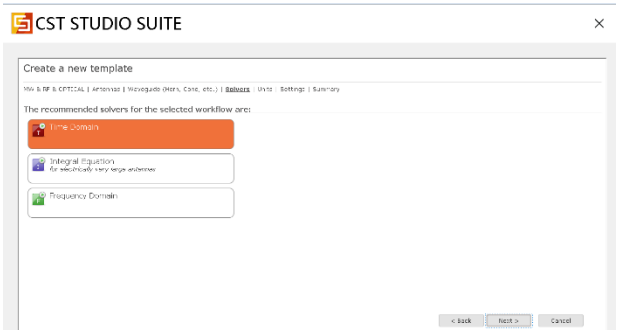
What is CST?

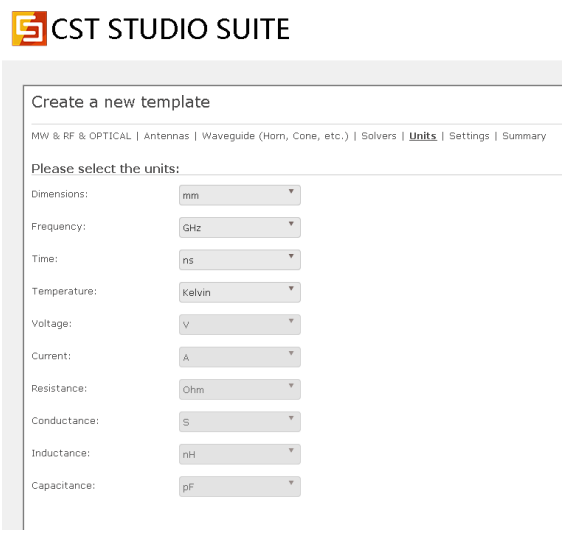
CST MICROWAVE STUDIO® is a fully featured software package for electromagnetic analysis and design in the high frequency range. It simplifies the process of inputting the structure by providing a powerful solid modeling front end which is based on the ACIS modeling kernel. Strong graphic feedback simplifies the definition of your device even further. After the component has been modeled, a fully automatic meshing procedure is applied before a simulation engine is started. A key feature of CST MICROWAVE STUDIO® is the Method on Demand™ approach which allows using the simulator or mesh type that is best suited to a particular problem.

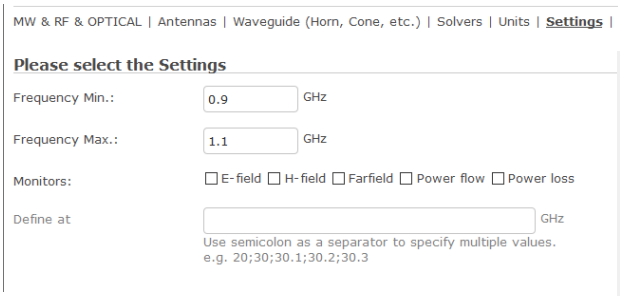
Procedure

1. Start CST DESIGN ENVIRONMENT™ and choose to create a new CST project

After starting CST DESIGN ENVIRONMENT, choose to create a new CST MICROWAVE STUDIO project. You will be asked to select a template for a structure which is closest to your device of interest, but you can also start from scratch opening an empty project：MW&RF&OPTICAL->Antennas->next->waveguide->next->Time domain->next-> Define the Units ->Next->finish







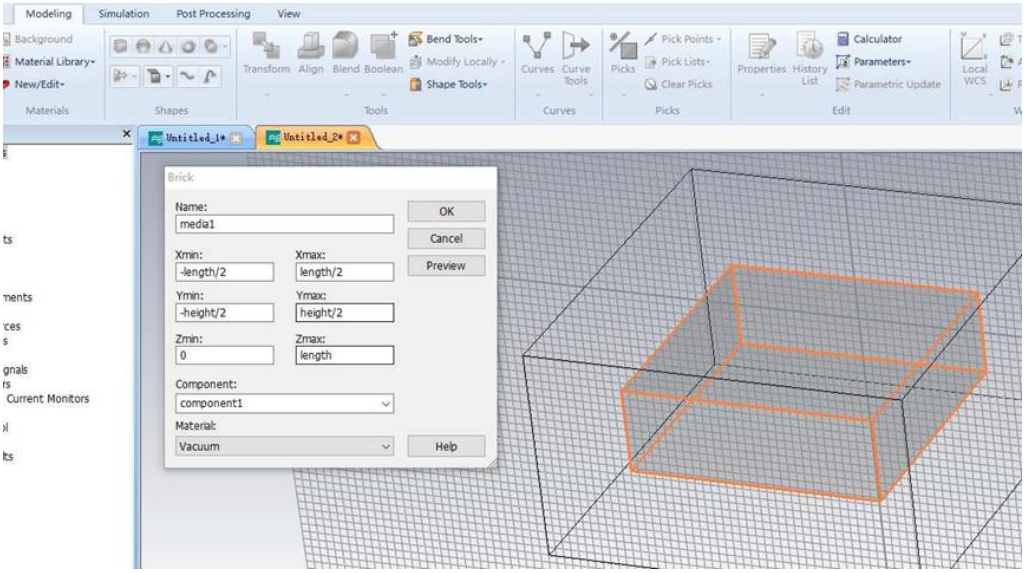
2. Incident from lossless material to lossless material

(1) In the parameter list, set the parameters needed for the experiment, lambda is the wavelength, frequency is the experimental frequency, height is the height of the cube, and length is the length of the cube.

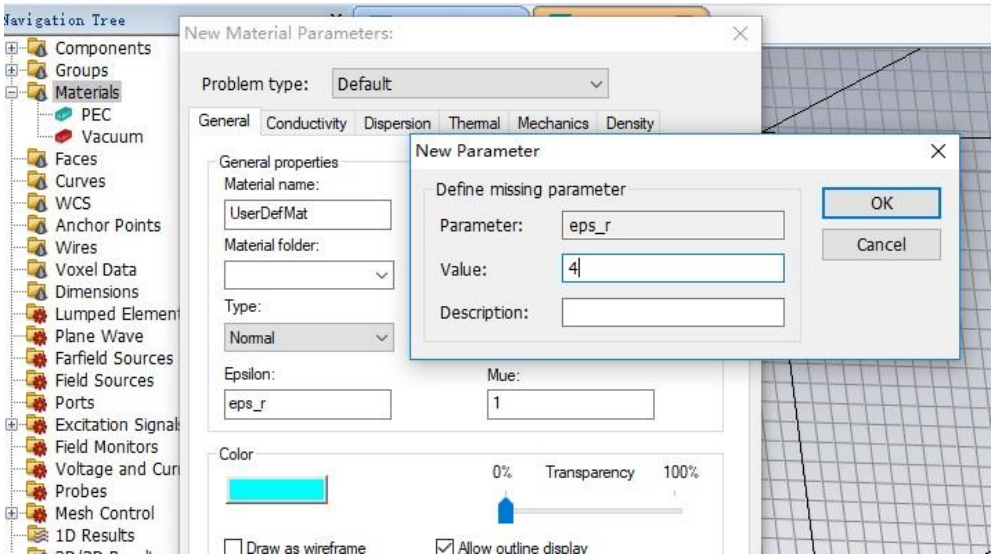
Parameter List

Name	Expression	Value	Description
lambda	= clight/frequency*1e3	299.792458	
frequency	= 1e9	1e9	
height	= 100	100	
length	= 1*lambda	299.792458	
<new parameter>			

