

CST Tutorial

Introduction:

- Basic operations and modeling in CST
- Solver Overview
- Mesh Generation Overview

Exercise:

- Virtual Machine connection
- Simulation of strip waveguides

Micro-xxx

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Introduction:

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Micro-xxx

TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]

File Home Modeling Simulation Post-Processing View New Tab

Search (Alt+Q)

Import/Export Background Material Library New/Edit Exchange Materials Shapes Tools Curves Picks Edit History List Edit WCS Sectional View Mesh Edges New Group

Navigation Tree

- Components
 - component1
 - component2
- Groups
- Materials
- Faces
- Curves
- WCS
- Anchor Points
- Wires
- Voxel Data
- Dimensions
- Design Space
- Lumped Elements
- Plane Wave
- Farfield Sources
- Field Sources
- Ports
- Excitation Signals
- Field Monitors
- Voltage and Current Monitors
- Probes
- Mesh
- 1D Results
- 2D/3D Results
- Farfields
- Tables

3D Schematic

Parameter List

Name	Expression	Value	Description
X	= antenna_length*3	600	
Y	= 100	100	
h_SiO2	= 4.7	4.7	
L	= L_cav*2+antenna_wide	2000	
h_LN	= 0.25	0.25	
gold_w	= 7	7	
gap	= 7	7	
h_Au	= 0.3	0.3	
R	= 0.0001	0.0001	
wg_wide	= 1.6	1.6	
wg_narrow	= 1.5	1.5	
h_SiO2box	= 1	1	

Progress

TL_750um_AirCladding_OnlyTL_ResonanceStudyEigenModeSolve_Reduce

has017.rcp.epfl.ch : 36700

Job 4608: has017:38702

0% Eigenmode: Preparing eigenmode decomposition

TL_750um_AirCladding_OnlyTL_loss study

Messages Progress

Ready

Raster=100.000 Tetrahedrons Normal μm THz ps K

How to control the views?

Change the view by dragging the mouse while pressing the left button and a key:

- Ctrl: rotation
- Shift: in-plane rotation
- ctrl+shift: panning

Some other useful options are:

- Spacebar: reset view to structure
- ctrl+f: reset view
- shift+spacebar: zoom into selected shape
- mouse wheel: dynamic zoom to mouse pointer

Parameter	Value	Value
gold_w	= 7	7
gap	= 7	7
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

Ready

Parameter List | Result Navigator | Messages | Progress | Raster=100.000 | Tetrahedrons | Normal | μm THz ps K

TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]

File Home Modeling Simulation Post-Processing View New Tab

Search (Alt+Q)

Background Material Library New/Edit

Import/Export

Exchange Materials

Shapes

Tools

Curves

Picks

Edit

History List

WCS

Sectional View

New Group

Navigation Tree

TL_750um_AirCladding_OnlyTL_ResonanceStudyEigenModeSolve_Reduce

TL_750um_AirCladding_OnlyTL_loss study

<Filter>

- Components
 - component1
 - component2
- Groups
- Materials
- Faces
- Curves
- WCS
- Anchor Points
- Wires
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Cylinder
 Cone
 Torus
 Sphere
 Rotation
 Brick
 Elliptical
 Cylinder
 Extrusion

Parameter List

h_LIN	= 7	7
gold_w	= 7	7
gap	= 7	7
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

Messages Progress

Ready

Raster=100.000 Tetrahedrons Normal μm THz ps K

TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]

File Home **Modeling** Simulation Post-Processing View New Tab

Search (Alt+Q)

Background Material Library New/Edit Import/Export Exchange Materials Shapes Transform **Boolean** Curves Picks Edit History Local WCS Cutting Plane Normal: X Position: 0 Mesh Edges

Navigation Tree

- Components
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 - component2
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TL_750um_AirCladding_OnlyTL_ResonanceStudyEigenModeSolve_Reduce

TL_750um_AirCladding_OnlyTL_loss study

Sphere

Brick

Add
Brick + Sphere

Subtract
Brick - Sphere

Intersect
Brick * Sphere

Boolean insert
Sphere / Brick

Brick / Sphere

Parameter List

h_LN		
gold_w	= 7	7
gap	= 7	7
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

Messages Progress

Ready

Raster=100.000 Tetrahedrons Normal μm THz ps K

TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]

File Home **Modeling** Simulation Post-Processing View New Tab

Search (Alt+Q)

Background Material Library New/Edit Transform Blend Boolean Align Pick Edit History Local WCS Cutting Plane Normal: X Position: 0 Mesh Edges

Exchange Navigation Tree

Curves can be used for structure creation

Curves

- Create 2D Curve
 - Polygon...
 - Line...
 - Circle...
 - Ellipse...
 - Arc...
 - Rectangle...
 - Spline...
- Create 3D Curve
 - 3D Polygon...
 - 3D Spline...
 - Analytical Curve...
- Blend and Trim
 - Blend Curve
 - Chamfer Curve
 - Trim Curves
 - Delete Segments
- Flex Tools
 - Wrap Curves...
 - Project Curves...
- Dev Preview
 - Trace Curves
 - Heal Curves

Selected Edges...

Blend and Trim

Flex Tools

Dev Preview

Progress

- TL_750um_AirCladding_OnlyTL_ResonanceStudyEigenModeSolve_Reduce
- haas017.rcp.epfl.ch : 36700
- Job 4608: haas017:38702
- 0% Eigenmode: Preparing eigenmode decomposition
- TL_750um_AirCladding_OnlyTL_loss study

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Y	= 100	100
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h_LN	= 0.25	0.25
gold_w	= 7	7
gap	= 7	7
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

Parameter List Result Navigator

Ready

Raster=100.000 Tetrahedrons Normal μm THz ps K

TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]

File Home Modeling Simulation Post-Processing View New Tab

Search (Alt+Q)

Background Material Library New/Edit Exchange Materials

Shapes

Align Blend Boolean Transform Curves Picks Edit History Local WCS Cutting Plane Sectional View Mesh Edges New Group

Navigation Tree

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TL_750um_AirCladding_OnlyTL_ResonanceStudyEigenModeSolve_Reduce

TL_750um_AirCladding_OnlyTL_loss study

3D Schematic

Parameter List

Name	Expression	Value
X	= antenn	
Y	= 100	
h_SiO2	= 4.7	
L	= L_cav*2	
h_LN	= 0.25	
gold_w	= 7	
gap	= 7	
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

Messages Progress

Raster=100.000 Tetrahedrons Normal μm THz ps K

Creating a sheet from a curve

Extrusion of a curve

TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]

File Home Modeling Simulation Post-Processing View New Tab

Search (Alt+Q)

Normal: X Mesh Edges
Position: 0
Cutting Plane

Exchange Materials Shapes Tools Curves Picks Edit History Local WCS Sectional View New Group

Navigation Tree

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3D

Rotation of a shape

Rotation Axis

Parameter List

Name		
X		
Y		
h_SiO2	= 4.7	
L	= L_cav*2+antenna_wide	2000
h_LN	= 0.25	0.25
gold_w	= 7	7
gap	= 7	7
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

0% Eigenmode: Preparing eigenmode decomposition

TL_750um_AirCladding_OnlyTL_loss study

Messages Progress

Raster=100.000 Tetrahedrons Normal μm THz ps K

Objects can be translated, rotated, mirrored, and scaled

Translate

Scale

Rotate

Name	Expr	
X	= ante	
Y	= 100	
h_SiO2	= 4.7	
L	= $L_{cav} * 2 + antenna_wide$	2000
h_LN	= 0.25	0.25
gold_w	= 7	7
gap	= 7	7
h_Au	= 0.3	0.3
R	= 0.0001	0.0001
wg_wide	= 1.6	1.6
wg_narrow	= 1.5	1.5
h_SiO2box	= 1	1

0% Eigenmode: Preparing eigenmode decomposition

TL_750um_AirCladding_OnlyTL_loss study

Messages Progress

Raster=100.000 Tetrahedrons Normal μm THz ps K

CST Tutorial

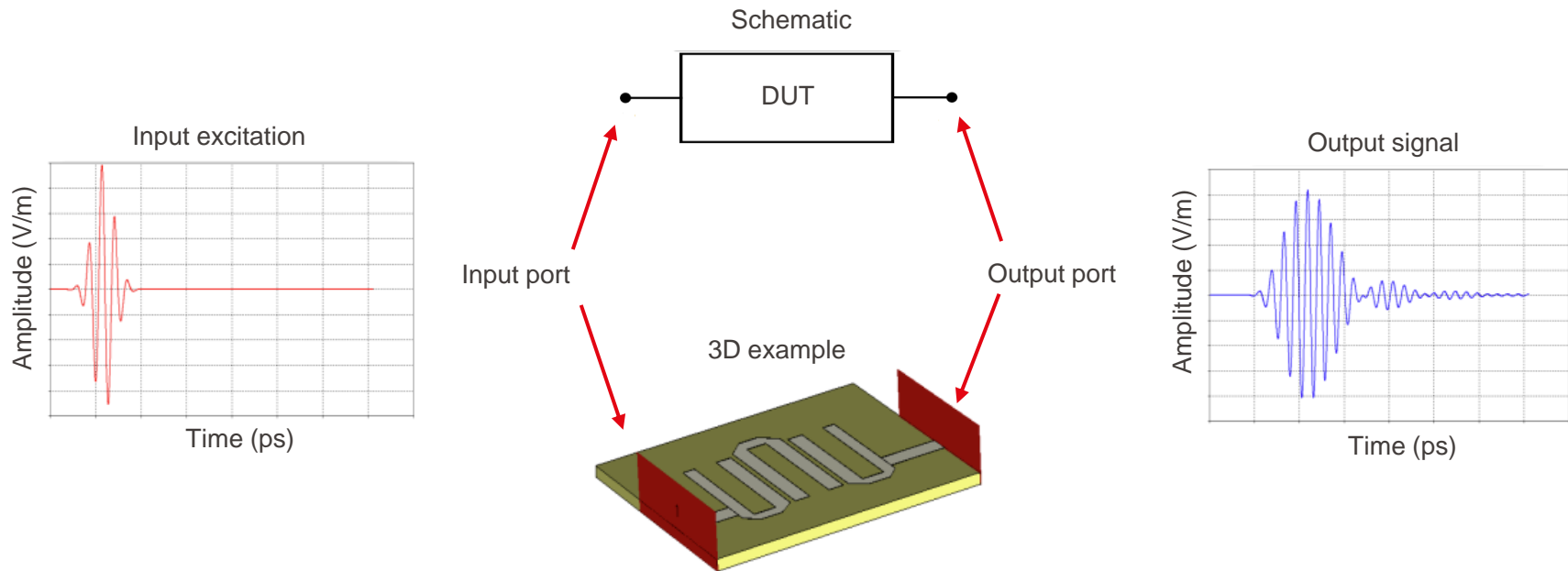
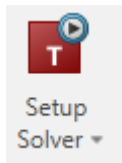
Introduction:

- Basic operations and modeling in CST
- **Solver Overview**
- Mesh Generation Overview

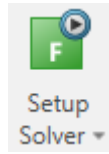
Exercise:

