CST Tutorial

Introduction:

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

Exercise:

- Virtual Machine connection
- Simulation of strip waveguides

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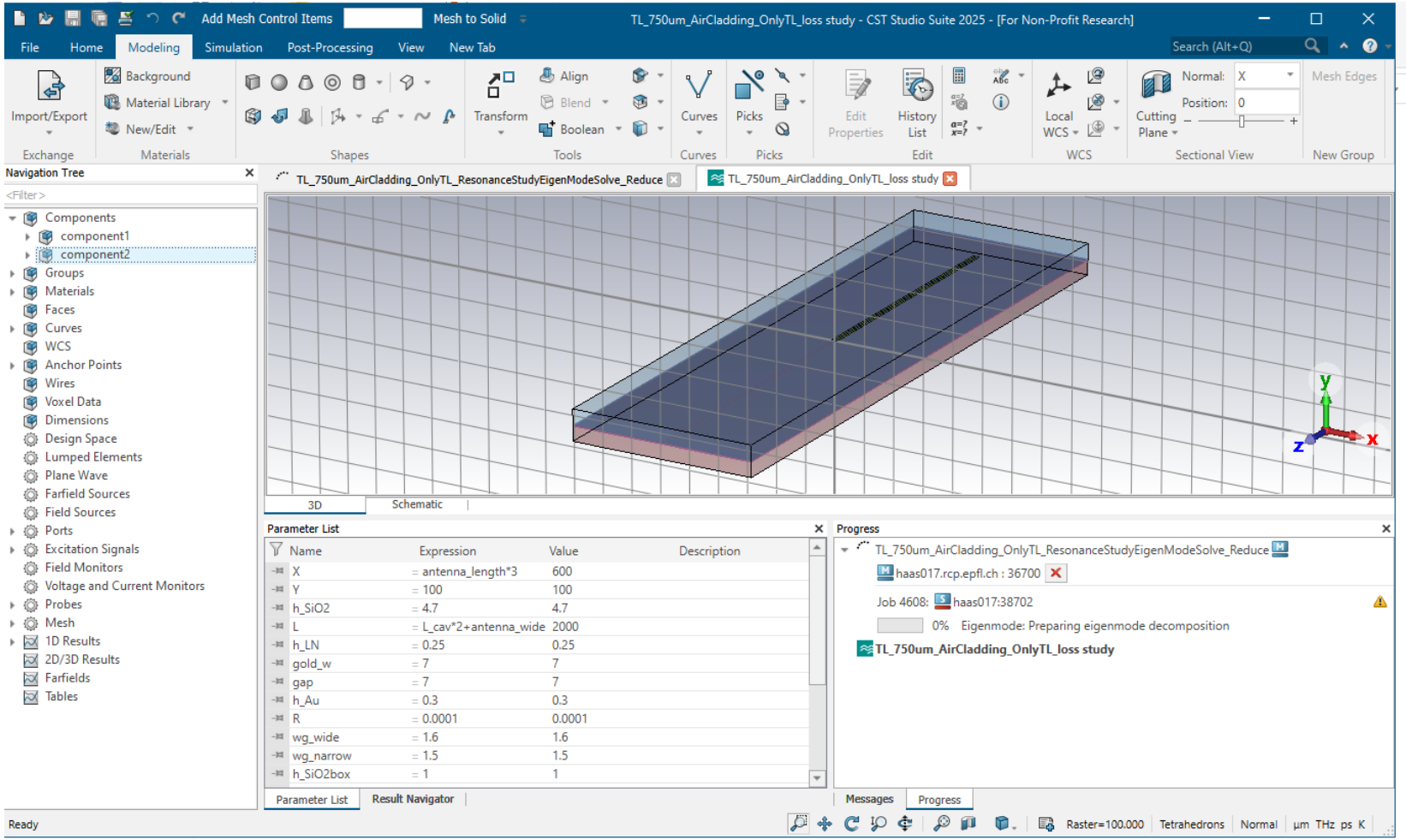
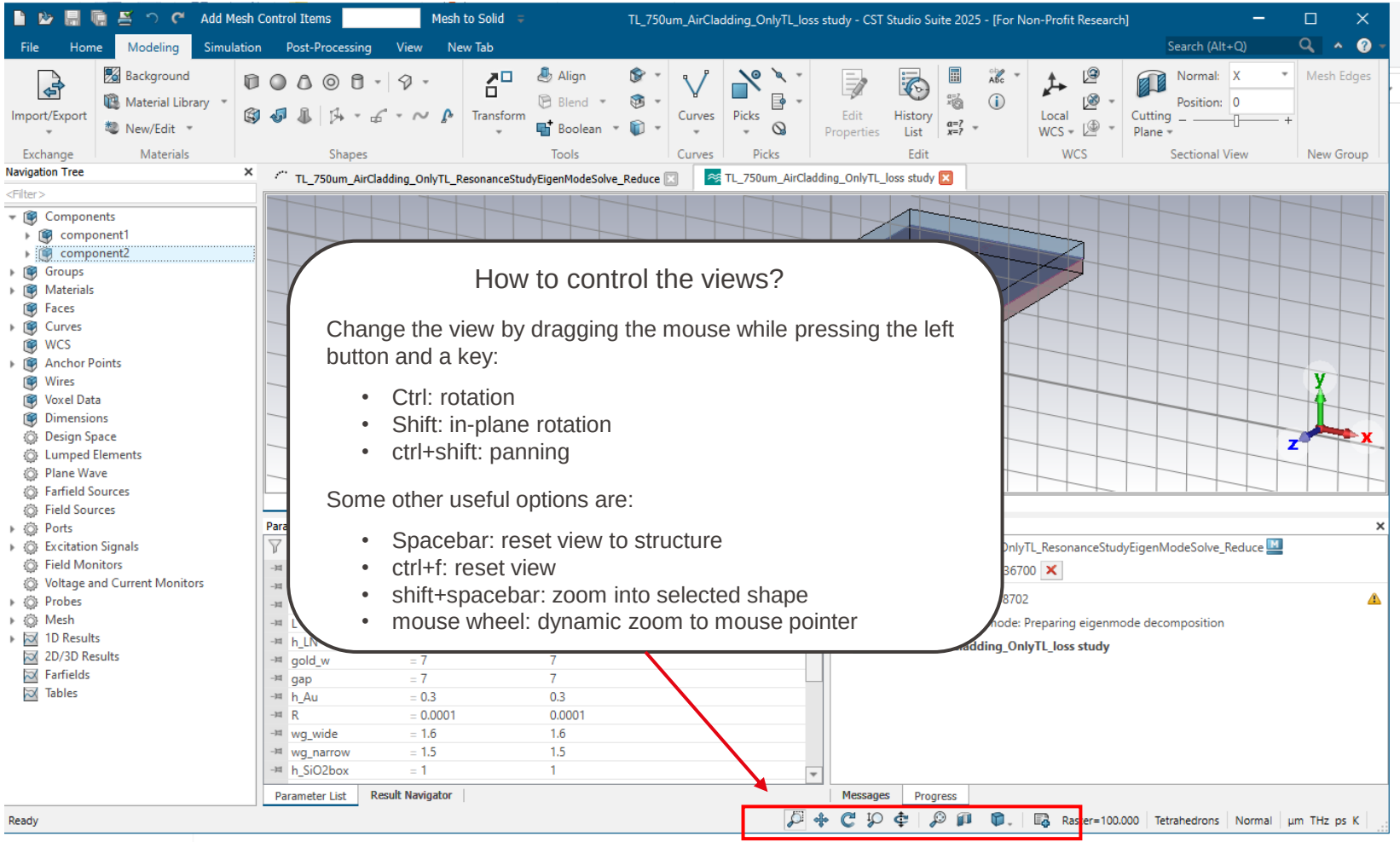
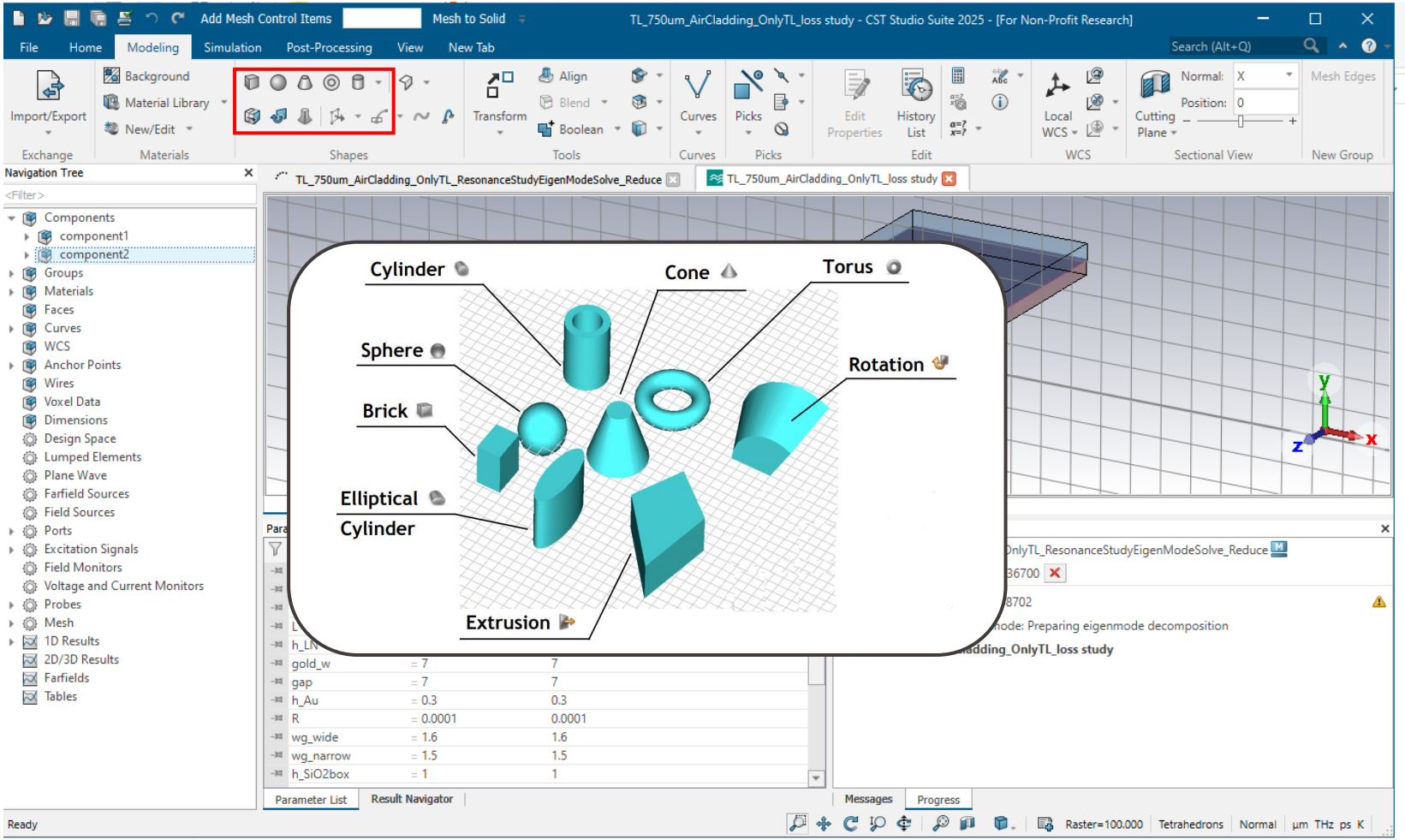
Common User Interface