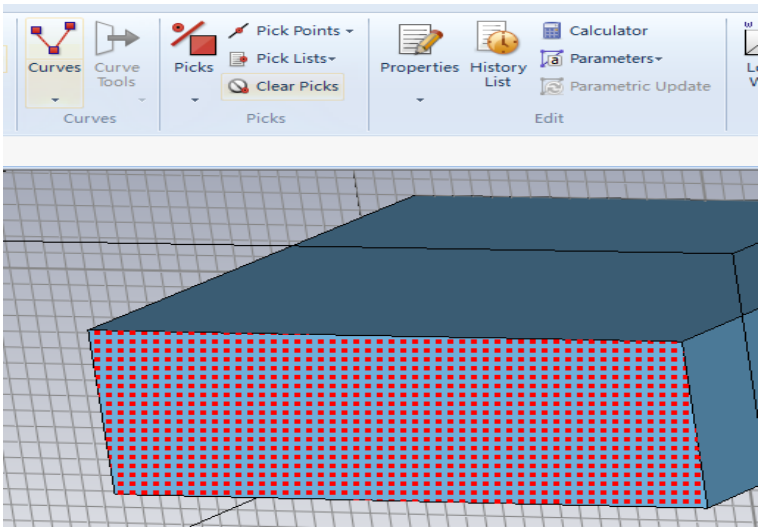
(2) Click the cube in Modeling-Shapes, and press the ESC key to enter the setting, as shown in the figure below. Preview the image and click OK to save the settings.



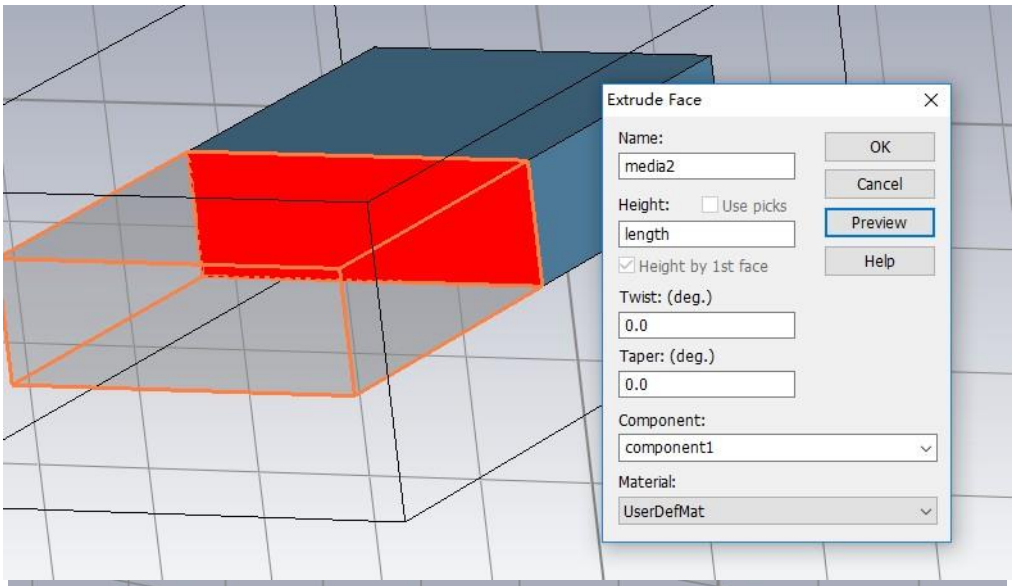
(3) Right click “Materials” in the left sidebar, select “New Material”, and set “Epsilon” to eps_r, and set the parameter values as shown in the figure below