- Virtual Machine connection
- Simulation of strip waveguides

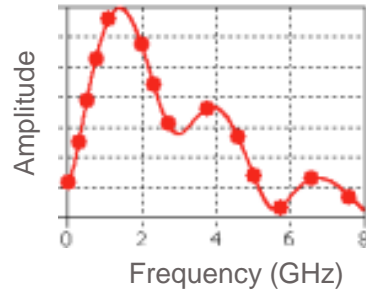
Micro-xxx



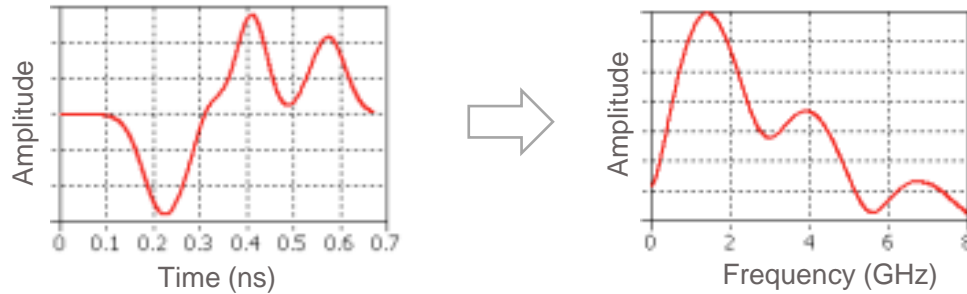
Numerical time integration of 3D Maxwell equations

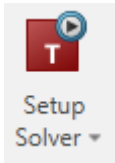


The steady state behavior of a model is calculated at different frequency points



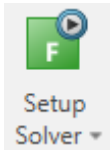
Should obtain same results using Time Domain Solver + Fourier transform





Time domain solver:

- Broadband
- Electrically medium and large sized problems
- Arbitrary time signals



Frequency domain solver

- Narrow band / Single frequency
- Electrically small and medium sized problem
- Periodic structures with Floquet port modes

CST Tutorial

Introduction:

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- **Mesh Generation Overview**

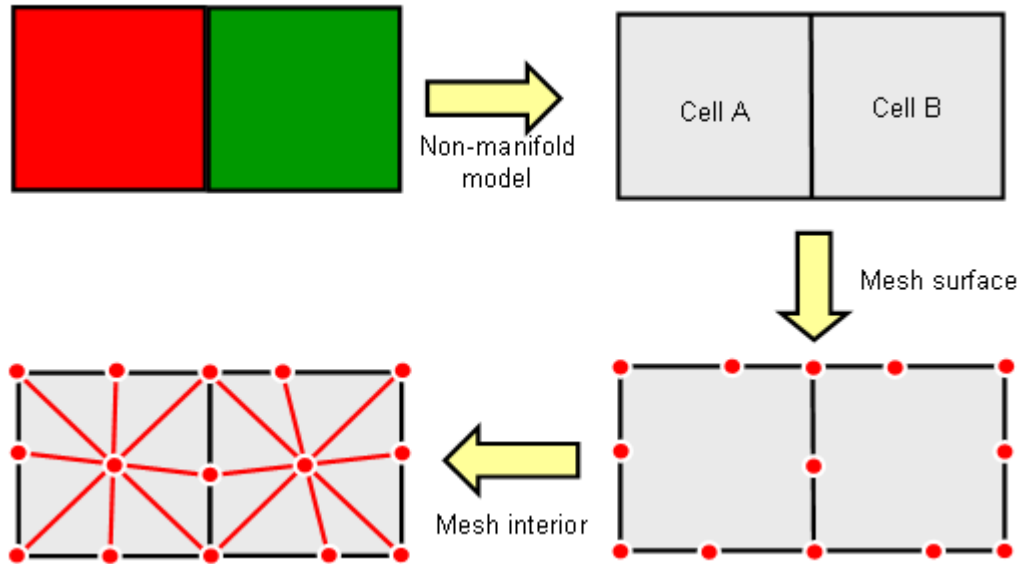
Exercise:

- Virtual Machine connection
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Micro-xxx

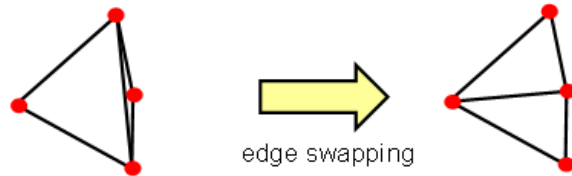
Tetrahedral mesh generation steps:

- Build the non-manifold simulation model
- Mesh the model's edges and faces: "surface meshing"
- Mesh the model's volumes based on surface mesh: "volume meshing"

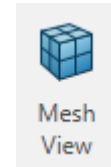


Once the initial volume mesh is created, its quality can be improved by mesh **smoothing** or mesh **optimization**.

For example, mesh optimization can swap edges and faces and reconnects them to form better quality tetrahedrons:



You can visualize the mesh results in “Home” → “Mesh View”



Control the mesh globally

The behavior of the automatic mesh generation can be changed by adjusting its parameters in:
“Home” → “Mesh” → “Global properties”

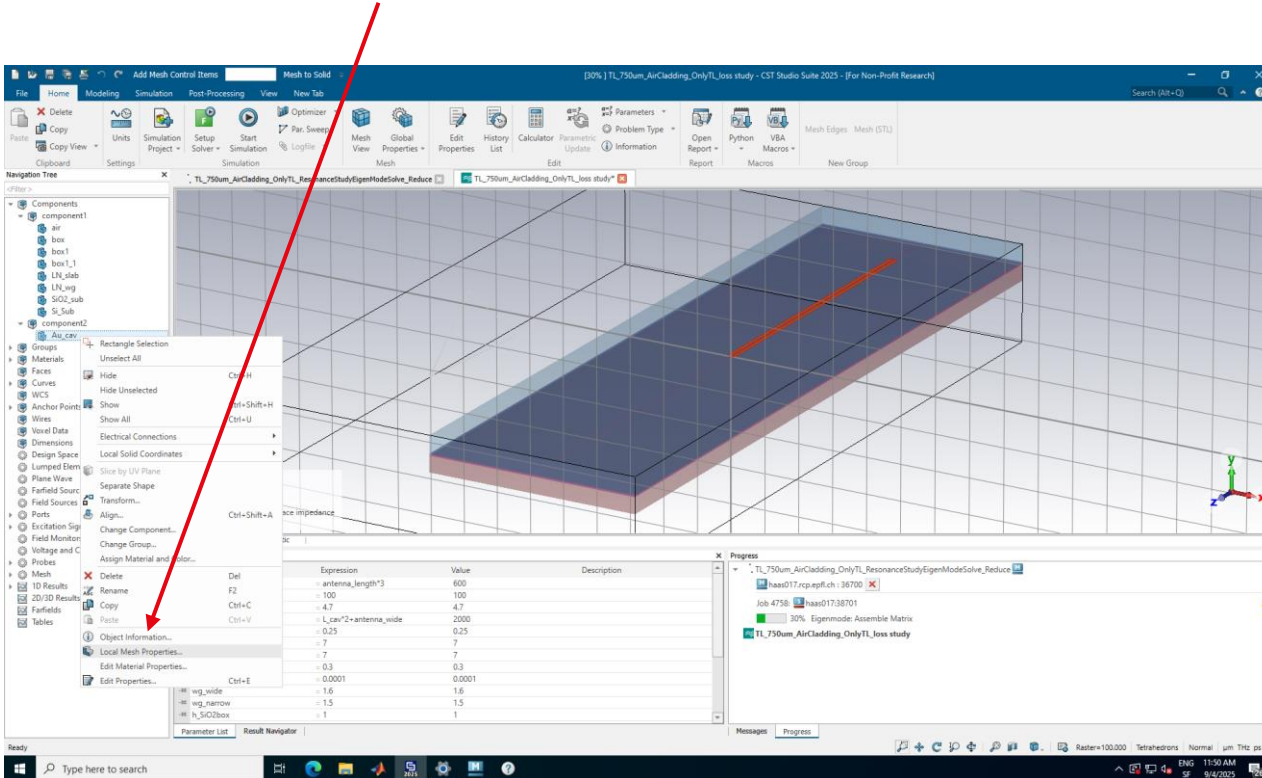
Mesh Properties - Tetrahedral ×

Maximum cell	
Cells per wavelength	Model: 4
Cells per max model box edge:	Background: 4
	4
	1
Minimum cell	
Absolute value	0
Meshing method: Default (surface based)	
Statistics	
Minimum edge length:	Minimum quality:
0	0
Maximum edge length:	Maximum quality:
0	0
Tetrahedrons:	Average quality:
0	0

OK
Cancel
Apply
Update
Specials...
Simplify Model...
Help

Control the mesh locally for specific structure elements

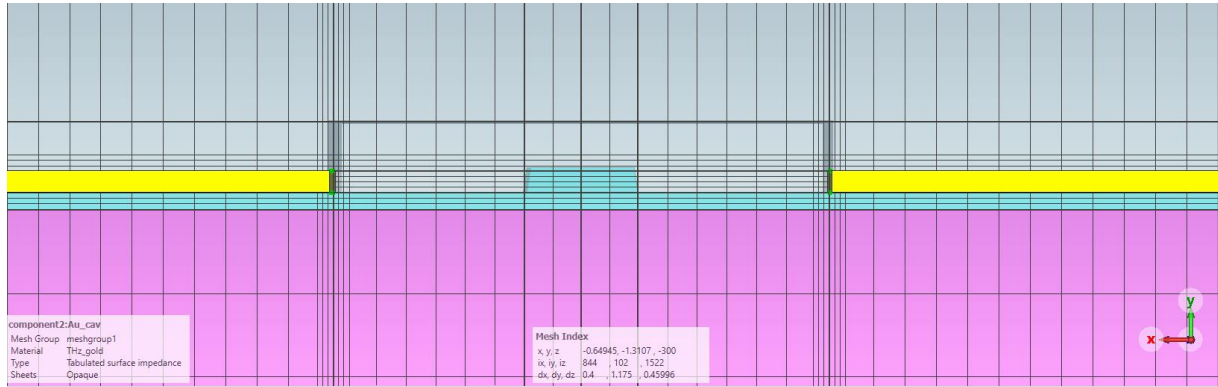
For specific structures of high importance for the simulation, or shapes with a too coarse geometry representation in the mesh, it is possible to set specific mesh control values by: Clicking “Local Mesh Properties” from the context menu.



based on hexahedral (brick-shaped) elements, which are aligned with the Cartesian grid.