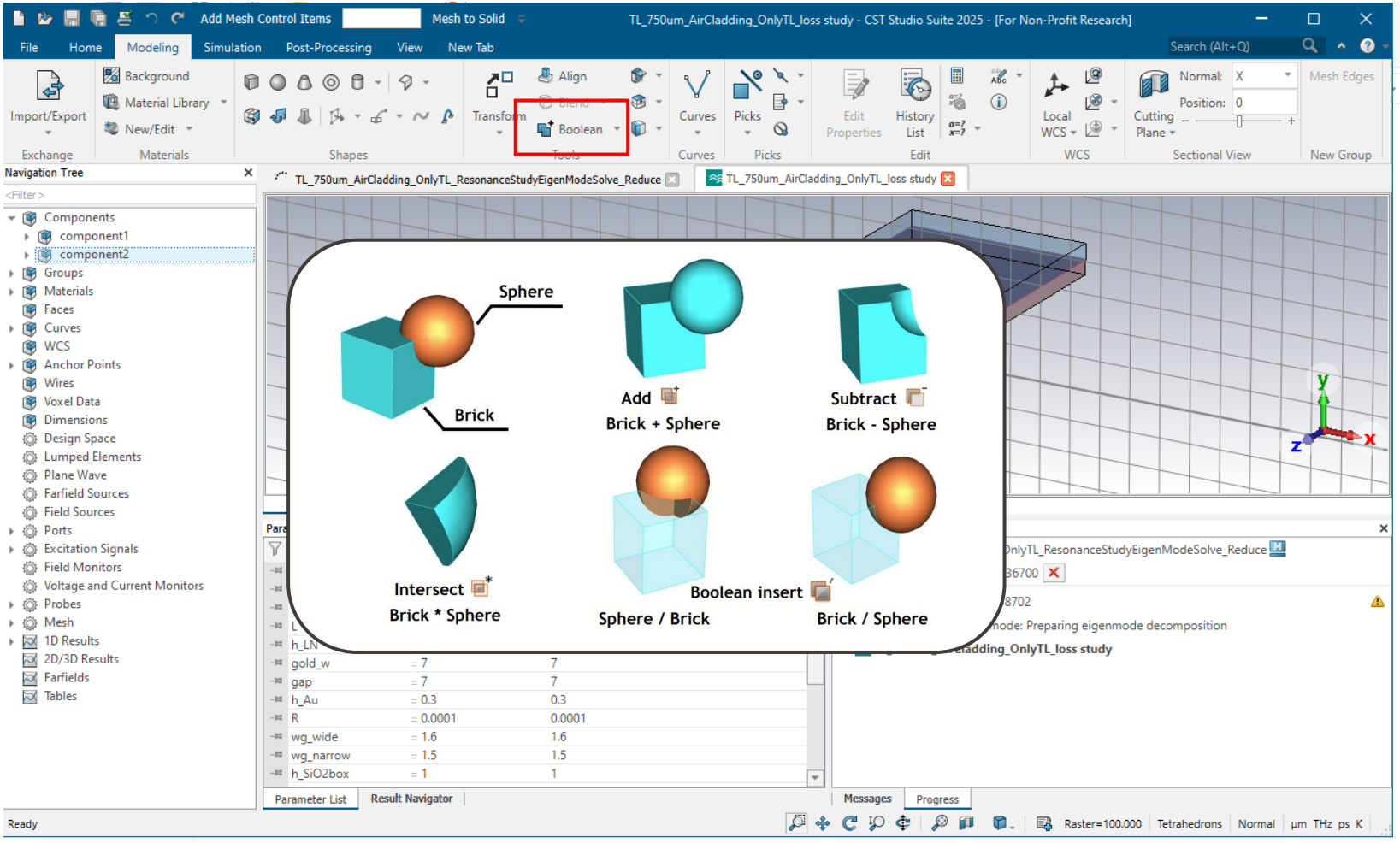
View Options



Primitives

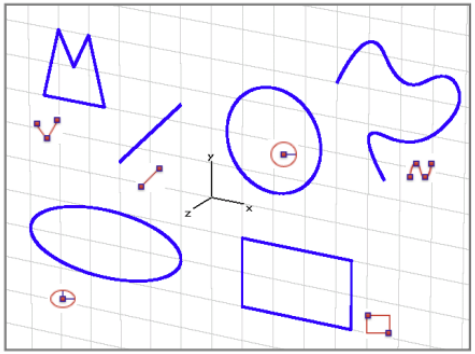

Add Mesh Control Items
Mesh to Solid
TL_750um_AirCladding_OnlyTL_loss study - CST Studio Suite 2025 - [For Non-Profit Research]
File
Home
Modeling
Simulation
Post-Processing
View
New Tab
Import/Export
Background
Material Library
New/Edit
Transform
Align
Blend
Boolean
Curves
Picks
Edit Properties
History List
Local WCS
Cutting Plane
Normal:
Position:
Mesh Edges
Exchange
Materials
Shapes
Tools
Curves
Picks
Edit
WCS
Sectional View
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
TL_750um_AirCladding_OnlyTL_ResonanceStudyEigenModeSolve_Reduce
TL_750um_AirCladding_OnlyTL_loss study
Cylinder
Cone
Torus
Sphere
Rotation
Brick
Elliptical Cylinder
Extrusion
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
Messages
Progress
Ready
Raster=100.000
Tetrahedrons
Normal
µm THz ps K