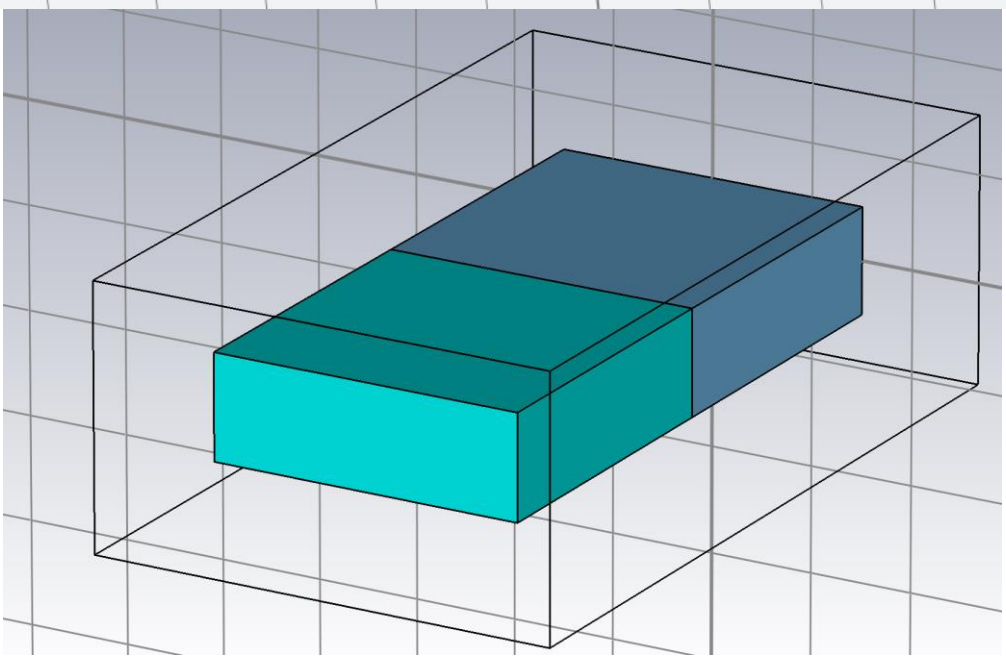


(4) Click Simulation ->Picks, select the surface in XY plane and double-click

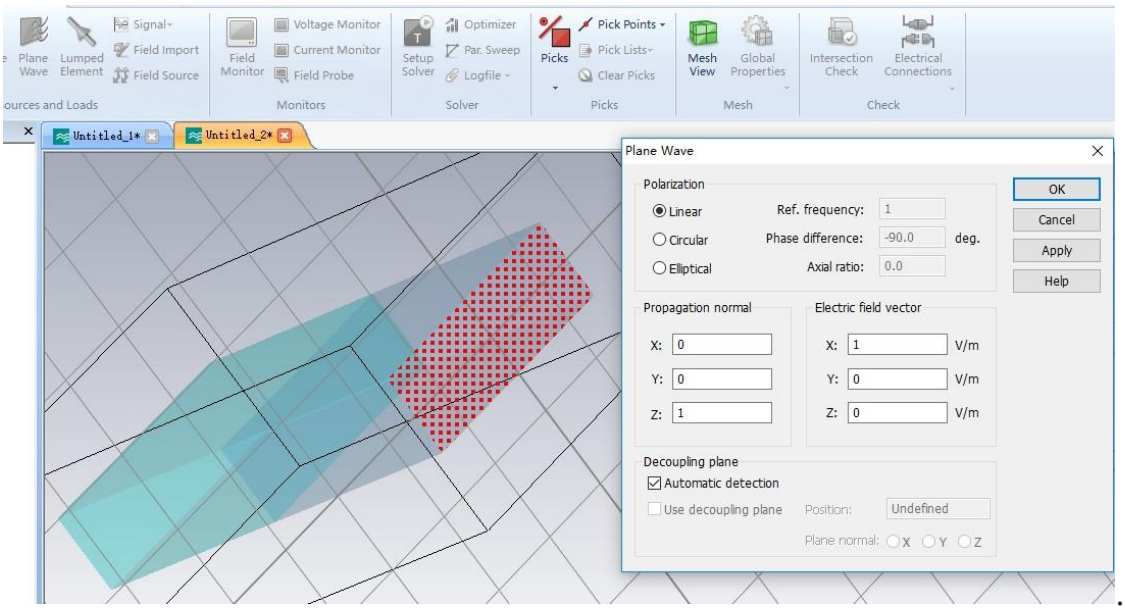


(5) Click Modeling—>Shapes—> Extrusions, set parameters as shown in the figure below. Note that the material is changed to be UserDefMat. Preview and click OK.

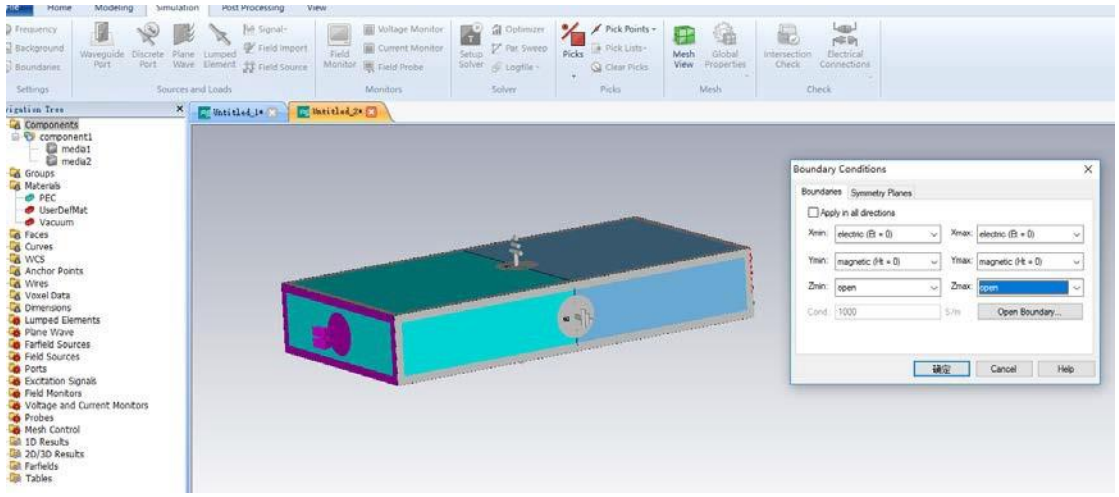




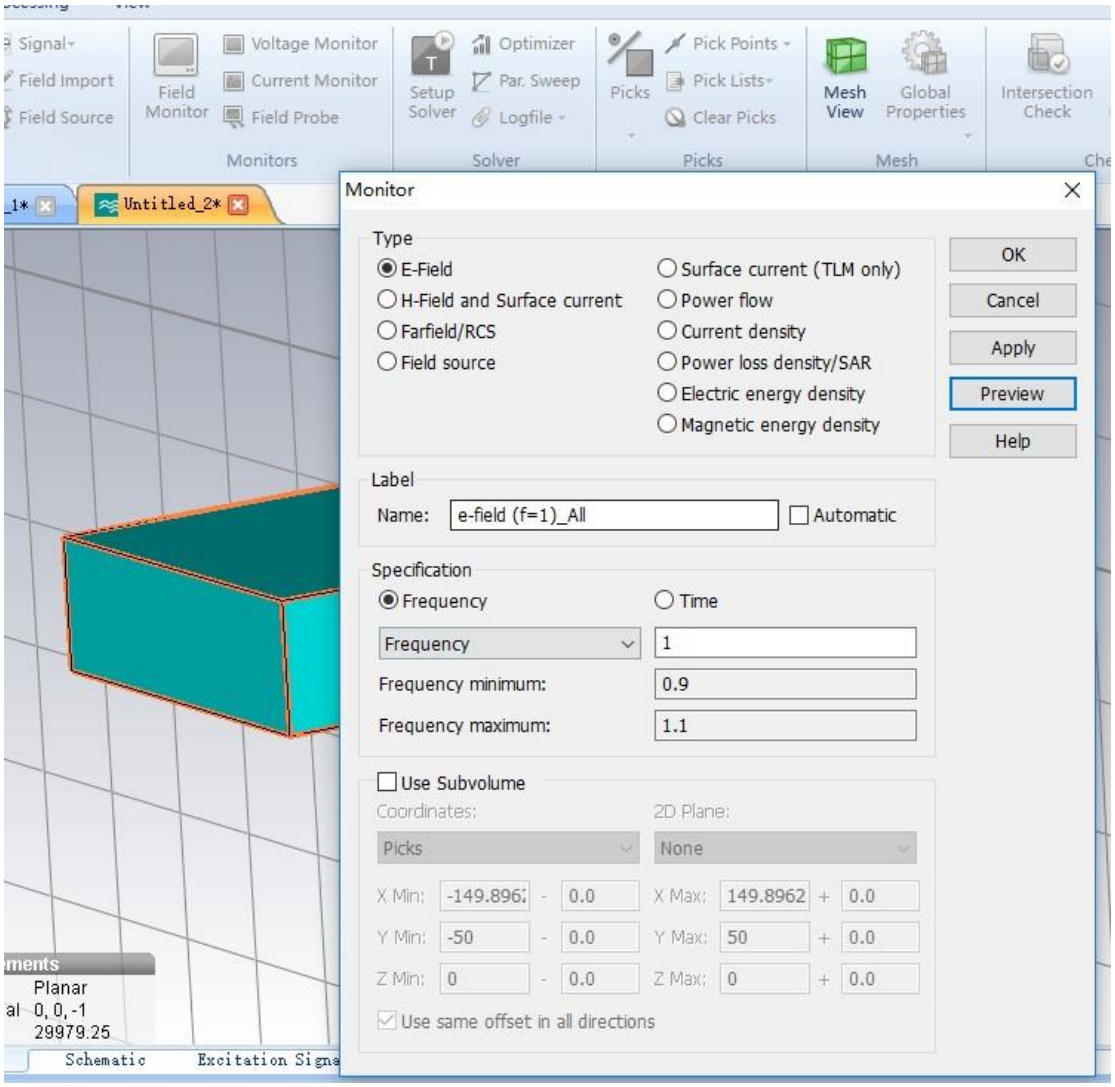
(6) Click Simulation—>Plane Wave, set parameters as shown in the figure and click OK.