The mesh generator automatically determines the important features of your structure and creates the mesh, and you can always manually improve it using:

“Local Mesh Properties” → “Volume refinement”



CST Tutorial

Introduction:

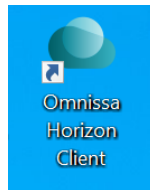
- Basic operations and modeling in CST
- Solver Overview
- Mesh Generation Overview

Exercise:

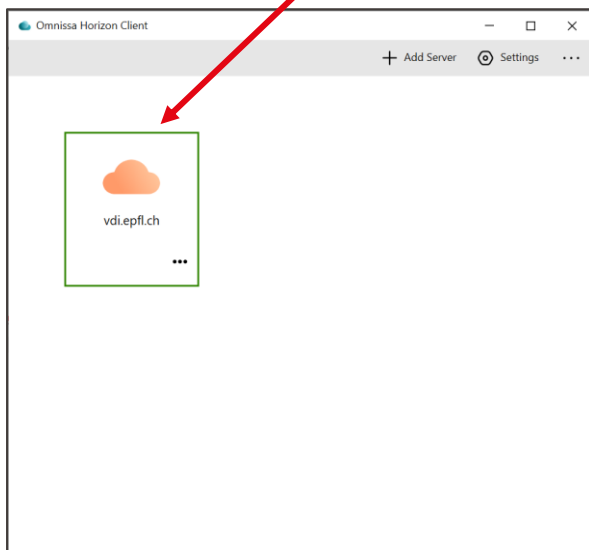
- Virtual Machine connection
- Simulation of strip waveguides

Micro-xxx

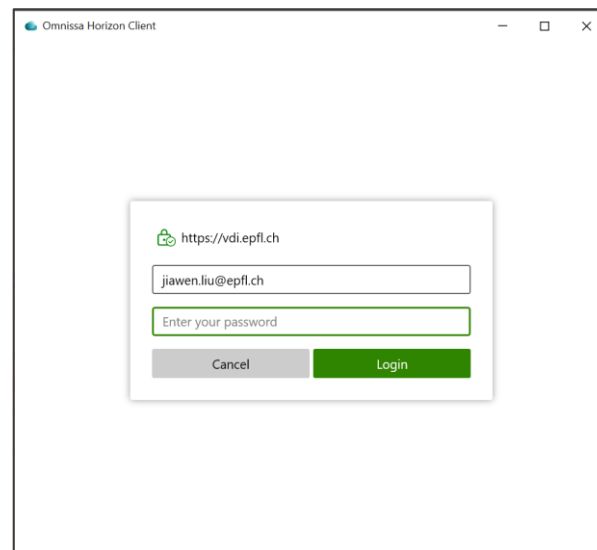
1. Run Virtual Machine tool



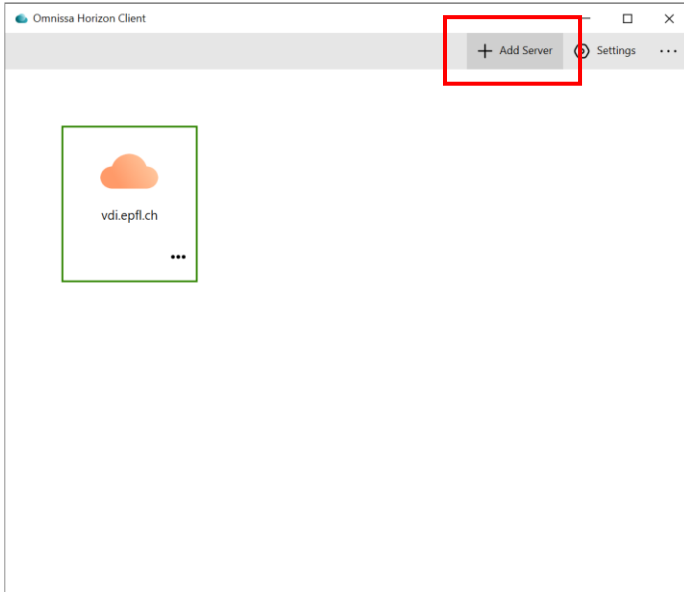
2. Double click on EPFL VDI server



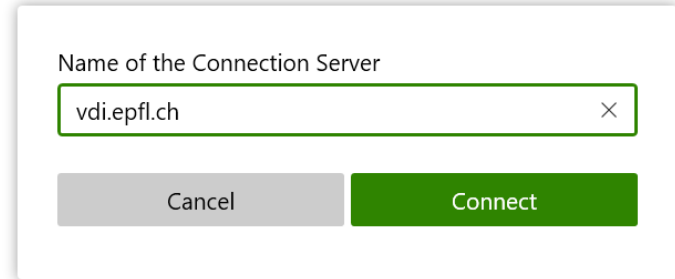
3. Log-in using your EPFL account



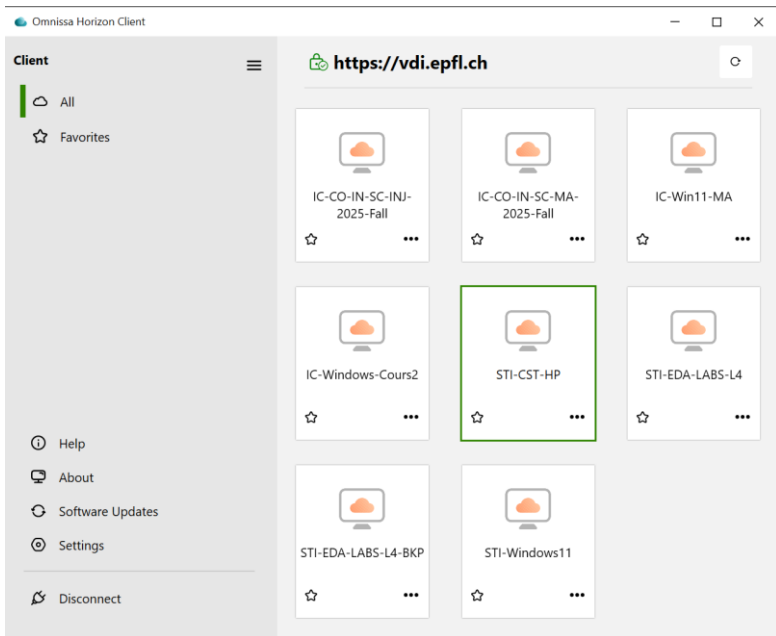
If you don't see EFPL VDI server, click on "add server"



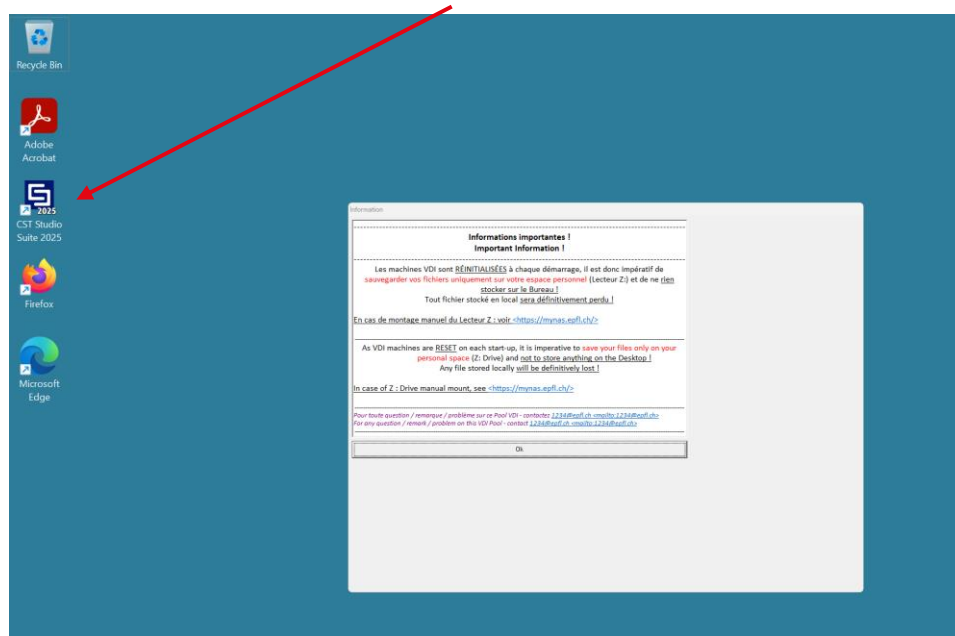
In the pop-up window, put "vdi.epfl.ch" then "Connect"



4. Double click on “STI-CST-HP”



5. Now you can run CST !



CST Tutorial

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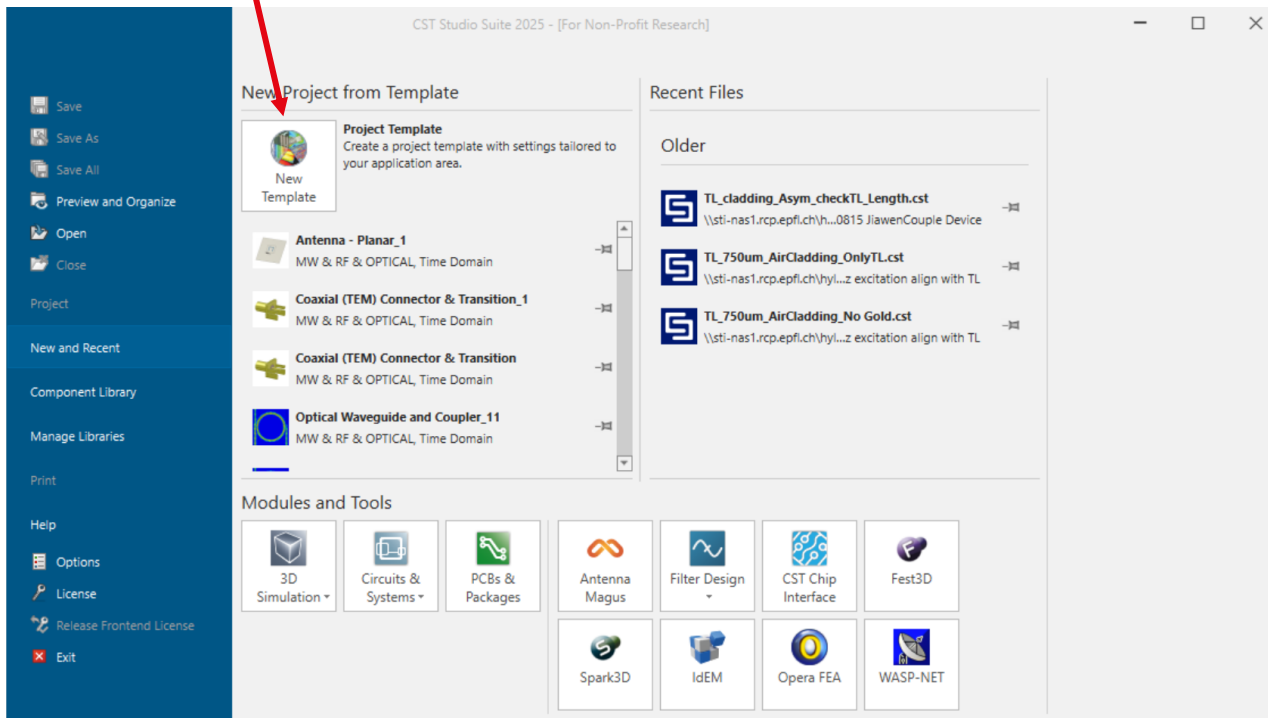
Exercise:

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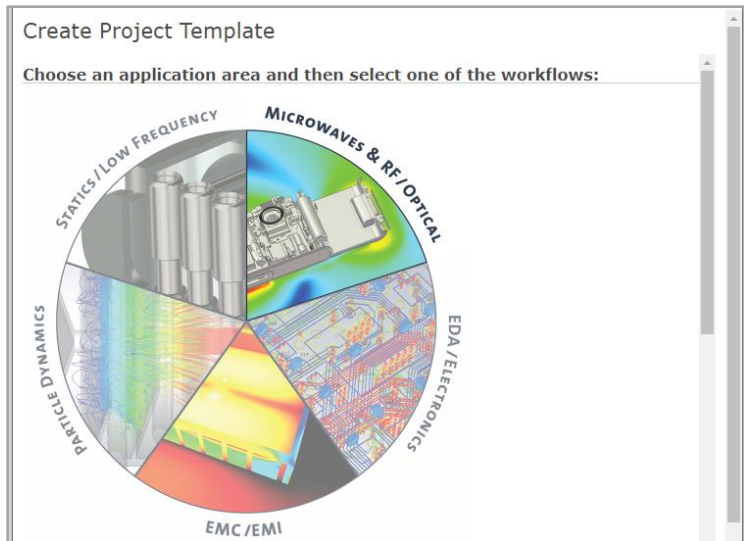
1. Setup new project