Boolean Operations

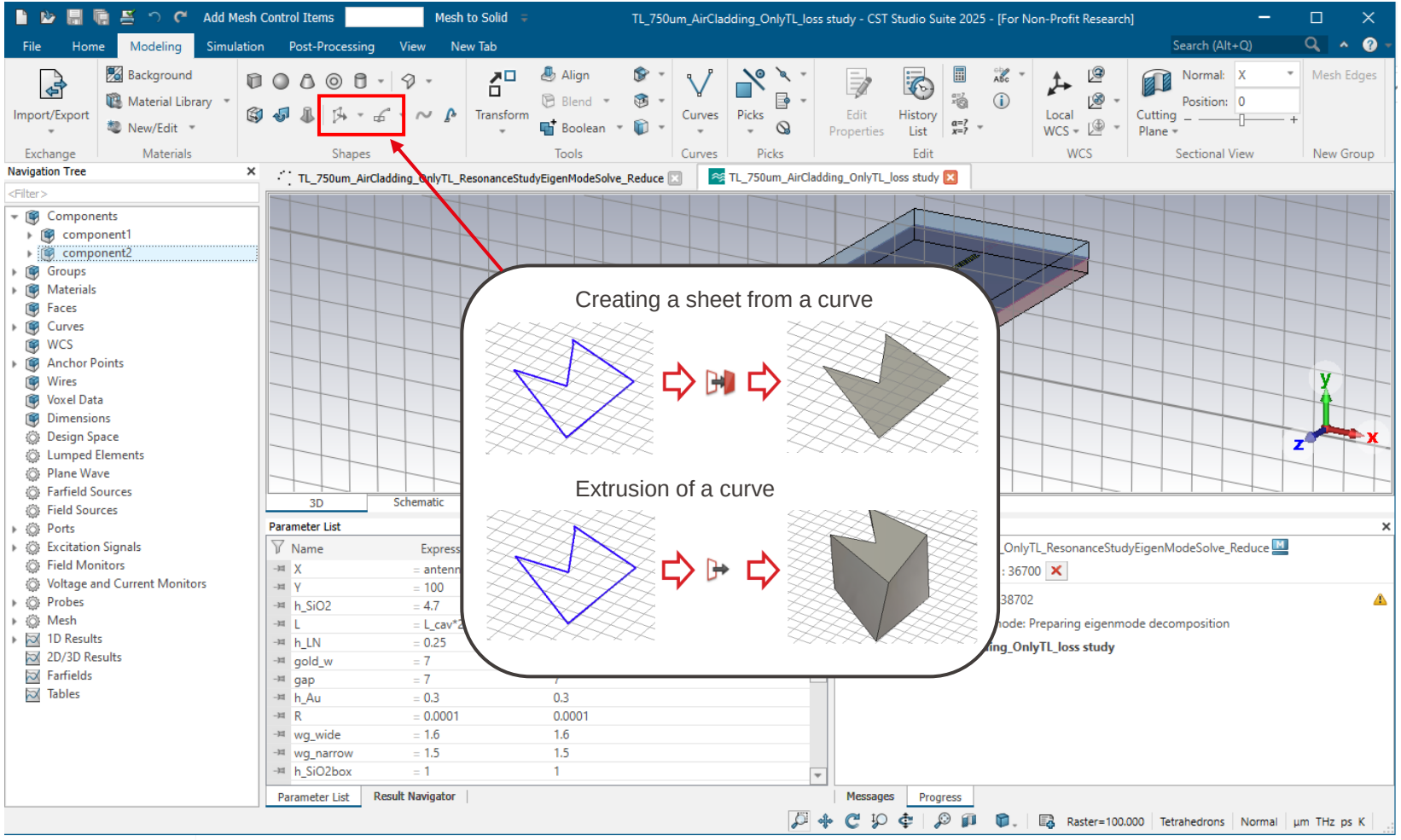


Structure Creations

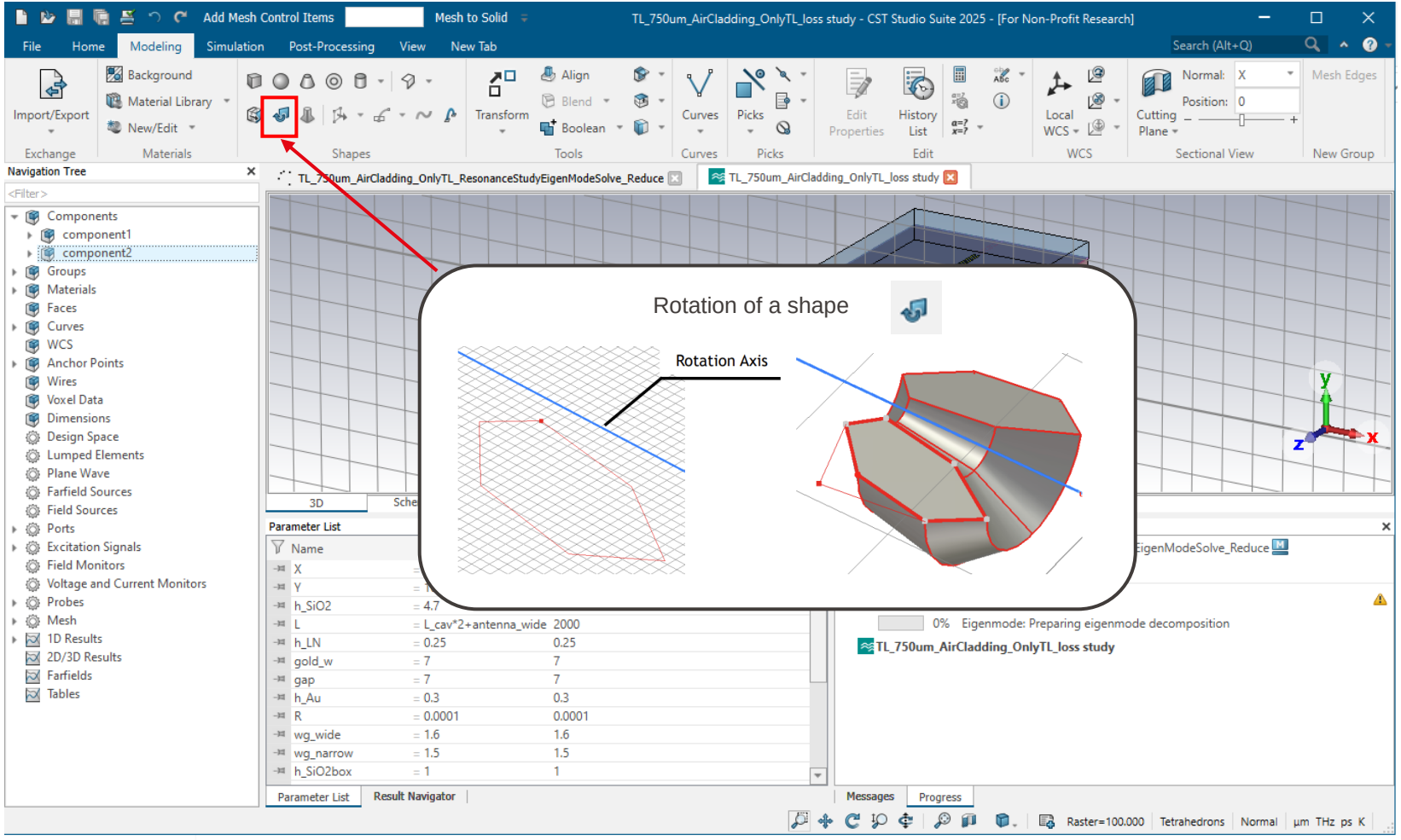
Curves can be used for structure creation