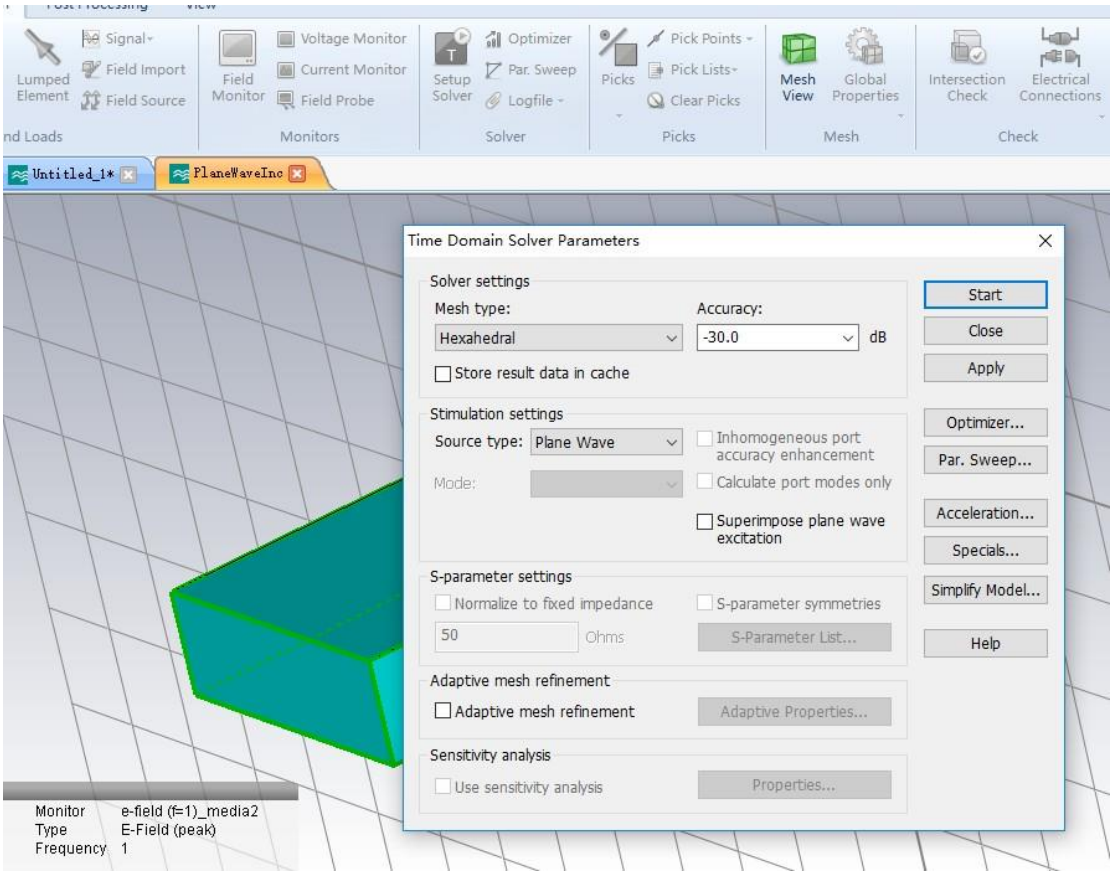
(7) Click Simulation—>Boundaries and the settings are as shown in the figure below and click OK.



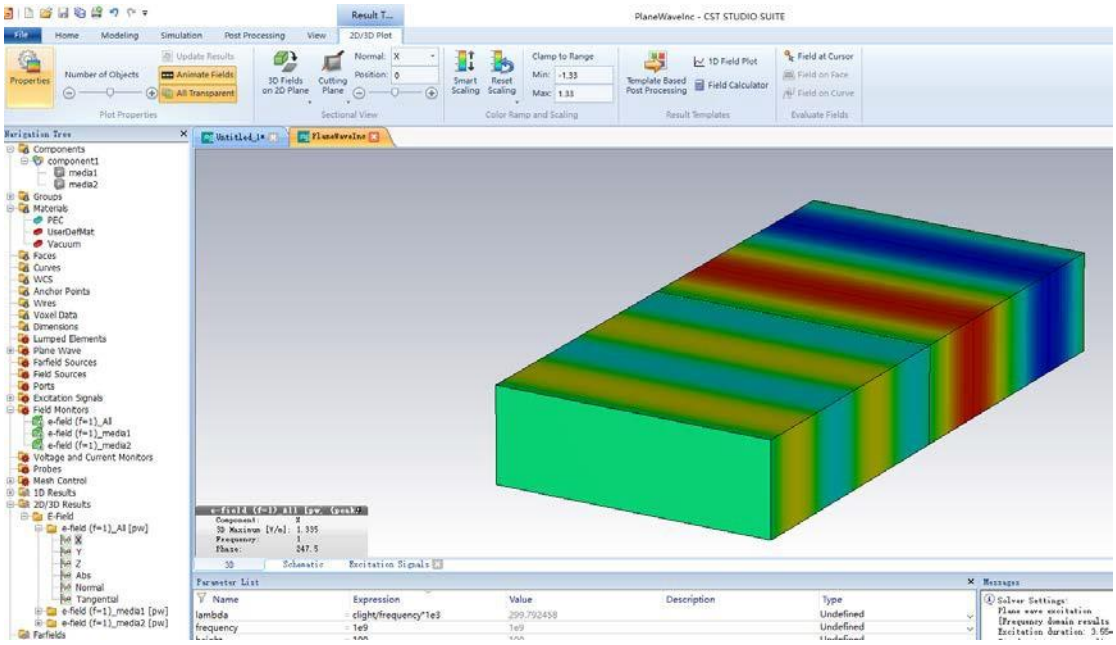
(8) Click Simulation—> Field Monitor, and the settings are as shown in the figure below and click OK.