Choose New Template

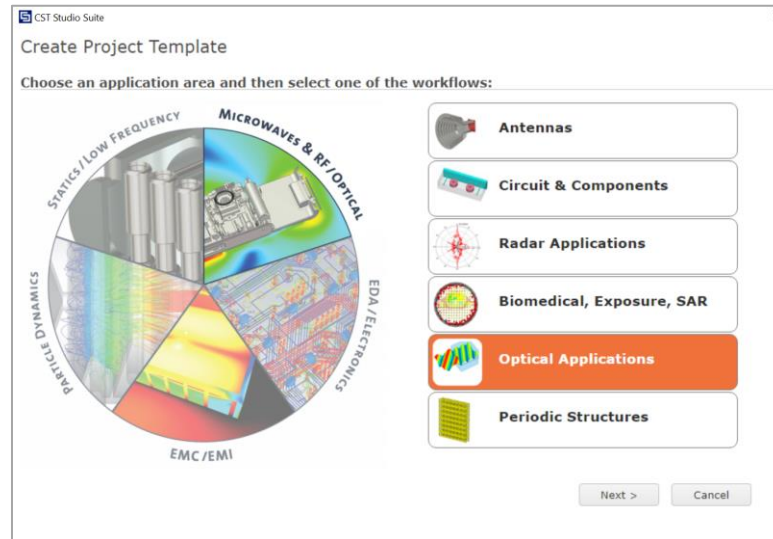


1. Setup new project

1.1 Choose Microwave & RF / Optical module

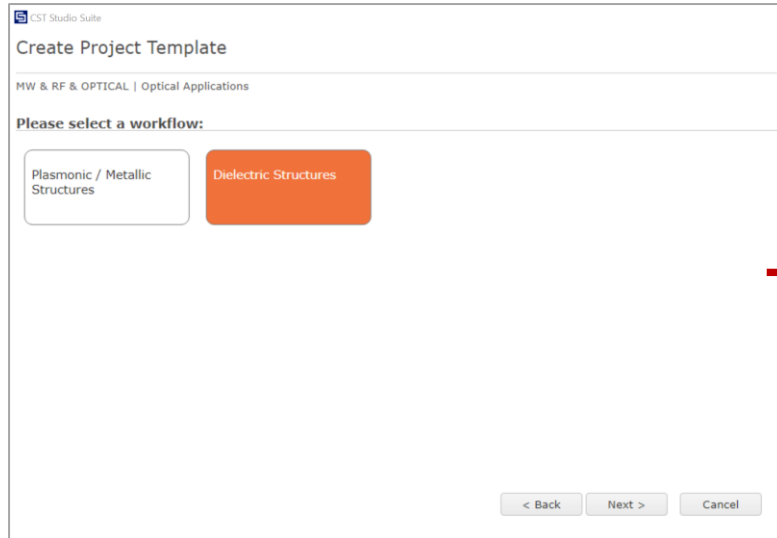


1.2 Choose Optical Applications, click on “Next”

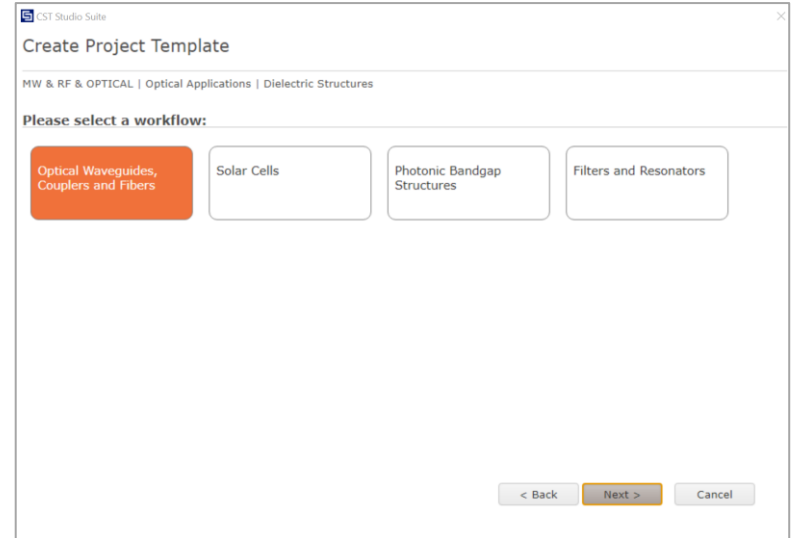


1. Setup new project

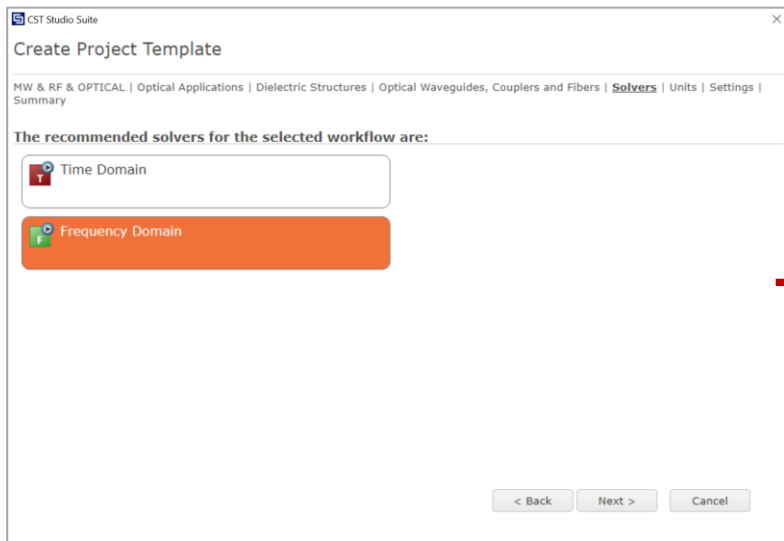
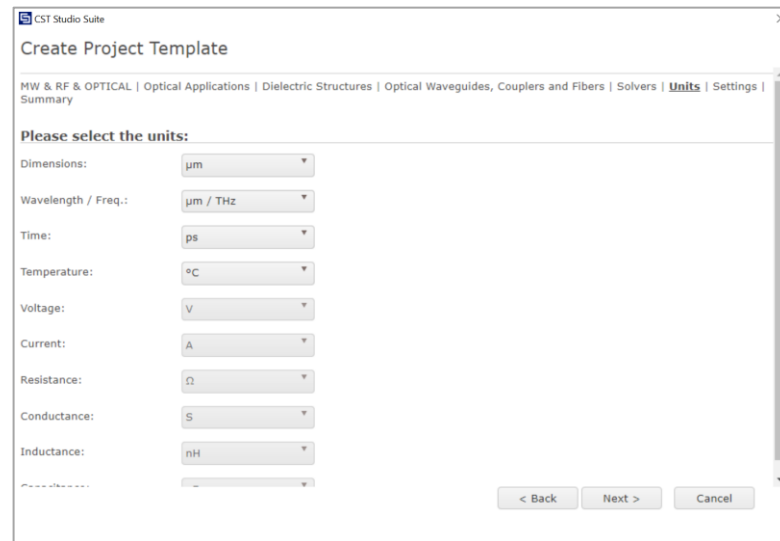
1.3 Choose “Dielectric Structures”, then “Next”



1.4 Choose “optical Waveguides”, then “Next”



1.5 Choose “Frequency Domain” solver, then “Next”

1.6 Choose units “ $\mu\text{m}/\text{THz}$ ”, then “Next”

1.7 Settings

CST Studio Suite

×

Create Project Template

MW & RF & OPTICAL | Optical Applications | Dielectric Structures | Optical Waveguides, Couplers and Fibers | Solvers | Units | **Settings** | Summary

Please select the Settings

Define using

 Frequency Wavelength

Wavelength Min.:

 μm

Determine you wavelength(frequency) range

Wavelength Max.:

 μm

Monitors:

 E-field H-field Farfield Power flow Power loss

Tick the on the results you need to see

Define at

 μm

Use semicolon as a separator to specify multiple values.
e.g. 20;30;30.1;30.2;30.3

Specify the frequencies at which you need to see the field patterns

 Calculate reflectance, transmittance and absorbance

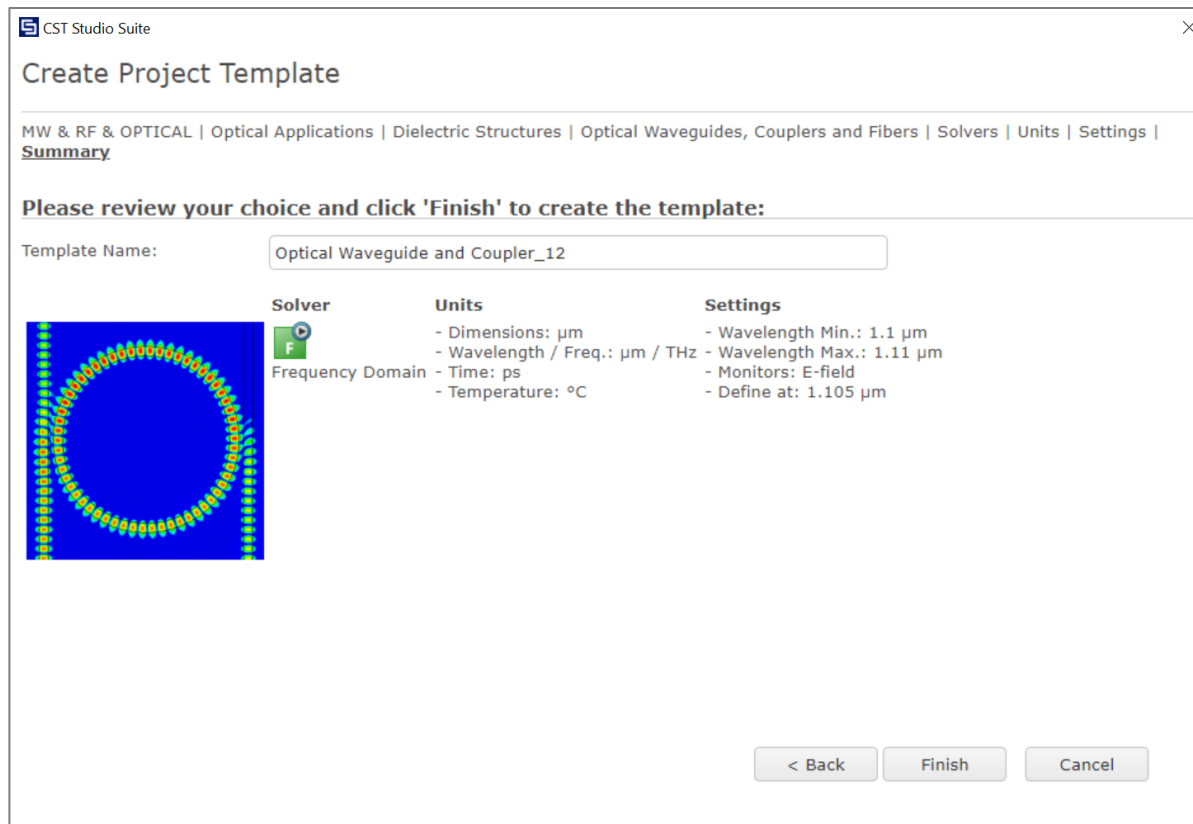
Tick if you want SCT to calculate reflectance, transmittance and absorbance for you