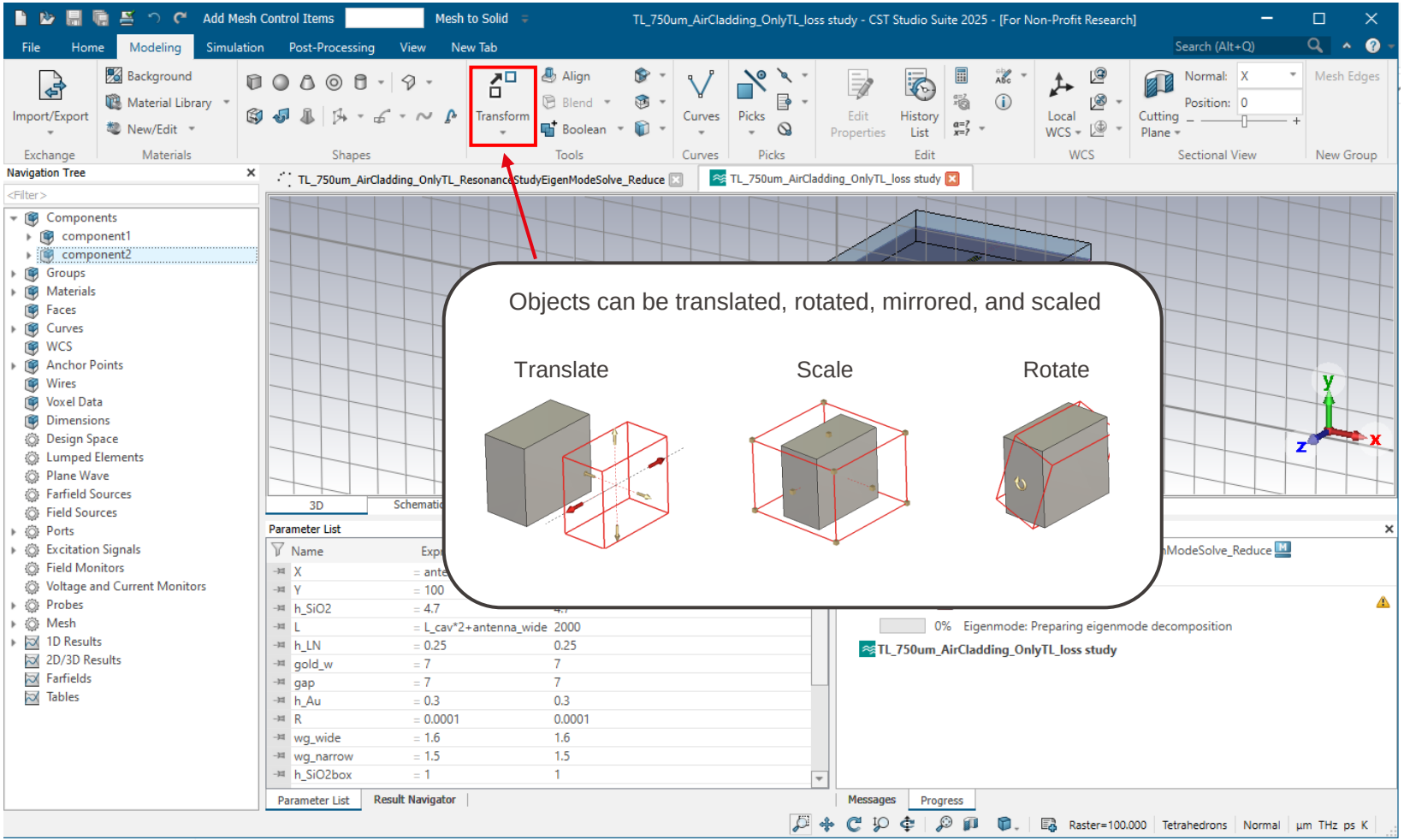
Structure Creations



Structure Creations



Transform Operations



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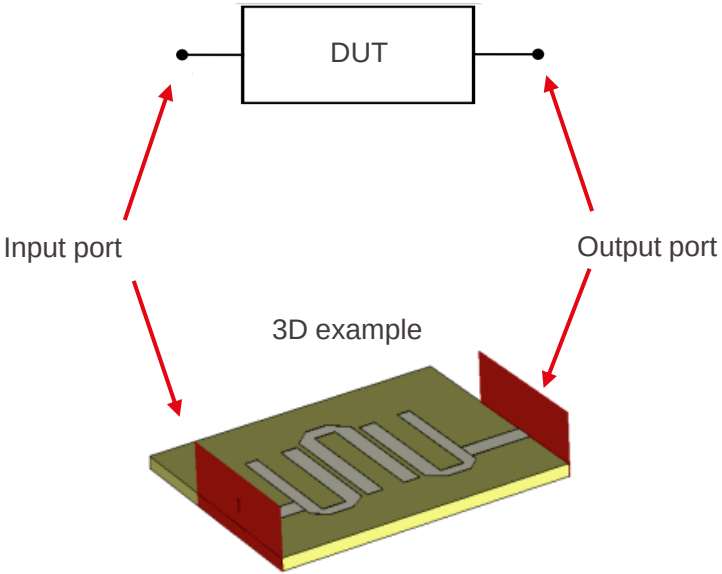
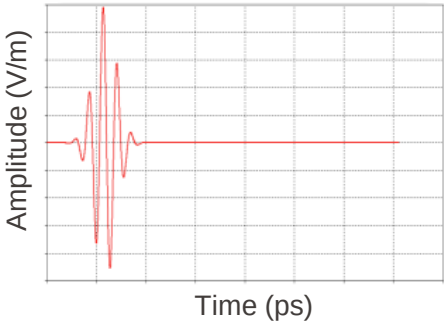
Time Domain solver

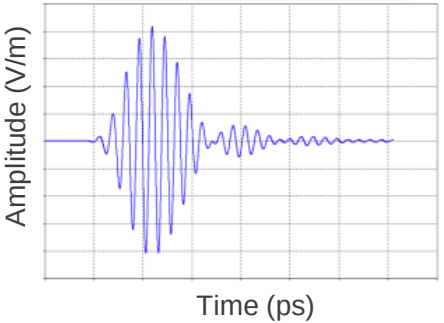
Schematic



Input excitation



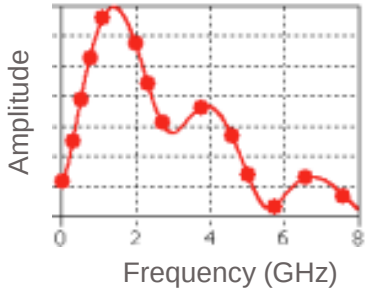
Output signal



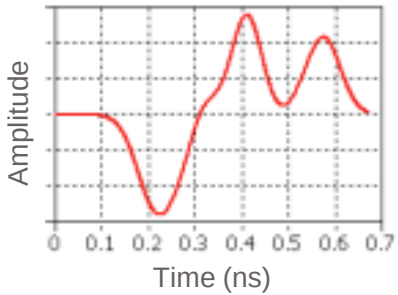
Numerical time integration of 3D Maxwell equations

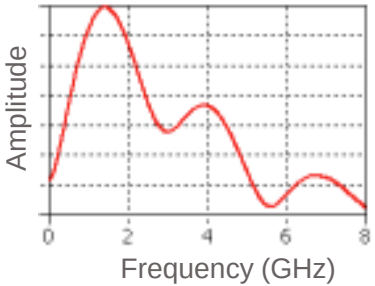
Frequency Domain solver

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 vs Frequency Domain Solver: Rule of Thumb

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

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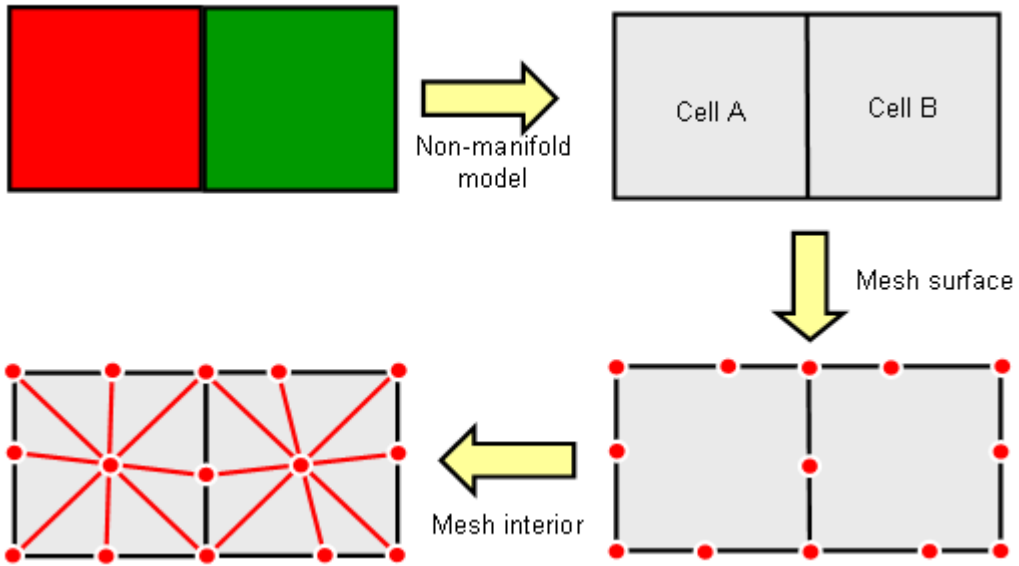
Tetrahedral Mesh

Tetrahedral mesh generation steps:

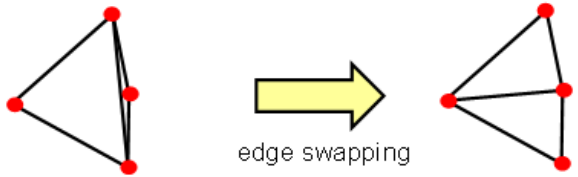
- Build the non-manifold simulation model
- Mesh the model's edges and faces: "surface meshing"
- Mesh the model's volumes based on surface mesh: "volume meshing"



Tetrahedral Mesh

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

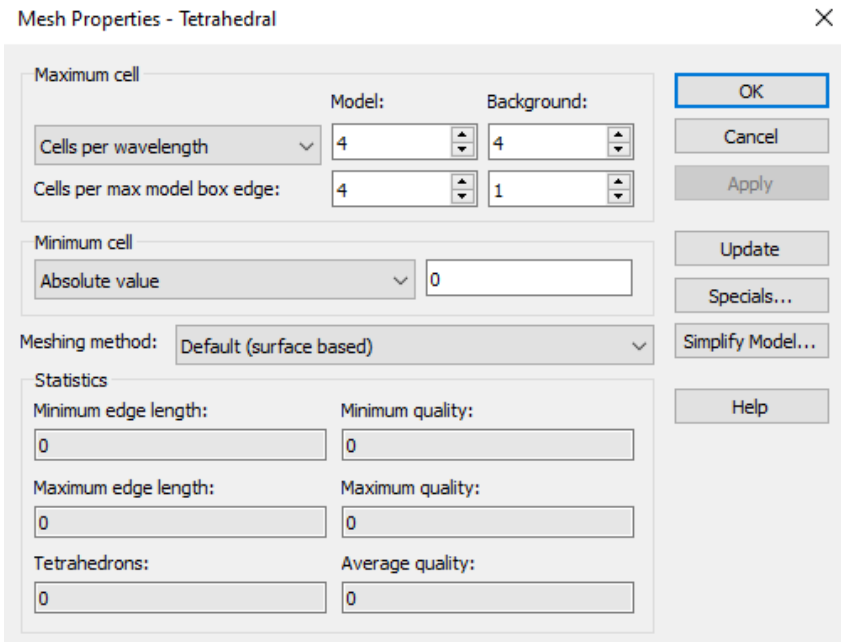
For example, mesh optimization can swaps edges and faces and reconnects them to form better quality tetrahedrons:



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

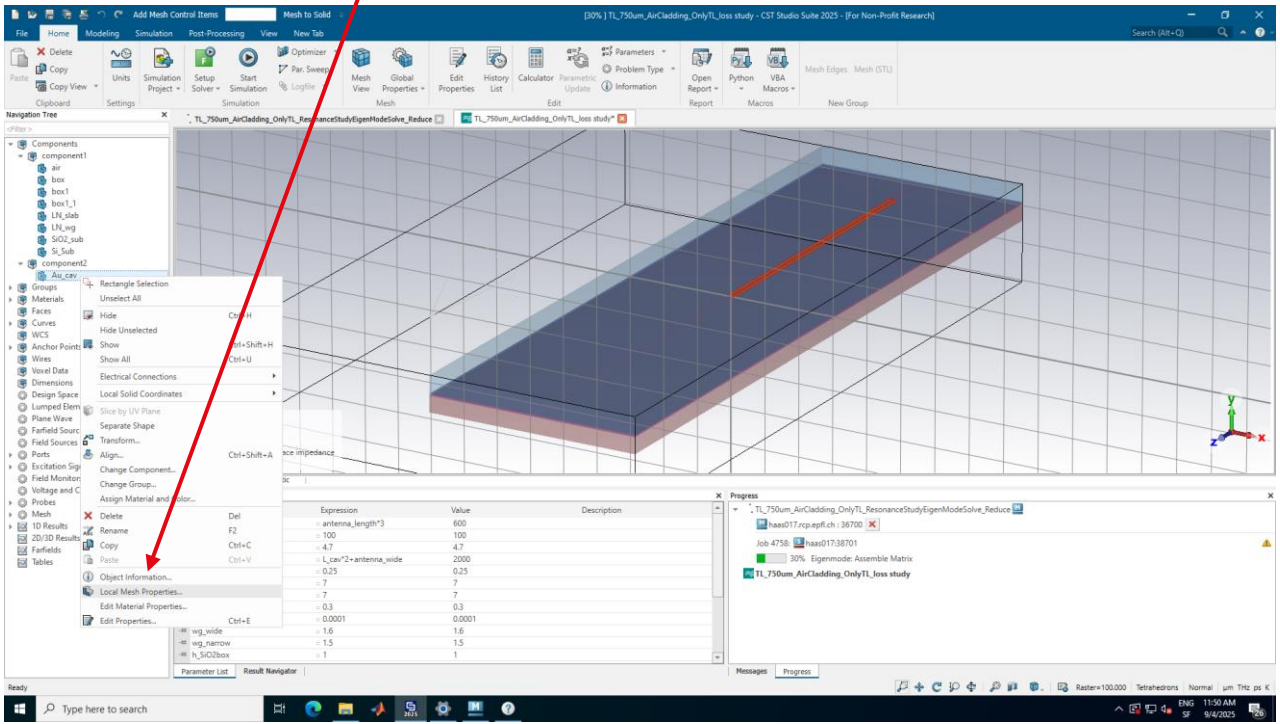
Control the mesh globally

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



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.

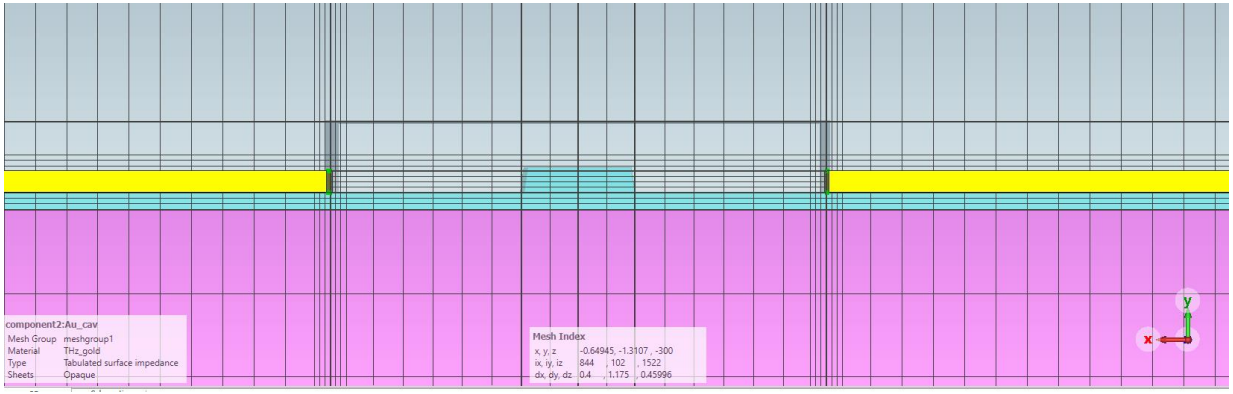


Hexahedral Mesh

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”



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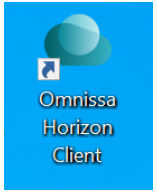
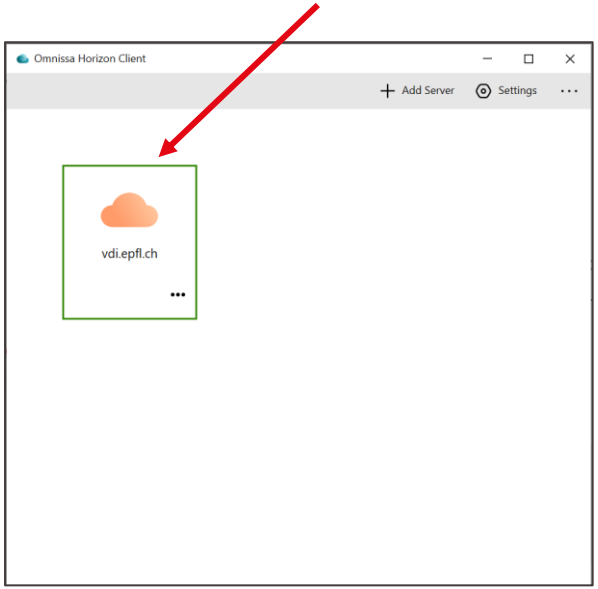
Virtual Machine connection

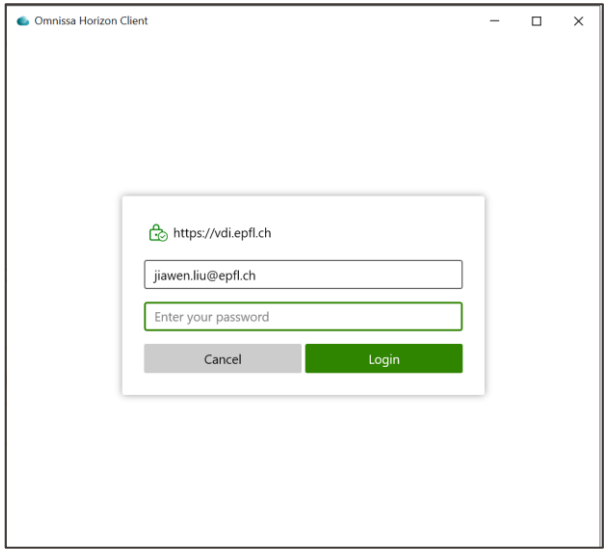
1. Run Virtual Machine tool



2. Double click on EPFL VDI server

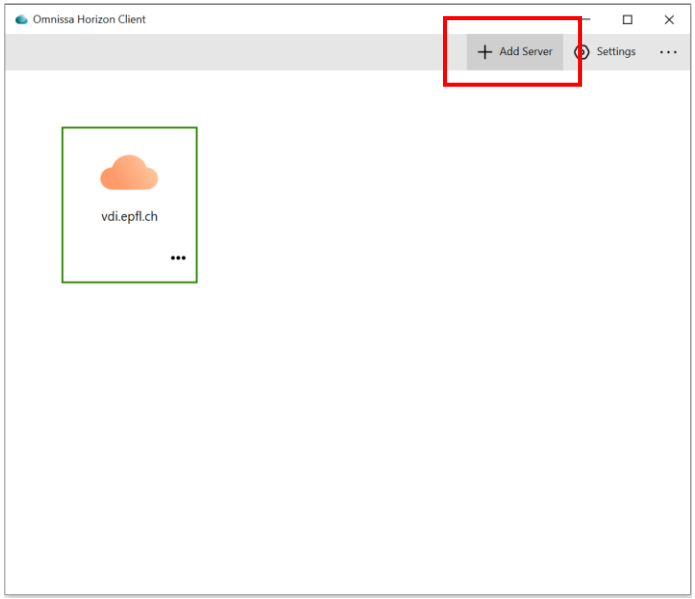


3. Log-in using your EPFL account

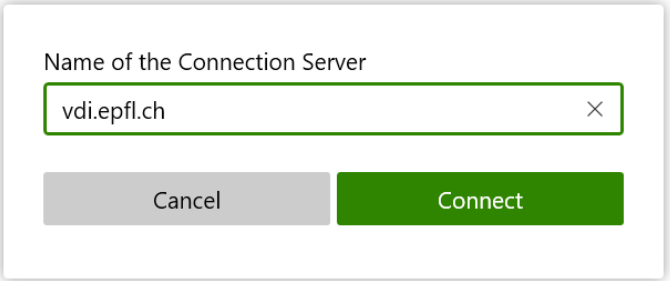


Virtual Machine connection

If you don’t see EFPL VDI server, click on “add server”