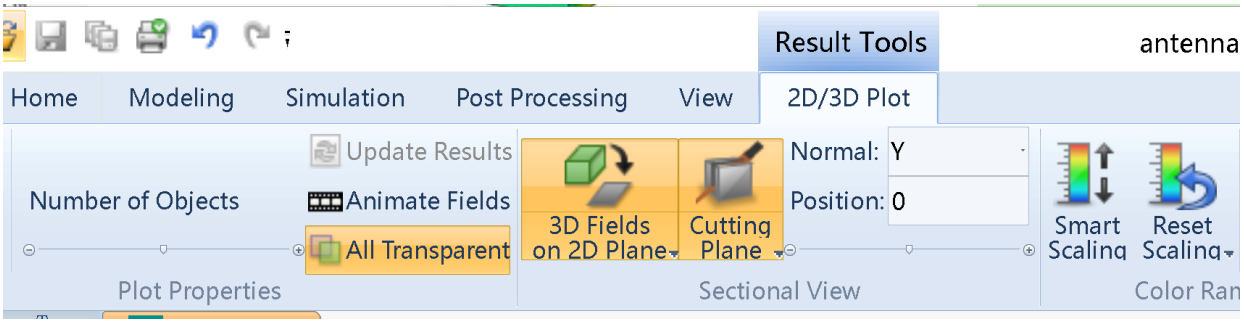
(9) Click Simulation—>Setup Solver，the settings are shown in the figure below. click “Start”.



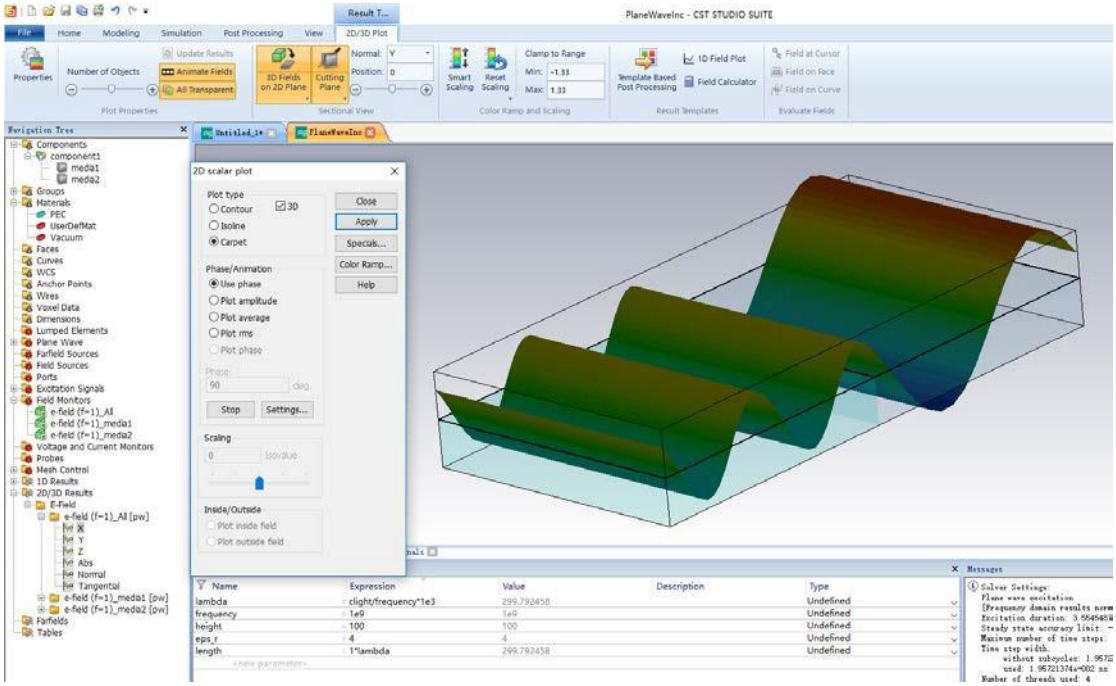
(10) There will be a progress bar in the lower right corner. After running, select 2D/3D Results—E-Eield—e-field(f=1)_All[pw]—X in the left column.



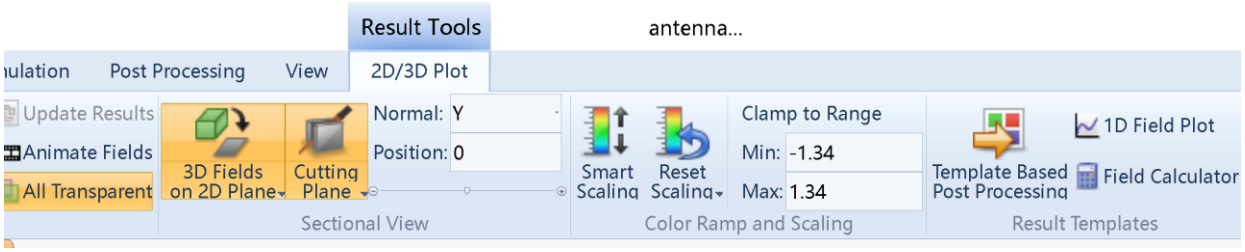
(11) Click “3D Fields on 2D Plane”, and then set “Normal” to be “Y”