< Back

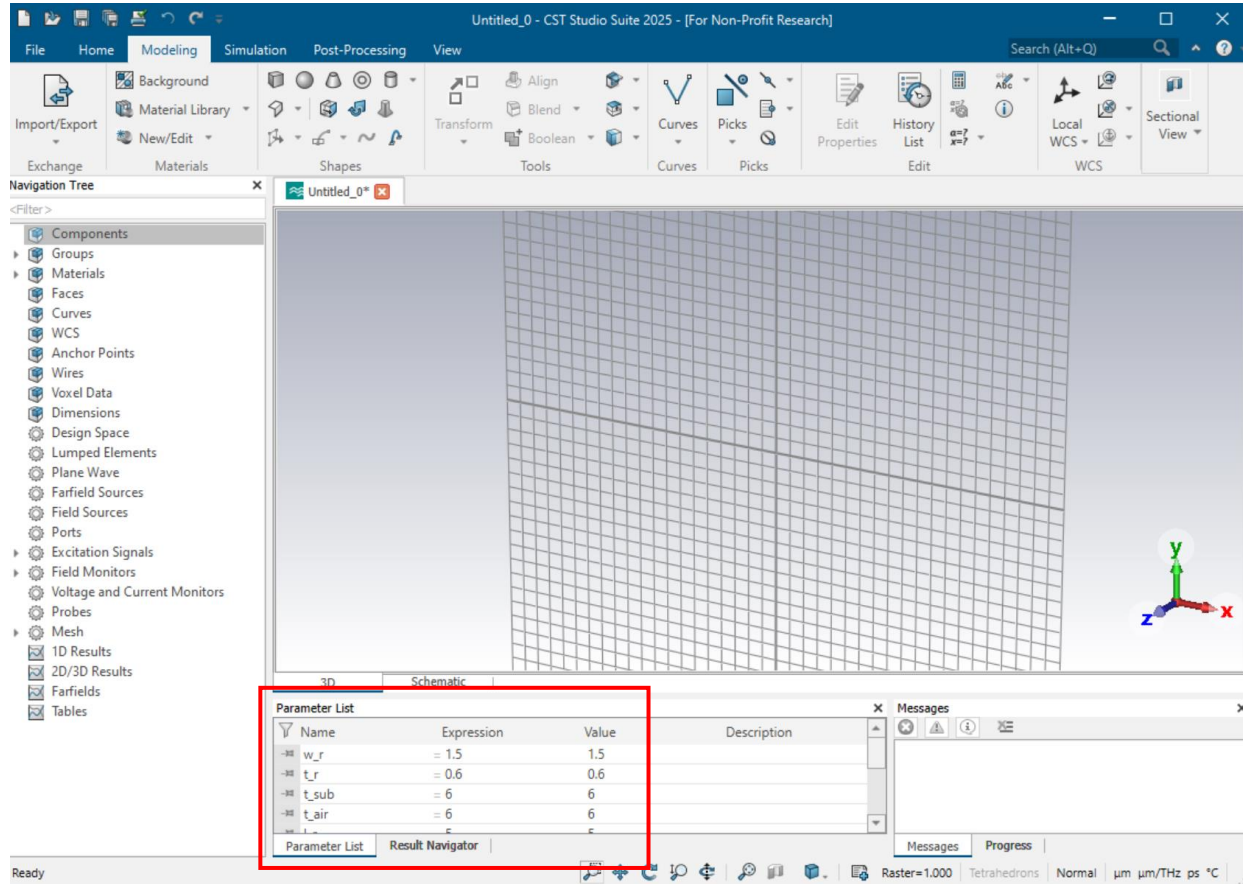
Next >

Cancel

1.8 Summary



2.1 Define parameters

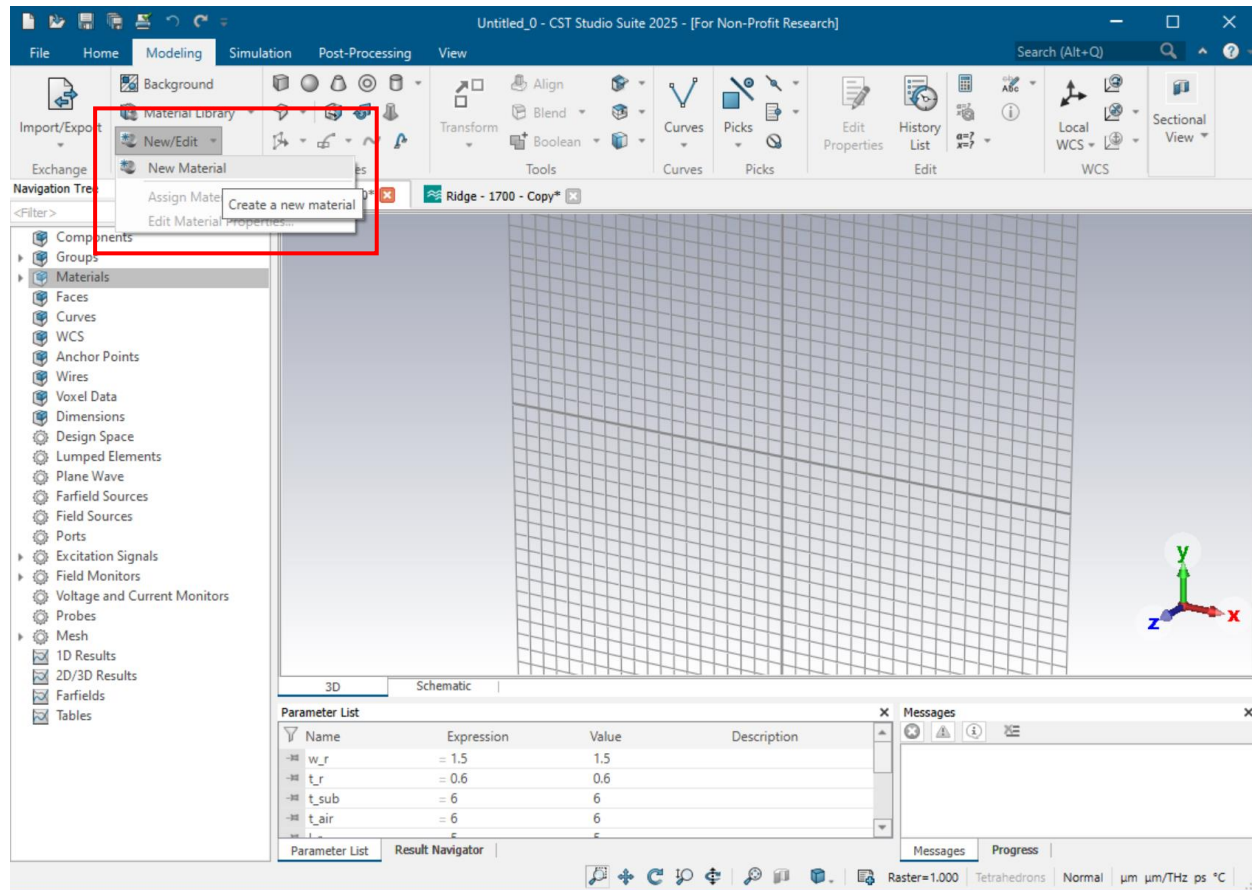


The screenshot displays the CST Studio Suite 2025 software interface. The main window shows a 3D model of a rectangular structure with a grid mesh. The 'Parameter List' panel is highlighted with a red box, showing a table of parameters.

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	
c		c	

The interface also shows a navigation tree on the left with categories like Components, Groups, Materials, Faces, Curves, WCS, Anchor Points, Wires, Voxel Data, Dimensions, Design Space, Lumped Elements, Plane Wave, Farfield Sources, Field Sources, Ports, Excitation Signals, Field Monitors, Voltage and Current Monitors, Probes, Mesh, 1D Results, 2D/3D Results, Farfields, and Tables. The bottom status bar indicates 'Ready', 'Raster=1.000', 'Tetrahedrons', 'Normal', and units 'µm µm/THz ps °C'.