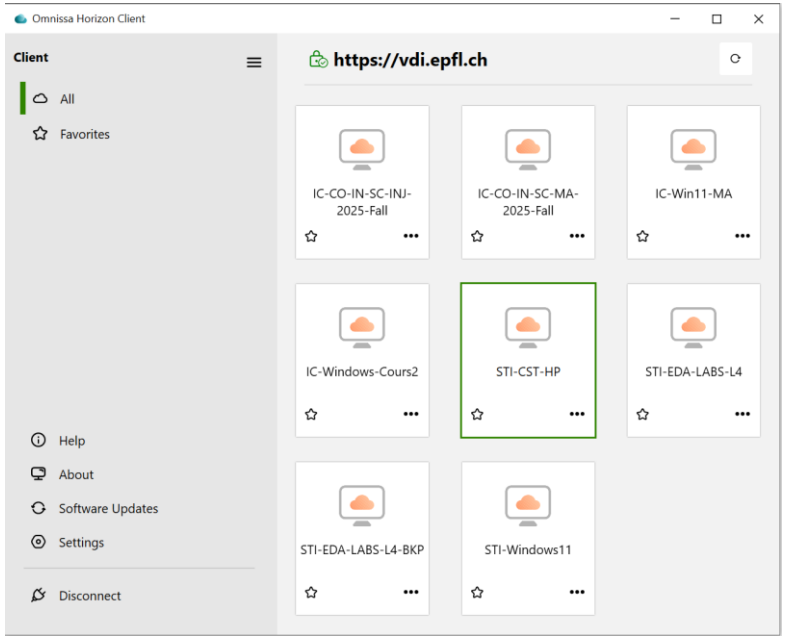


In the pop-up window, put “vdi.epfl.ch” then “Connect”

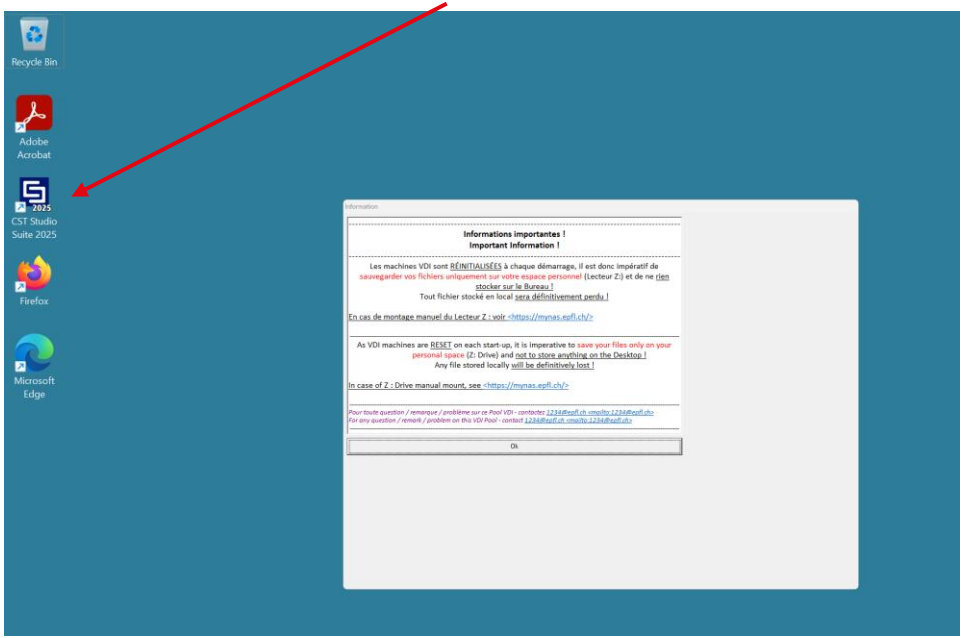


Virtual Machine connection

4. Double click on “STI-CST-HP”



5. Now you can run CST !



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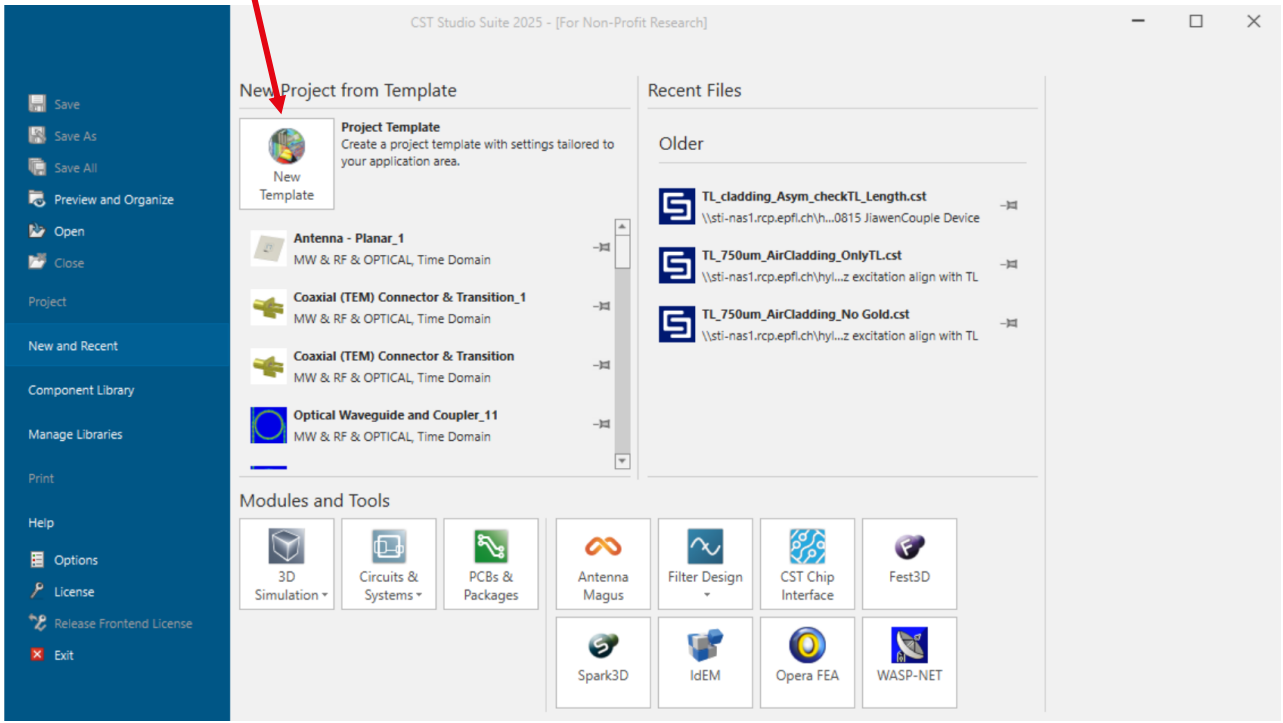
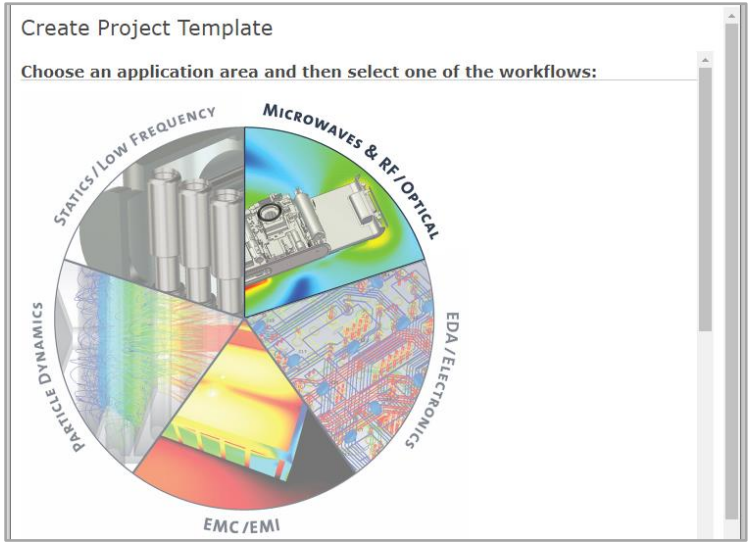
1. Setup new project