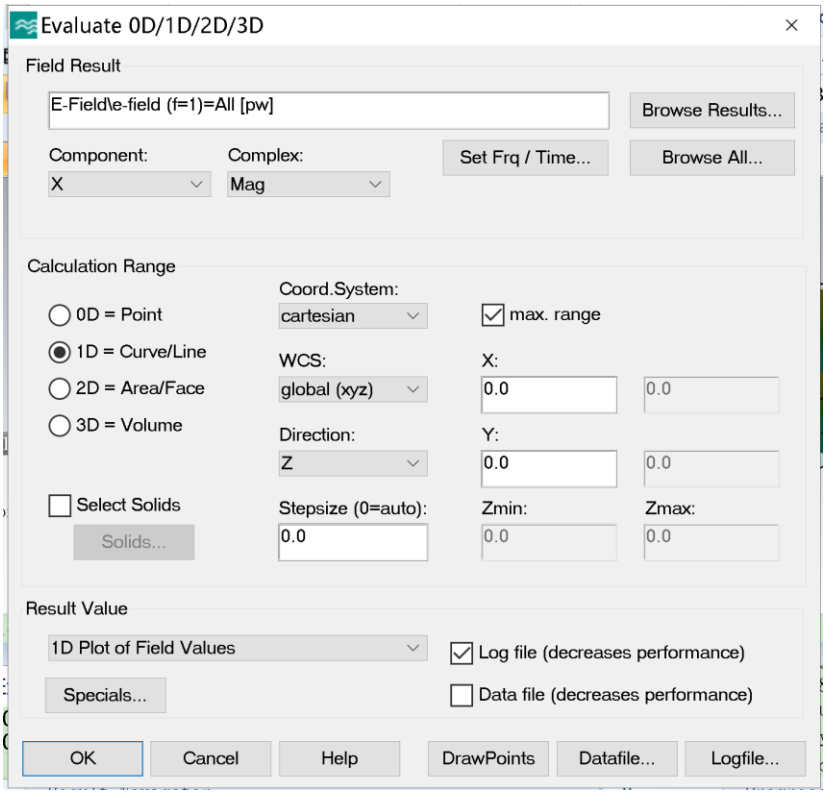
(12) Click “Properties” as shown in the figure. Select “Carpet”, apply and take screenshots.

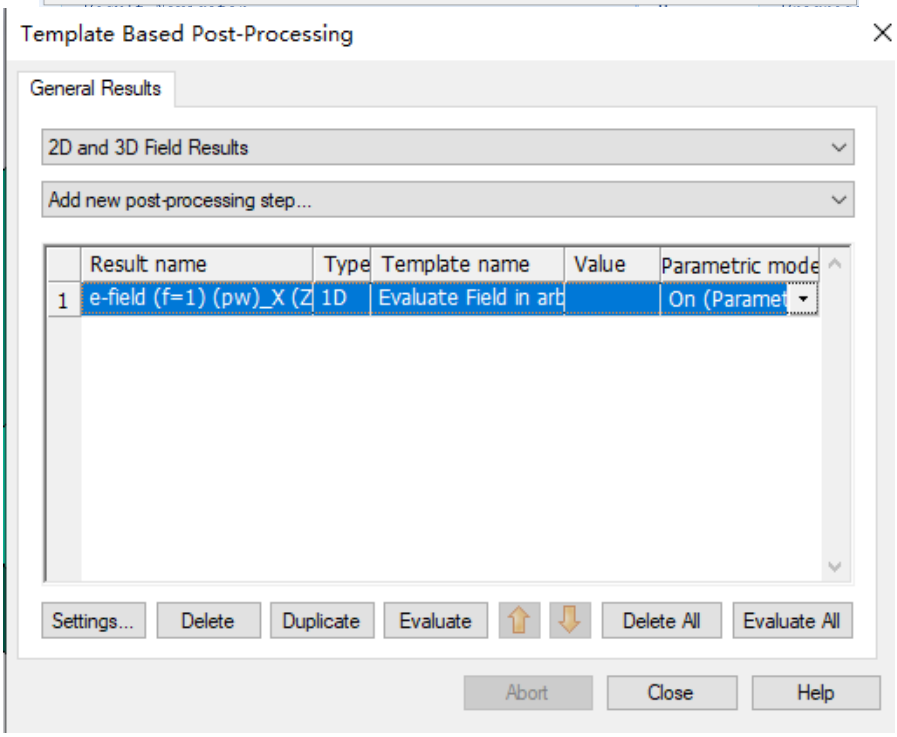


(13) Click “1D Field Plot” as shown in the figure. screenshots.

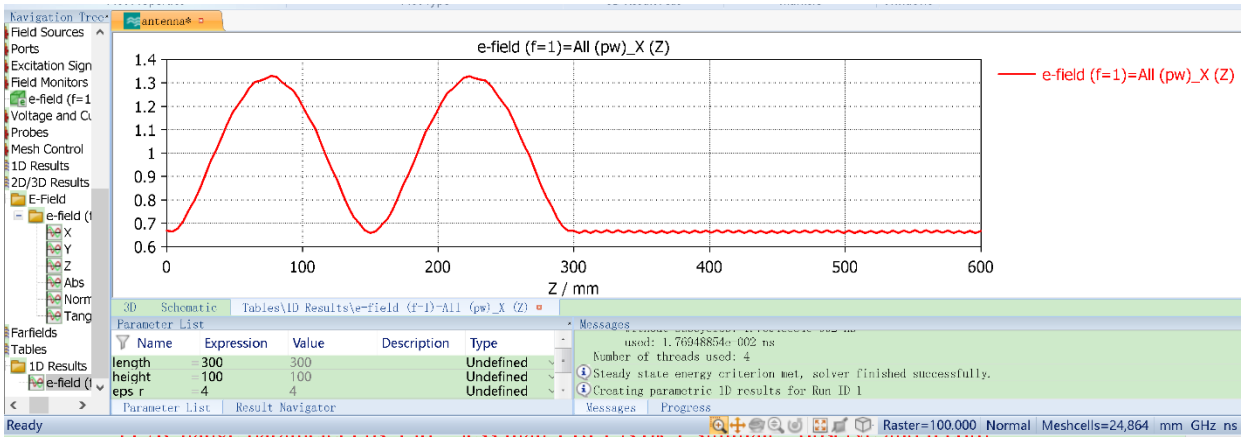


Set parameters as below, and click ok


Evaluate 0D/1D/2D/3D
Field Result
E-Field\e-field (f=1)=All [pw]
Browse Results...
Component:
X
Complex:
Mag
Set Frq / Time...
Browse All...
Calculation Range
0D = Point
1D = Curve/Line
2D = Area/Face
3D = Volume
Coord.System:
cartesian
max. range
WCS:
global (xyz)
X:
0.0
0.0
Direction:
Z
Y:
0.0
0.0
Select Solids
Solids...
Stepsize (0=auto):
0.0
Zmin:
0.0
Zmax:
0.0
Result Value
1D Plot of Field Values
Log file (decreases performance)
Specials...
Data file (decreases performance)
OK
Cancel
Help
DrawPoints
Datafile...
Logfile...


Template Based Post-Processing
General Results
2D and 3D Field Results
Add new post-processing step...
Result name
Type
Template name
Value
Parametric mode
1
e-field (f=1) (pw)_X (Z
1D
Evaluate Field in arb
On (Parame
Settings...
Delete
Duplicate
Evaluate
Delete All
Evaluate All
Abort
Close
Help

(14) Click" Evaluate" after this plot is selected.