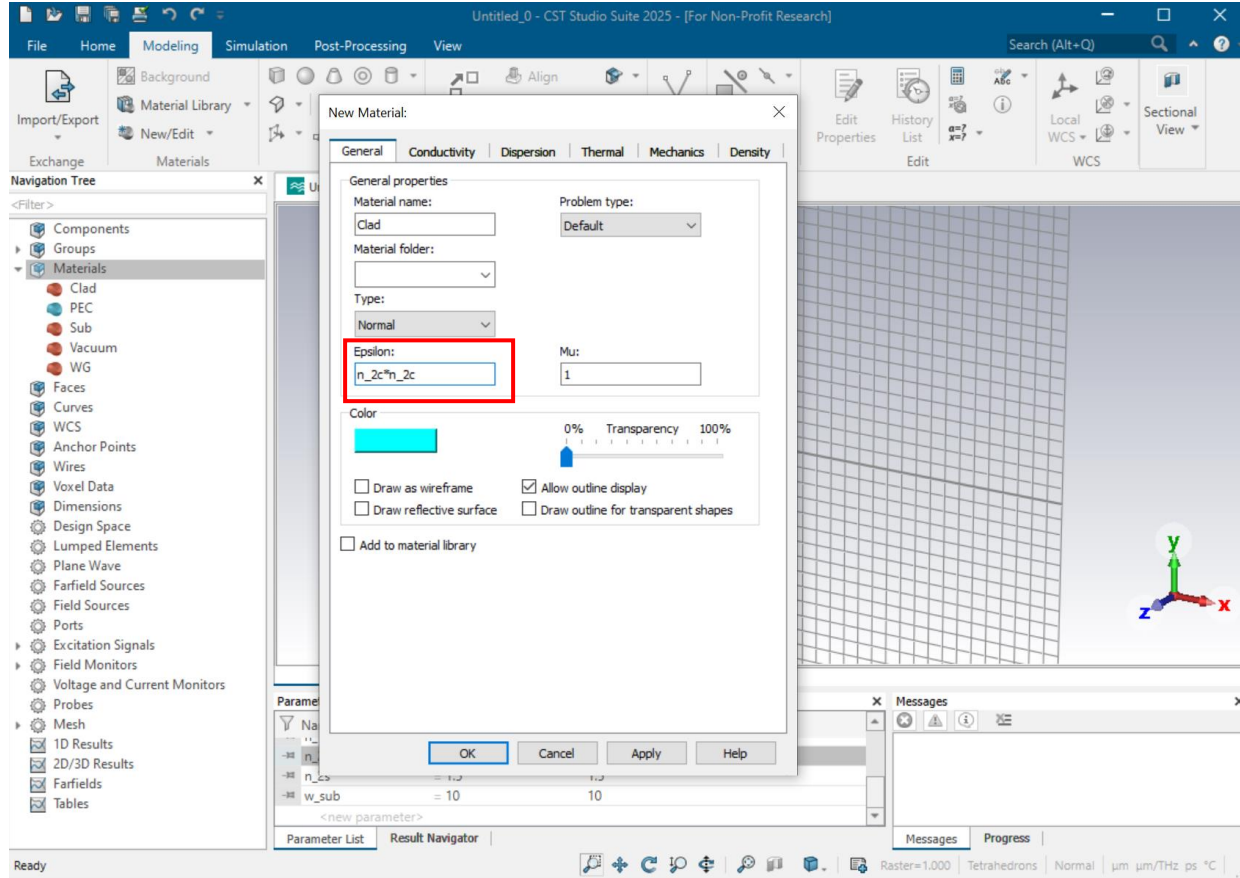
2.2 Create Materials



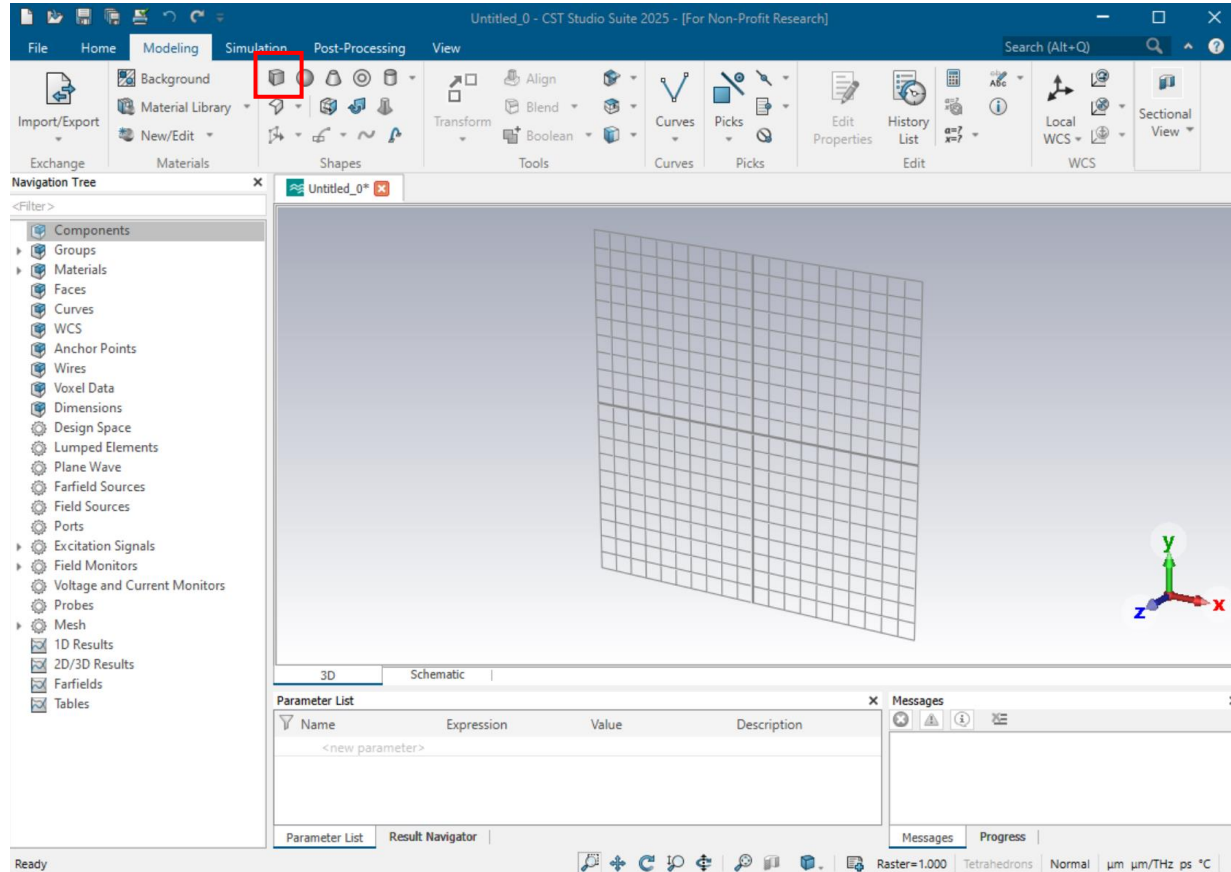
The screenshot shows the CST Studio Suite 2025 interface. The 'Material Library' menu is open, with 'New/Edit' and 'New Material' options highlighted. The main window displays a 3D grid model of a structure. The 'Parameter List' panel at the bottom shows parameters w_r, t_r, t_sub, and t_air with their respective values.

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

2.2 Create Materials



2.3 Using “Brick” to create waveguide



2.3 Using “Brick” to create waveguide

The screenshot shows the CST Studio Suite 2025 interface. The main window displays a 3D mesh of a waveguide structure. A dialog box titled "Brick" is open, allowing the user to define the object's properties. The dialog box contains the following fields:

- Name: WG
- Xmin: $-w_r/2$
- Xmax: $w_r/2$
- Ymin: $-t_r/2$
- Ymax: $t_r/2$
- Zmin: 0
- Zmax: l_r
- Component: component1
- Material: Clad

Red arrows point to the "Name" field, the dimension fields, and the "Material" dropdown menu, with the following labels:

- Name the object
- Define the dimensions
- Assign a material

The "Parameter List" table at the bottom shows the following parameters:

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

2.3 Using “Brick” to create waveguide

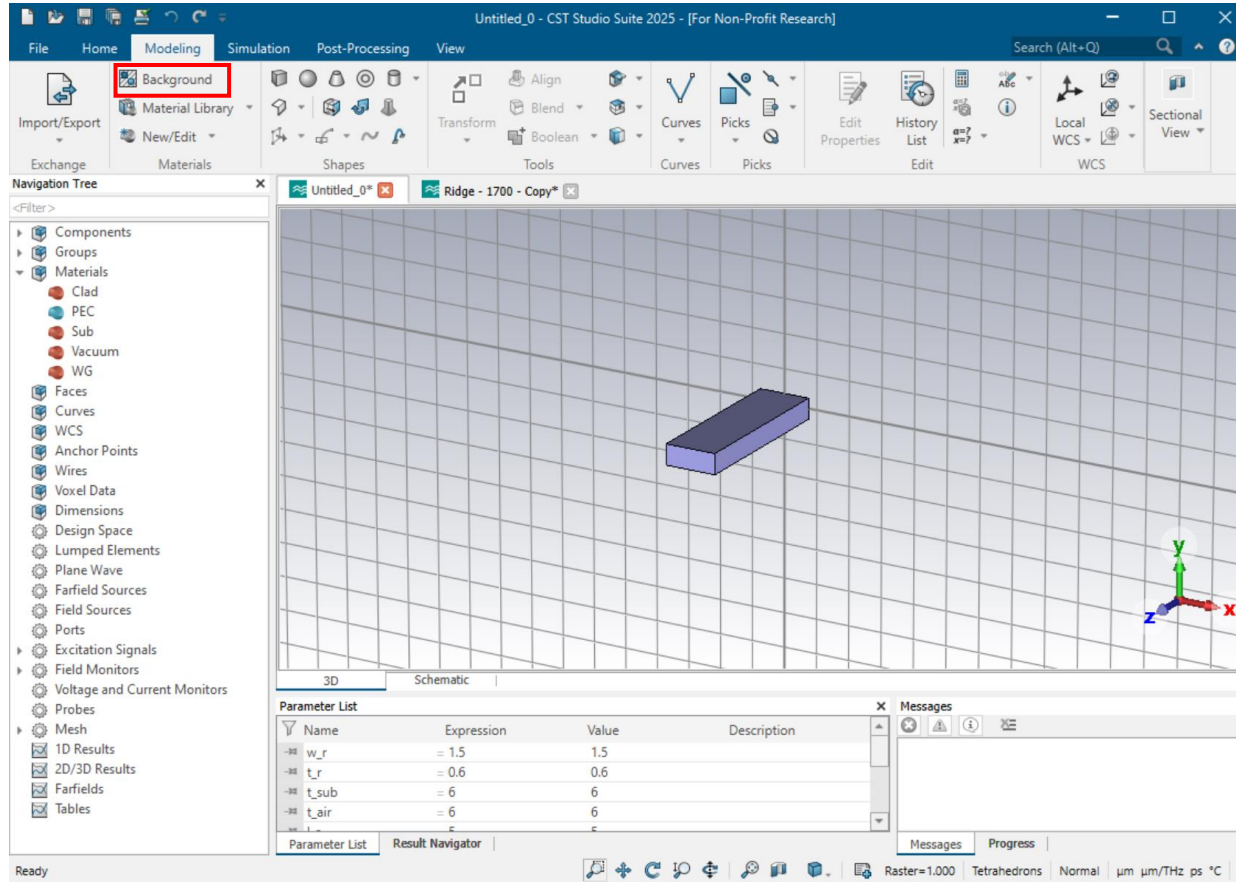
The screenshot displays the CST Studio Suite 2025 software interface. The main window shows a 3D view of a rectangular brick (waveguide) on a grid. The interface includes a menu bar (File, Home, Modeling, Simulation, Post-Processing, View), a toolbar with various tools (Import/Export, Background, Material Library, New/Edit, Shapes, Transform, Align, Blend, Boolean, Curves, Picks, Edit Properties, History List, Local WCS, Sectional View), and a navigation tree on the left. The navigation tree lists various components and objects, including Components, Groups, Materials (Clad, PEC, Sub, Vacuum, WG), Faces, Curves, WCS, Anchor Points, Wires, Voxel Data, Dimensions, Design Space, Lumped Elements, Plane Wave, Farfield Sources, Field Sources, Ports, Excitation Signals, Field Monitors, Voltage and Current Monitors, Probes, Mesh, 1D Results, 2D/3D Results, Farfields, and Tables.

The 3D view shows a blue rectangular brick centered on a grid. A coordinate system (X, Y, Z) is visible in the bottom right corner. The status bar at the bottom indicates "Ready" and "Raster=1.000 Tetrahedrons Normal μm μm/THz ps °C".

The Parameter List at the bottom shows the following data:

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	
c	= c	c	

2.4 Using “Background” to create Cladding layer and Substrate layer



The screenshot displays the CST Studio Suite 2025 software interface. The 'Modeling' ribbon is active, and the 'Background' tool is highlighted with a red box. The main 3D view shows a blue rectangular block on a grid. The left sidebar shows a navigation tree with 'Materials' expanded, listing 'Clad', 'PEC', 'Sub', 'Vacuum', and 'WG'. The bottom panel shows a 'Parameter List' table with columns for Name, Expression, Value, and Description.

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	
c		c	

2.4 Using “Background” to create Cladding layer and Substrate layer

Background Properties

Material properties
Material type: Normal Properties...