Choose New Template

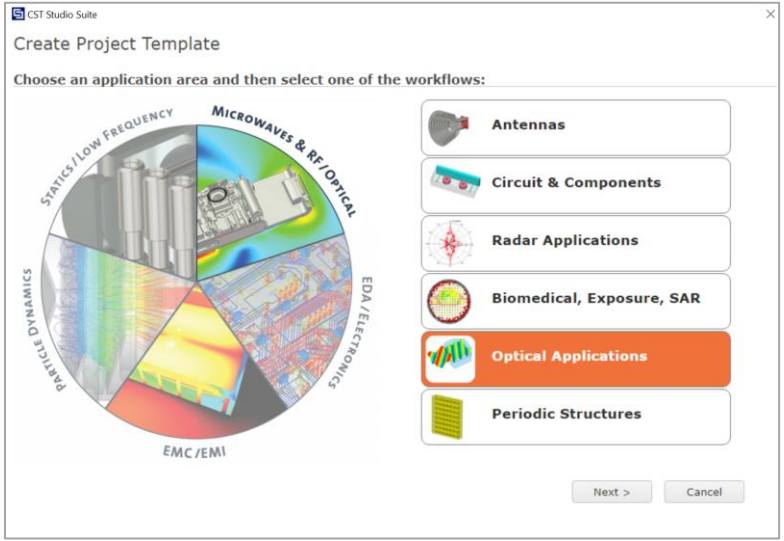


1. Setup new project

1.1 Choose Microwave & RF / Optical module

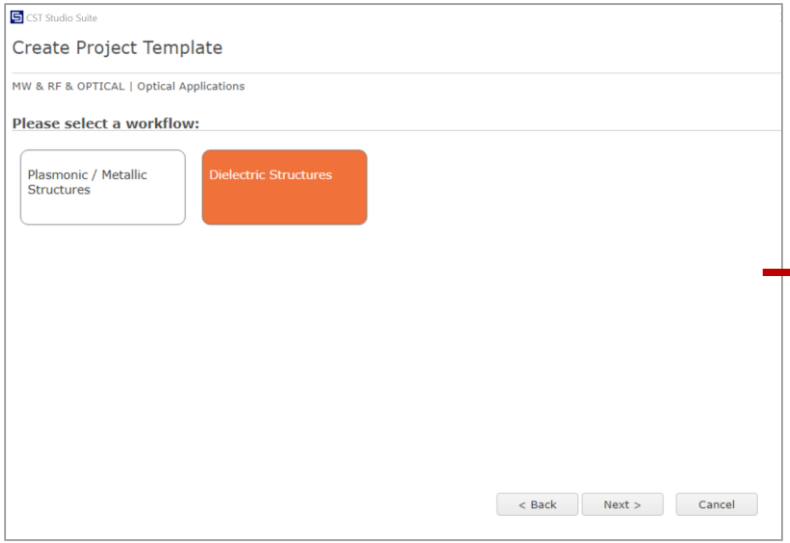


1.2 Choose Optical Applications, click on “Next”

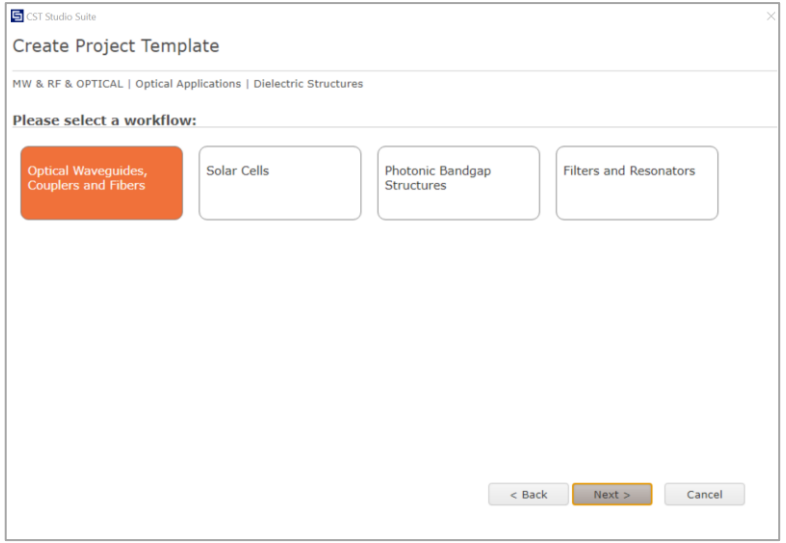


1. Setup new project

1.3 Choose “Dielectric Structures”, then “Next”

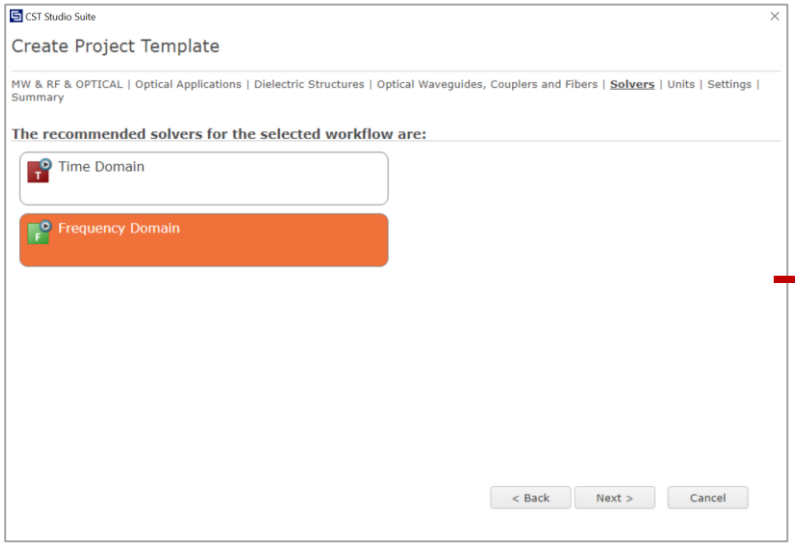


1.4 Choose “optical Waveguides”, then “Next”

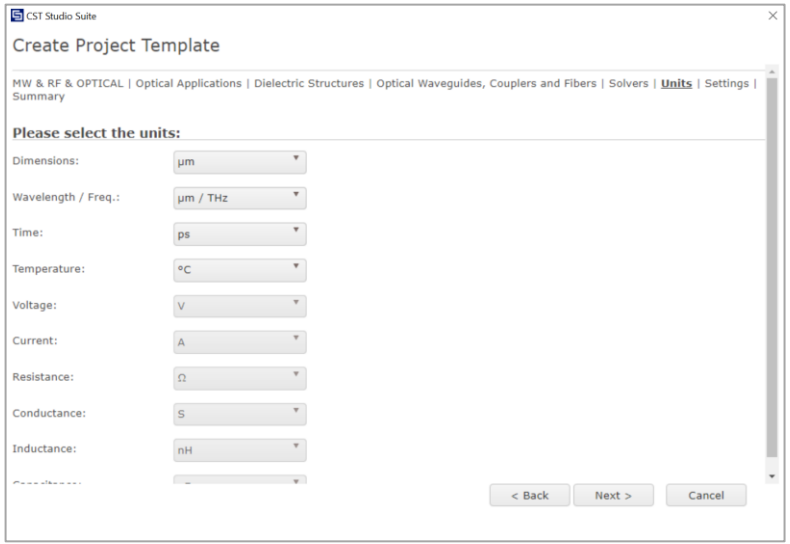


1. Setup new project