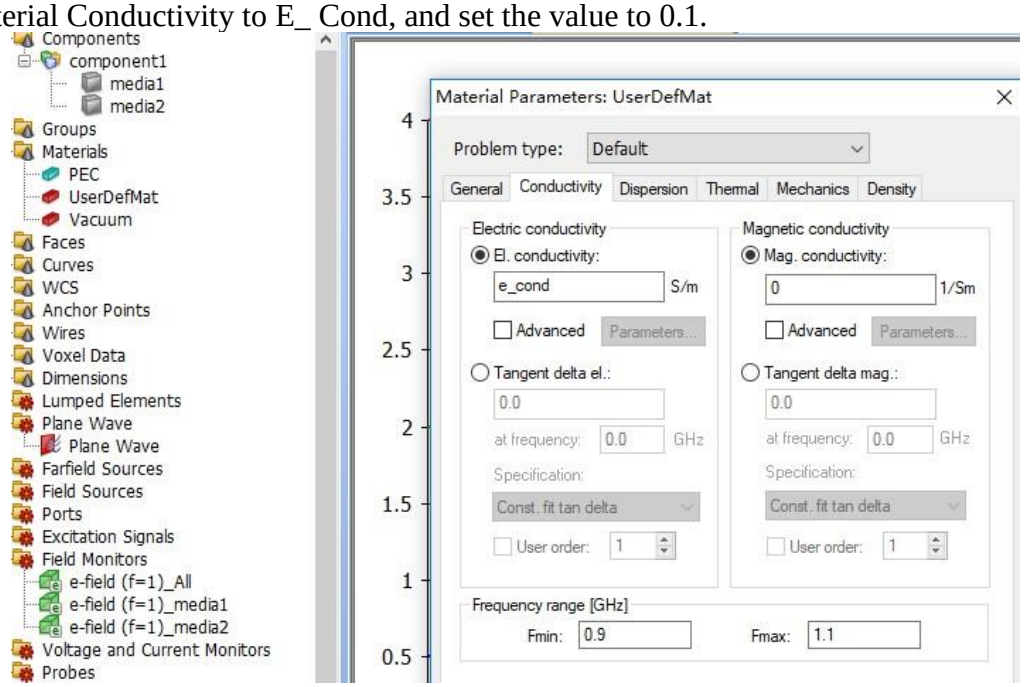


(15) Analyze and try to calculate the reflection coefficient and transmission coefficient, and compare the theoretical value. The calculation formula is required.

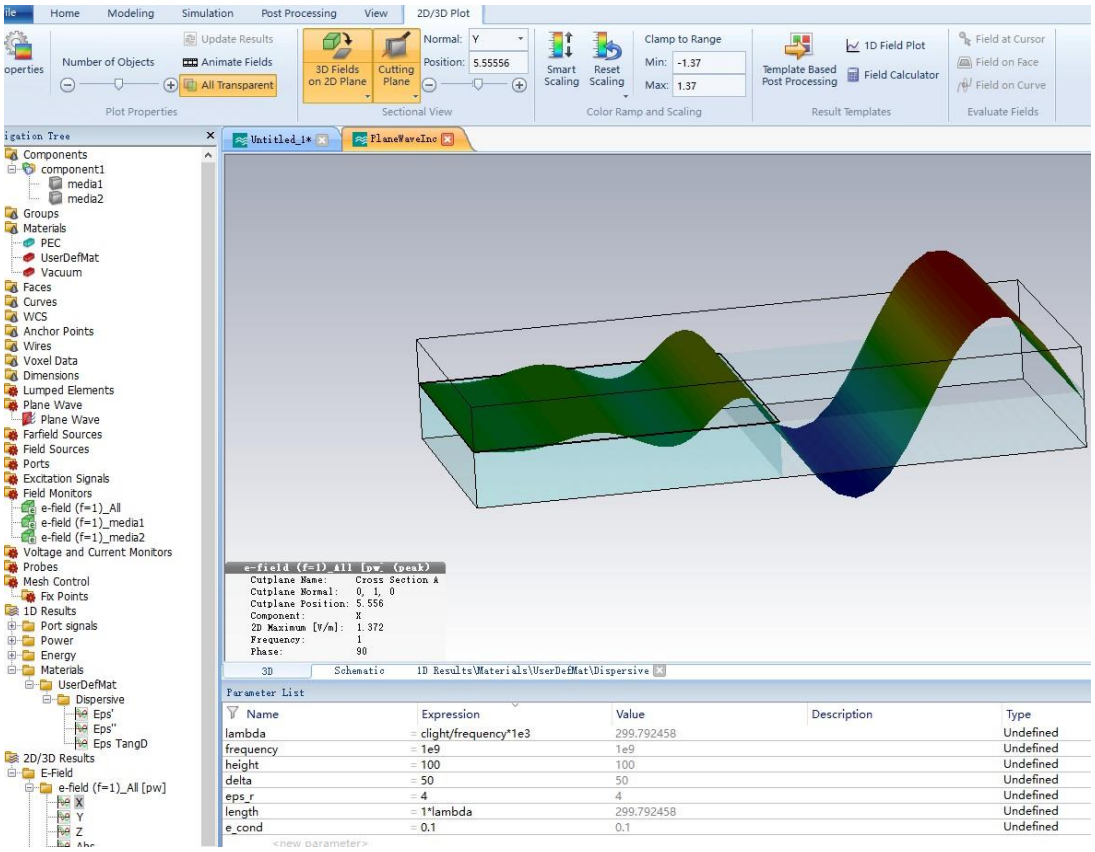
(16) Change parameter eps_r to = less than 1 (0.1 is ok), repeat the steps above.

3. Incident from lossless material to lossy material

(1) Double click UserDefMat(or right-click UserDefMat→Properties） to open the material setting interface, and click conductivity as shown in the figure to set the material Conductivity to E_ Cond, and set the value to 0.1.

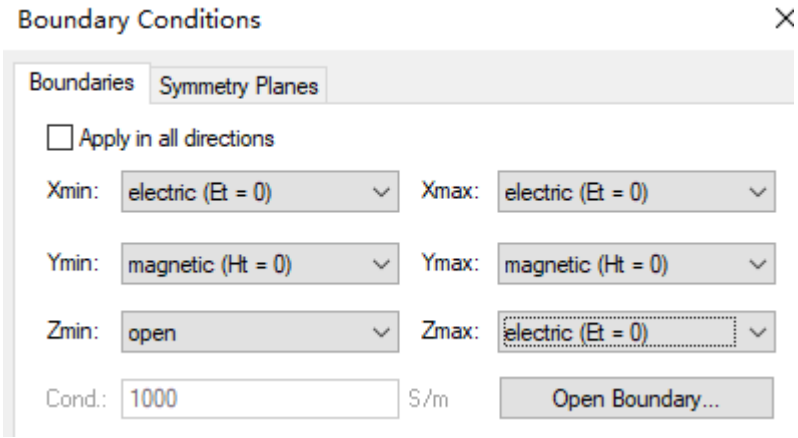


(2) click Setup Solver→Start, click "3D Fields on 2D Plane", and then click "Properties", Select "Carpet", apply and take screenshots. In addition, try to calculate the theoretical value.