Multiple layers

Surrounding space
 Apply in all directions
Lower X distance: 5 Upper X distance: 5
Lower Y distance: 0.0 Upper Y distance: 0.0
Lower Z distance: 0.0 Upper Z distance: 0.0

Multiple layers

Height	Material
1 10*t _r	Clad
2 +10*t _r -t _r /2	Sub
3	

Orientation: X Y Z Delete Insert

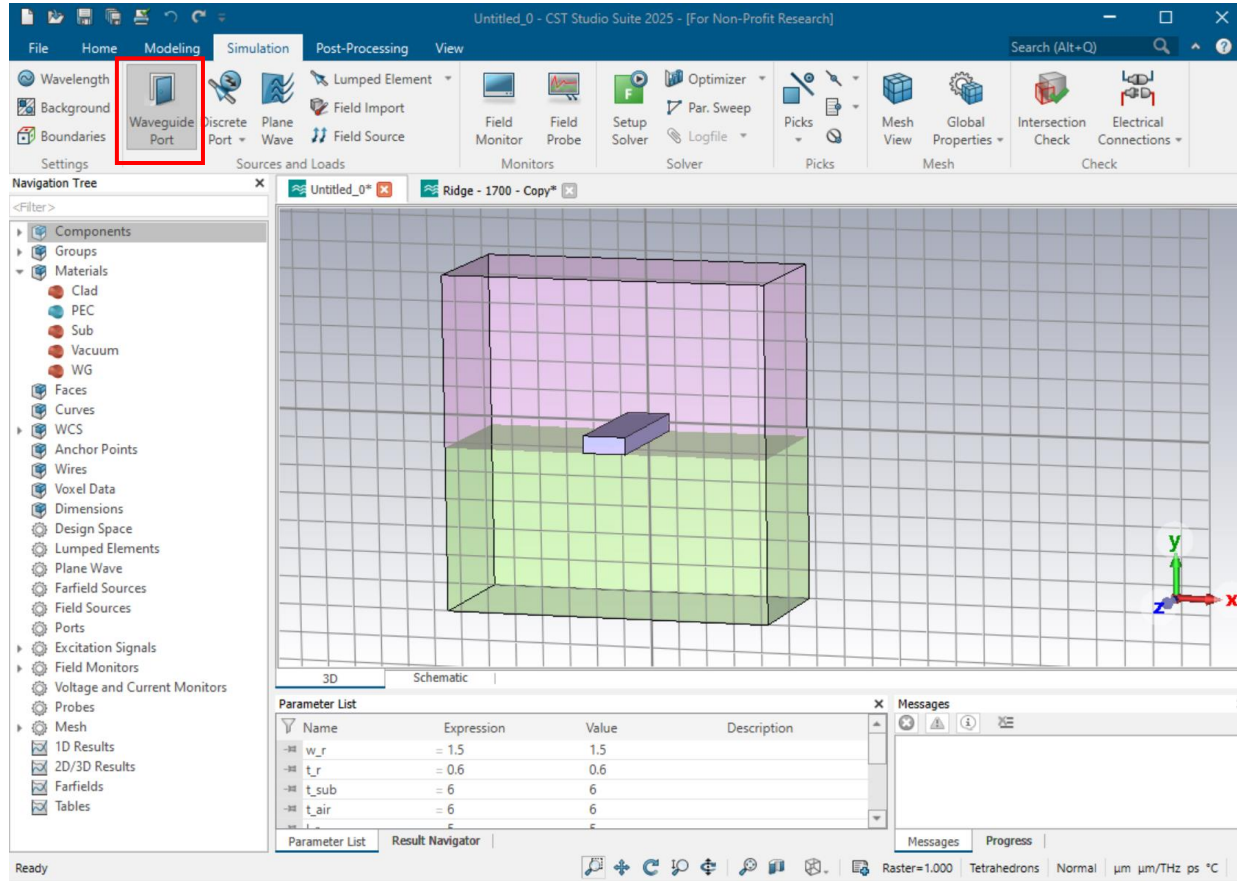
Y offset: +10*t_r-t_r/2 Invert direction Fix transversal

[Background]
Type: Normal
Epsilon: 1
Mu: 1
Rho: 1.204 [kg/m³]
Thermal cond.: 0.026 [W/K/m]
Specific heat: 1005 [J/K/kg]
Diffusivity: 2.14872e-05 [m²/s]

Parameter List

Name	Expression	Value	Description
w _r	= 1.5	1.5	
t _r	= 0.6	0.6	
t _{sub}	= 6	6	
t _{air}	= 6	6	

2.5 Create Waveguide Port



The screenshot displays the CST Studio Suite 2025 interface. The 'Modeling' tab is active, and the 'Waveguide Port' button is highlighted with a red box. The 3D view shows a waveguide structure with a purple top half and a green bottom half. The Parameter List at the bottom shows the following variables and values:

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

2.5 Create Waveguide Port

The screenshot displays the CST Studio Suite 2025 interface. The main 3D view shows a rectangular waveguide structure with a red box highlighting the port area. The 'Waveguide Port' dialog box is open, showing settings for Name, Label, Normal (Z), Orientation (Negative), Position (Full plane), Reference plane (Distance to ref. plane: 0), and Mode settings (Number of modes: 1).

Waveguide Port Dialog Box Settings:

- General: Name: 1, Folder: [empty], Label: [empty]
- Normal: X, Y, Z
- Orientation: Positive, Negative
- Text size: [slider]
- Limit text size to port area:
- Position: Coordinates: Free, Full plane, Use picks
- Xmin: -5.75, Xmax: 5.75
- Ymin: -6, Ymax: 5.7
- Free normal position: Zpos: 5
- Reference plane: Distance to ref. plane: 0
- Mode settings: Multipin port, Define Pins...
Number of modes: 1
- Single-ended, Ensure shielding
- Monitor only, Electric
- Impedance and calibration, Polarization angle
- Define Lines...: 0.0

Parameter List:

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

2.5 Create Waveguide Port

The screenshot displays the CST Studio Suite 2025 software interface. The ribbon menu at the top includes tabs for File, Home, Modeling, Simulation, Post-Processing, and View. The Simulation tab is active, showing various simulation tools like Wavelength, Background, Boundaries, Waveguide Port, Discrete Port, Plane Wave, Lumped Element, Field Import, Field Source, Field Monitor, Field Probe, Setup Solver, Par. Sweep, Logfile, Picks, Mesh View, Global Properties, Intersection Check, and Electrical Connections.

The Navigation Tree on the left shows a hierarchy of components, including Components, Groups, Materials (Clad, PEC, Sub, Vacuum, WG), Faces, Curves, WCS, Anchor Points, Wires, Voxel Data, Dimensions, Design Space, Lumped Elements, Plane Wave, Farfield Sources, Field Sources, Ports, Excitation Signals, Field Monitors, Voltage and Current Monitors, Probes, Mesh, 1D Results, 2D/3D Results, Farfields, and Tables.

The main 3D view shows a rectangular waveguide structure with a red waveguide port on the left side. The structure is surrounded by a grid. A coordinate system (x, y, z) is visible in the bottom right corner.

The Parameter List at the bottom shows the following parameters:

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

The bottom status bar shows the software is ready, with a raster size of 1,000, tetrahedrons, normal view, and units of μm , $\mu\text{m}/\text{THz}$, ps, and $^{\circ}\text{C}$.

2.6 Boundary Condition

The screenshot displays the CST Studio Suite 2025 software interface. The main window shows a 3D model of a rectangular structure with a red top surface and a brown bottom surface, set against a grid background. The 'Boundaries' panel is open on the left, showing a tree view of simulation settings. The 'Parameter List' panel at the bottom left contains the following data:

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

The 'Messages' panel at the bottom right is empty. The status bar at the bottom indicates 'Ready' and 'Raster=1.000 Tetrahedrons Normal μm μm/THz ps °C'.

2.6 Boundary Condition

Uses a Perfectly Matched Layer (PML) absorber at the boundary

Boundary Conditions

Boundaries | Symmetry Planes

Apply in all directions

Xmin: open Xmax: open

Ymin: open Ymax: open

Zmin: open Zmax: open

Cond.: 1000 S/m Open Boundary...

OK Cancel Help

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

Parameter List

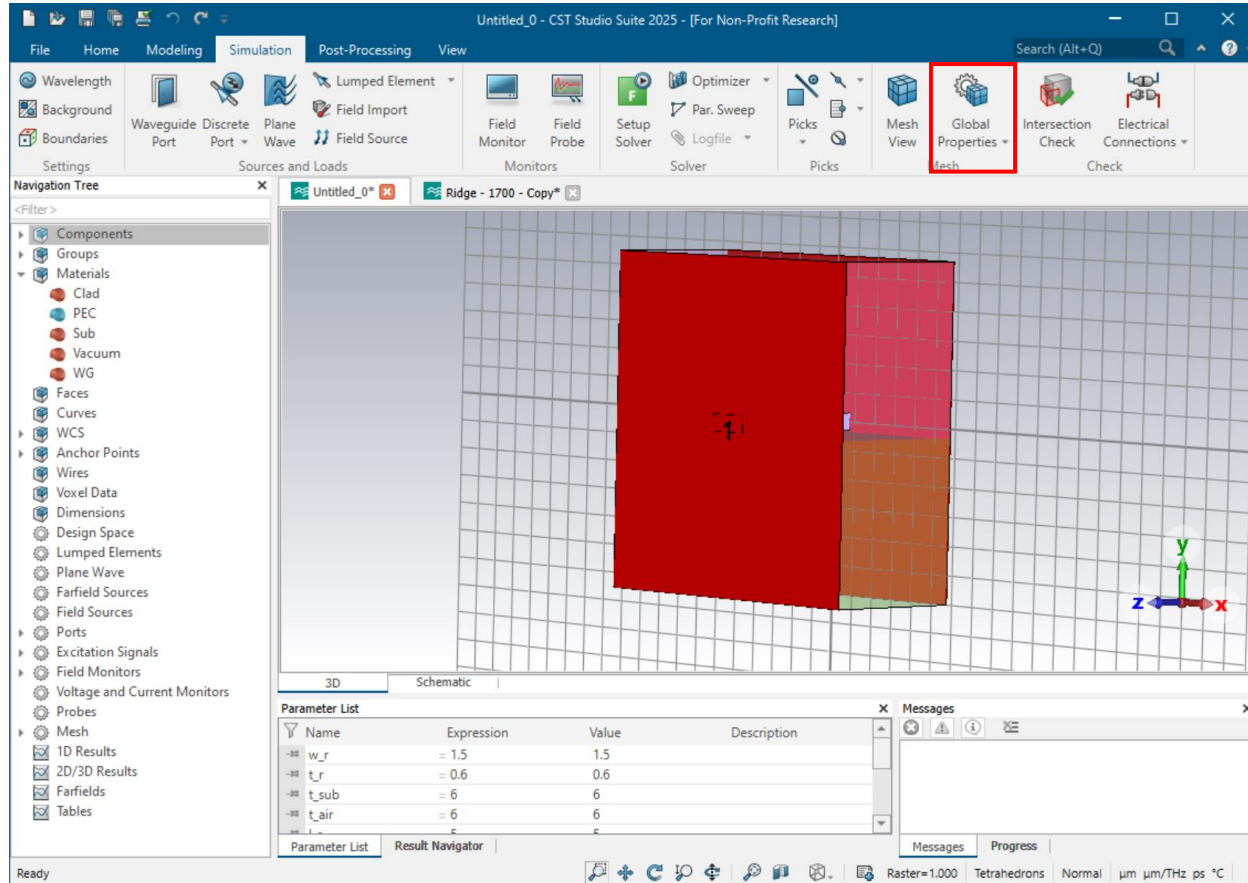
Messages

Messages Progress

Ready

Raster=1.000 Tetrahedrons Normal μm $\mu\text{m}/\text{THz}$ ps $^{\circ}\text{C}$

2.7 Mesh



The screenshot displays the CST Studio Suite 2025 interface. The main window shows a 3D model of a rectangular structure with a mesh applied to its surface. The 'Global Properties' menu item is highlighted with a red box, and the 'Mesh' sub-menu is also visible. The 'Navigation Tree' on the left shows a hierarchy of components including Clad, PEC, Sub, Vacuum, and WG. The 'Parameter List' at the bottom shows parameters w_r , t_r , t_{sub} , and t_{air} with their respective values.

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_{sub}	= 6	6	
t_{air}	= 6	6	

2.7 Mesh

The screenshot displays the CST Studio Suite 2025 software interface. The main window shows a 3D model of a ridge structure with a tetrahedral mesh applied. A red vertical rectangular object is positioned on the ridge. The 'Mesh Properties - Tetrahedral' dialog box is open, showing the following settings:

- Maximum cell: Model: 4, Background: 4
- Cells per wavelength: 4
- Cells per max model box edge: 10
- Minimum cell: Absolute value: 0
- Meshing method: Default (surface based)
- Statistics:
 - Minimum edge length: 0
 - Minimum quality: 0
 - Maximum edge length: 0
 - Maximum quality: 0
 - Tetrahedrons: 0
 - Average quality: 0

The 'Parameter List' at the bottom shows the following parameters:

Name	Expression	Value	Description
-# w_r	= 1.5	1.5	
-# t_r	= 0.6	0.6	
-# t_sub	= 6	6	
-# t_air	= 6	6	

2.8 Setup Frequency domain Solver, and start simulation

Frequency Domain Solver Parameters

Method

Broadband sweep:
General purpose

Results

Store result data in cache
 Calculate port modes only
 Normalize S-parameter to 50 Ohm

Mesh type:
Tetrahedral

Excitation

Source type: Port 1 Mode: All

Frequency samples

Active	Type	Adapt.	Samples	From	To	Unit
<input checked="" type="checkbox"/>	Max.Range		1	270.083	272.539	THz
<input checked="" type="checkbox"/>	Monitors		1	271.305	271.305	THz
<input checked="" type="checkbox"/>	Automatic	<input checked="" type="checkbox"/>	1			THz
<input type="checkbox"/>	Automatic	<input type="checkbox"/>	1			THz
<input type="checkbox"/>	Single	<input type="checkbox"/>	1			THz
<input type="checkbox"/>	Single	<input type="checkbox"/>	1			THz

Adaptive mesh refinement

Adaptive tetrahedral mesh refinement

Sensitivity analysis

Use sensitivity analysis

Parameter List

Name	Expression	Value	Description
w_r	= 1.5	1.5	
t_r	= 0.6	0.6	
t_sub	= 6	6	
t_air	= 6	6	

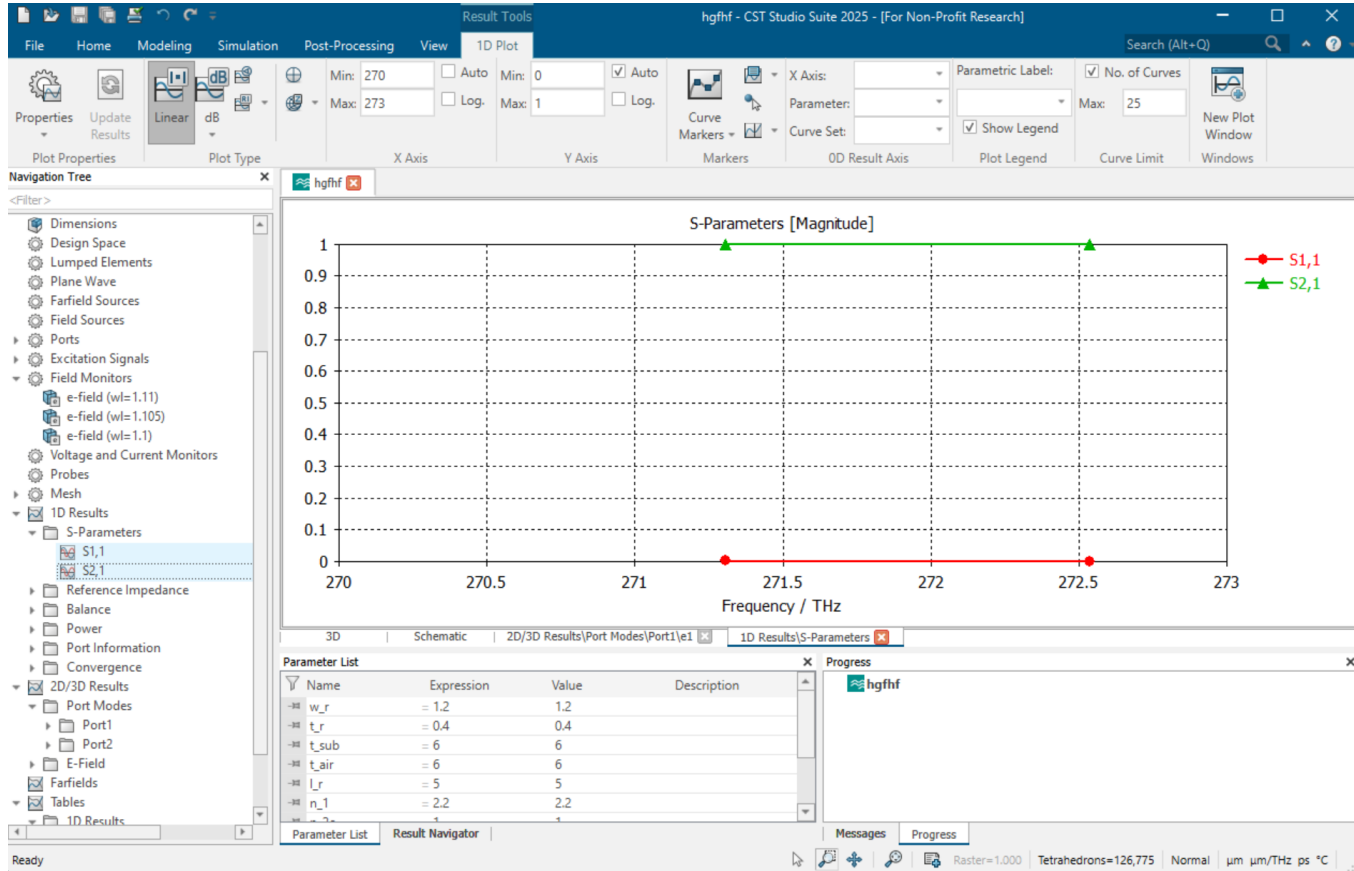
Start

Select Tetrahedral

Untick to save time

3. Results visualization

1D results: S-Parameters



Name	Expression	Value	Description
w_r	= 1.2	1.2	
t_r	= 0.4	0.4	
t_sub	= 6	6	
t_air	= 6	6	
l_r	= 5	5	
n_1	= 2.2	2.2	

Progress
hgfhf

3. Results visualization

2D results: mode profile.

The screenshot displays the CST Studio Suite 2025 interface for a 2D/3D plot. The main window shows a 2D mode profile of an e-field within a rectangular waveguide structure. The field is visualized as a color map with a color bar on the right labeled 'V/m', ranging from 0 to 3.14×10^7 . The plot is titled 'Port1 e1'.

The left navigation tree shows the following structure:

- Farfield Sources
- Field Sources
- Ports
- Excitation Signals
- Field Monitors
 - e-field (wl=1.11)
 - e-field (wl=1.105)
 - e-field (wl=1.1)
- Voltage and Current Monitors
- Probes
- Mesh
- 1D Results
 - S-Parameters
 - S1,1
 - S2,1
 - Reference Impedance
 - Balance
 - Power
 - Port Information
 - Convergence
 - 2D/3D Results
 - Port Modes
 - Port1
 - e1
 - h1
 - Port2
 - E-Field
 - Farfields
 - Tables
 - 1D Results
 - Convert all 1D Results from Frequency to Effective Refractive Index

The bottom status bar contains a 'Parameter List' table:

Name	Expression	Value	Description
w_r	= 1.2	1.2	
t_r	= 0.4	0.4	
t_sub	= 6	6	
t_air	= 6	6	
l_r	= 5	5	
n_1	= 2.2	2.2	

3. Results visualization

2D results: mode profile.

hgfhf - CST Studio Suite 2025 - [For Non-Profit Research]

2D/3D Plot

Contour: Abs, Phase: 0, Time: n/a, Real, dB, Fields on Plane, Cutting Plane, Normal: Z, Position: 5, Min: 0, Max: 3.1411e+07, Unit: V/m, Color Ramp: Log, Auto

Navigation Tree

- Farfield Sources
- Field Sources
- Ports
- Excitation Signals
- Field Monitors
 - e-field (wl=1.11)
 - e-field (wl=1.105)
 - e-field (wl=1.1)
- Voltage and Current Monitors
- Probes
- Mesh
- 1D Results
 - S-Parameters
 - S1,1
 - S2,1
 - Reference Impedance
 - Balance
 - Power
 - Port Information
 - Convergence
 - 2D/3D Results
 - Port Modes
 - Port1
 - e1
 - h1

Port1 e1

Component	Abs
Frequency	271.305 THz
Phase	0 °
Mode type	Hybrid
Wave Imp.	185.168 Ω
Beta	1.11351e+07 1/m
Accuracy	7.19457e-11
Maximum (Plot)	3.14107e+07 V/m

3D | Schematic | 2D/3D Results | Port Modes | Port1 | e1 | 1D Results | Port Information | Wave Impedance | 2(1)

Parameter List

Name	Expression	Value	Description
w_r	= 1.2	1.2	
t_r	= 0.4	0.4	
t_sub	= 6	6	
t_air	= 6	6	
l_r	= 5	5	
n_1	= 2.2	2.2	

Messages | Progress

Ready

Raster=1.000 | Tetrahedrons=126,775 | Normal | μm μm/THz ps °C

3. Results visualization

2D results: mode profile.

The screenshot displays the CST Studio Suite 2025 interface for visualizing simulation results. The main window shows a 2D/3D plot of the electric field (E-field) mode profile. The plot is a color map showing the field distribution within a waveguide structure. A color scale on the right indicates the field magnitude in V/m, ranging from 0 to 3.3122×10^7 . The plot is titled "e-field (wl=1.1) [1]".

The interface includes a navigation tree on the left, a top toolbar with "2D/3D Plot" options, and a parameter list at the bottom. The parameter list shows the following values:

Name	Expression	Value	Description
w_r	= 1.2	1.2	
t_r	= 0.4	0.4	
t_sub	= 6	6	
t_air	= 6	6	
l_r	= 5	5	
n_1	= 2.2	2.2	

The plot properties are as follows:

- Plot Type: 2D/3D Plot
- Phase: 33.75
- Time: n/a
- Orientation: Inside
- Component: Abs
- Frequency: 272.539 THz
- Phase: 33.75°
- Cross section: A
- Cutplane at Y: -0.2 μm
- Maximum on Plane (Plot): 1.91752×10^7 V/m
- Maximum (Plot): 3.3122×10^7 V/m