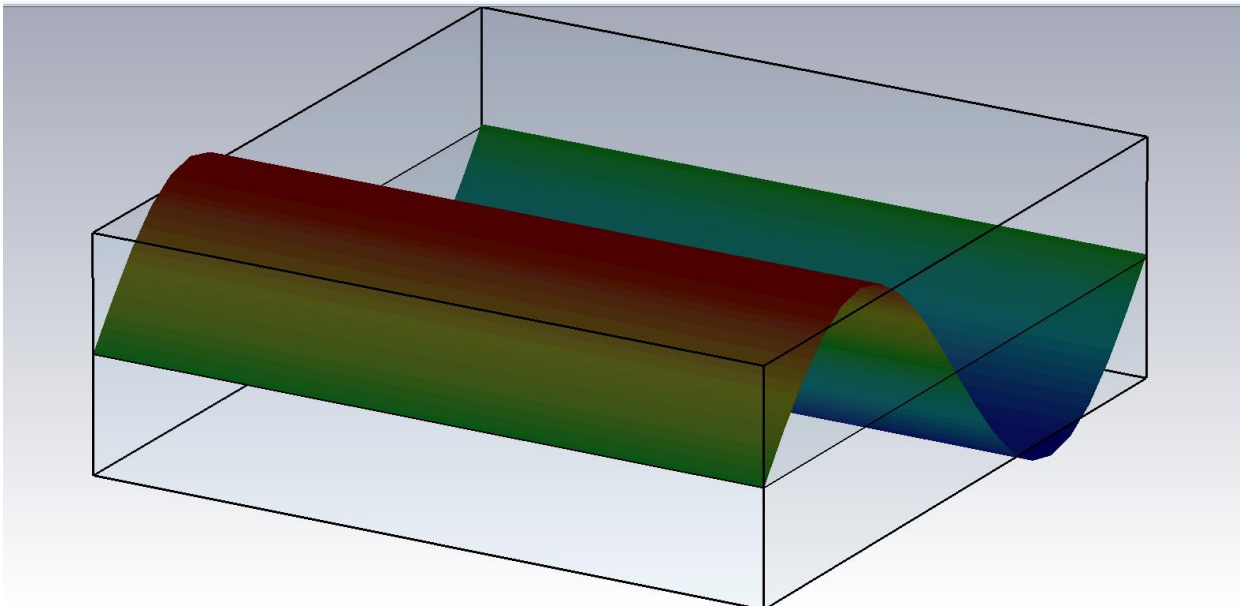
4. Incident from lossless material to PEC and PMC

(1) Delete “media2”, Click Simulation—>Boundaries and set “Zmax” to be “electric(Et=0), which represents PEC, the settings are as shown in the figure below and click OK.



(2) Click “ok”

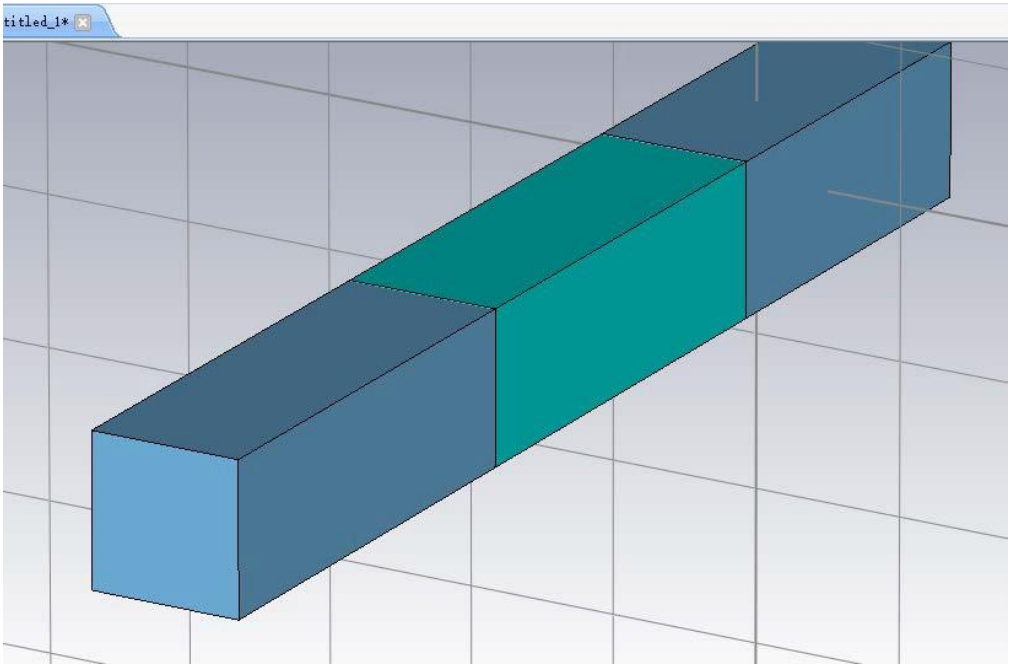
(3) Click Simulation—>Setup Solver, the settings are shown in the figure below. click “Start”.



(4) Change “Zmax” to be “magnetic(Ht=0), which represents PMC, repeat the above steps

5. Incidence of three lossless materials

(1) Refer to step2 Incident from lossless material to lossless material, establish the third medium (vacuum is selected here).



(17) Refer to the step2 Incident from lossless material to lossless material, analyze and try to calculate the reflection coefficient and transmission coefficient, and compare the theoretical value. The calculation formula is required.

Report

1. Fill in the table, analyze and try to calculate the reflection coefficient and transmission coefficient, and compare the theoretical value. The calculation formula is required.
2. Analysis and try to explain each waveform phenomena.

		介质一		介质二		介质三		理论值		测量值	
		eps_r	Mue_r	eps_r	Mue_r	eps_r	Mue_r	反射系数	透射系数	反射系数	透射系数
无损到无损	1					/	/				
	2					/	/				
无损到有损	3					/	/				
无损到PEC	4			/	/	/	/				
无损到PMC	5			/	/	/	/				
三种介质	6										