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

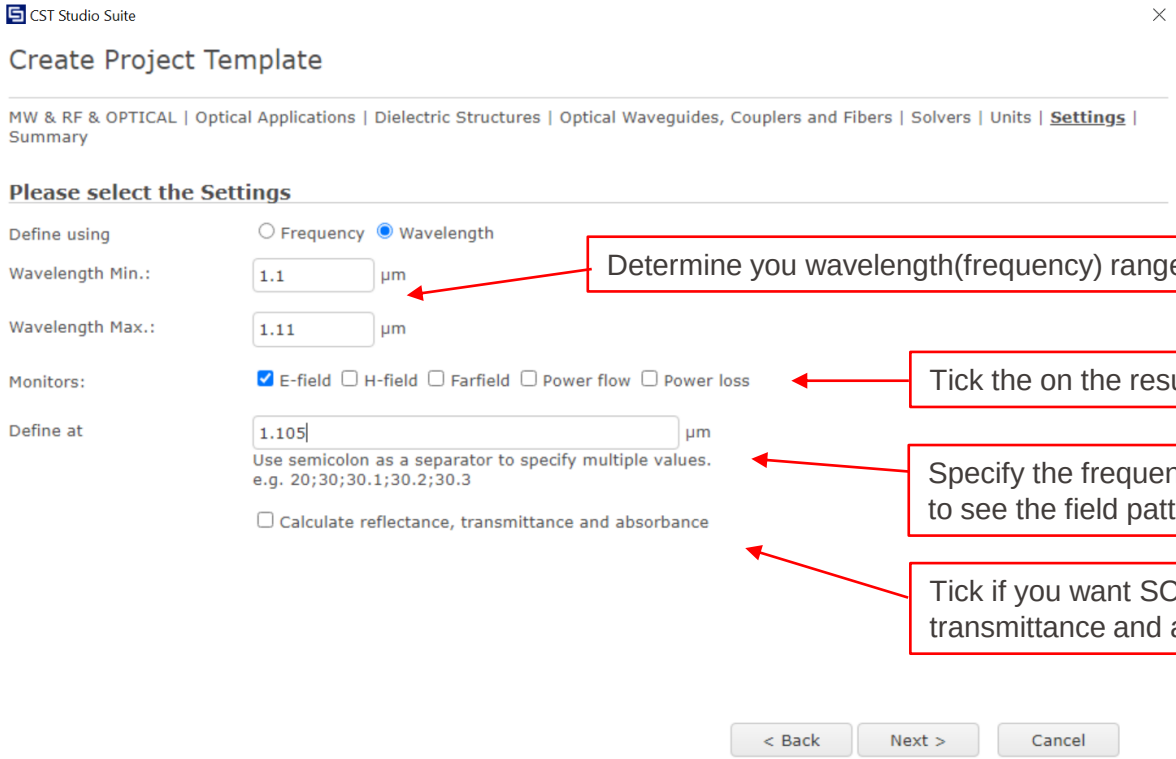


1.6 Choose units “µm/THz”, then “Next”



1. Setup new project

1.7 Settings



Determine you wavelength(frequency) range

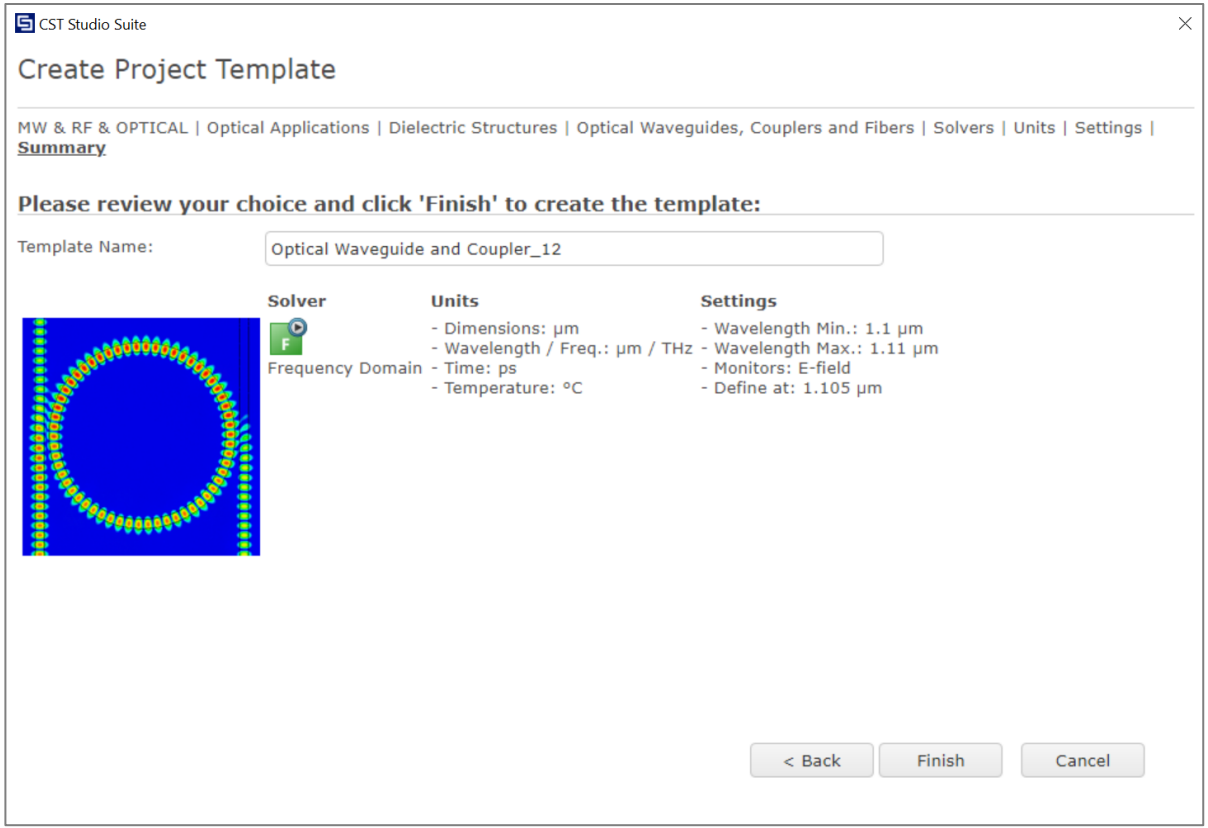
Tick the on the results you need to see

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

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

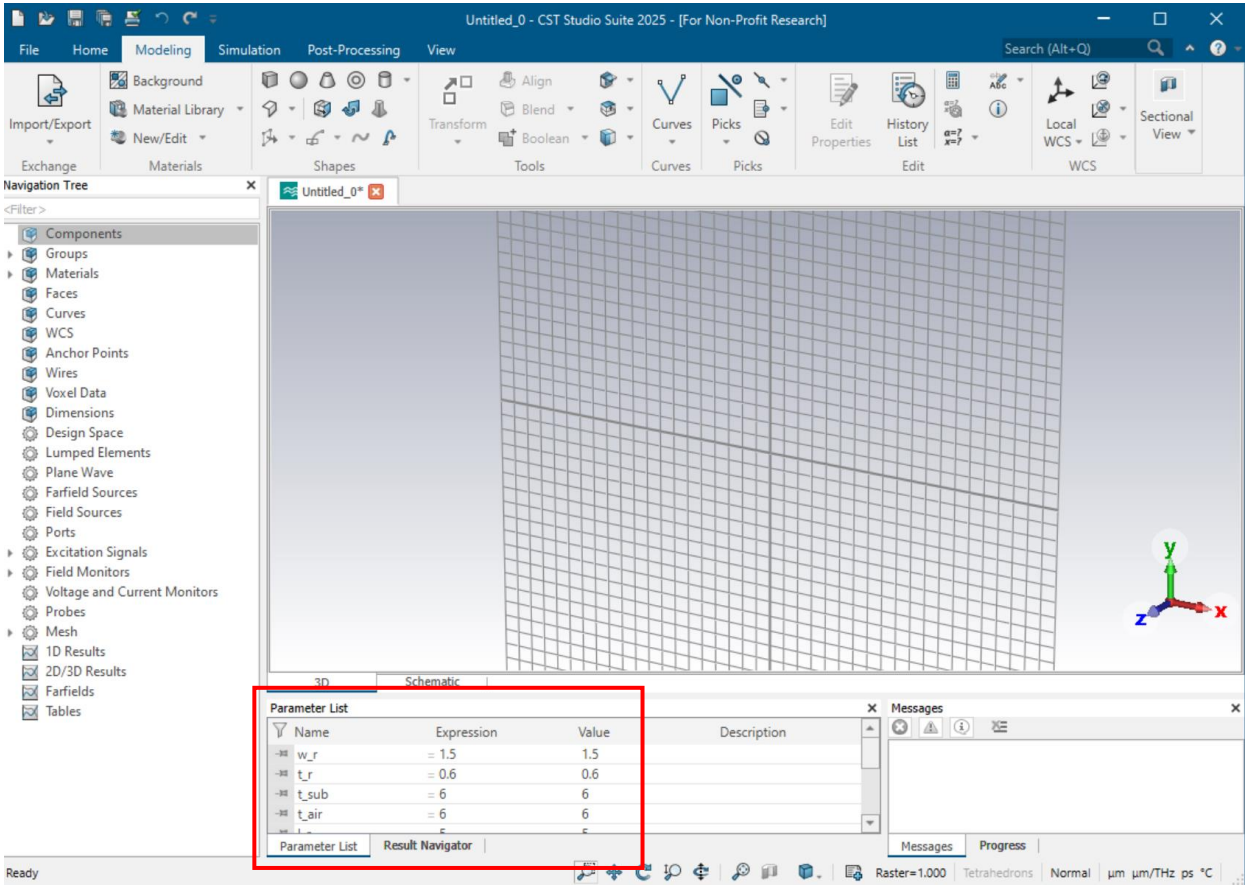
1. Setup new project

1.8 Summary



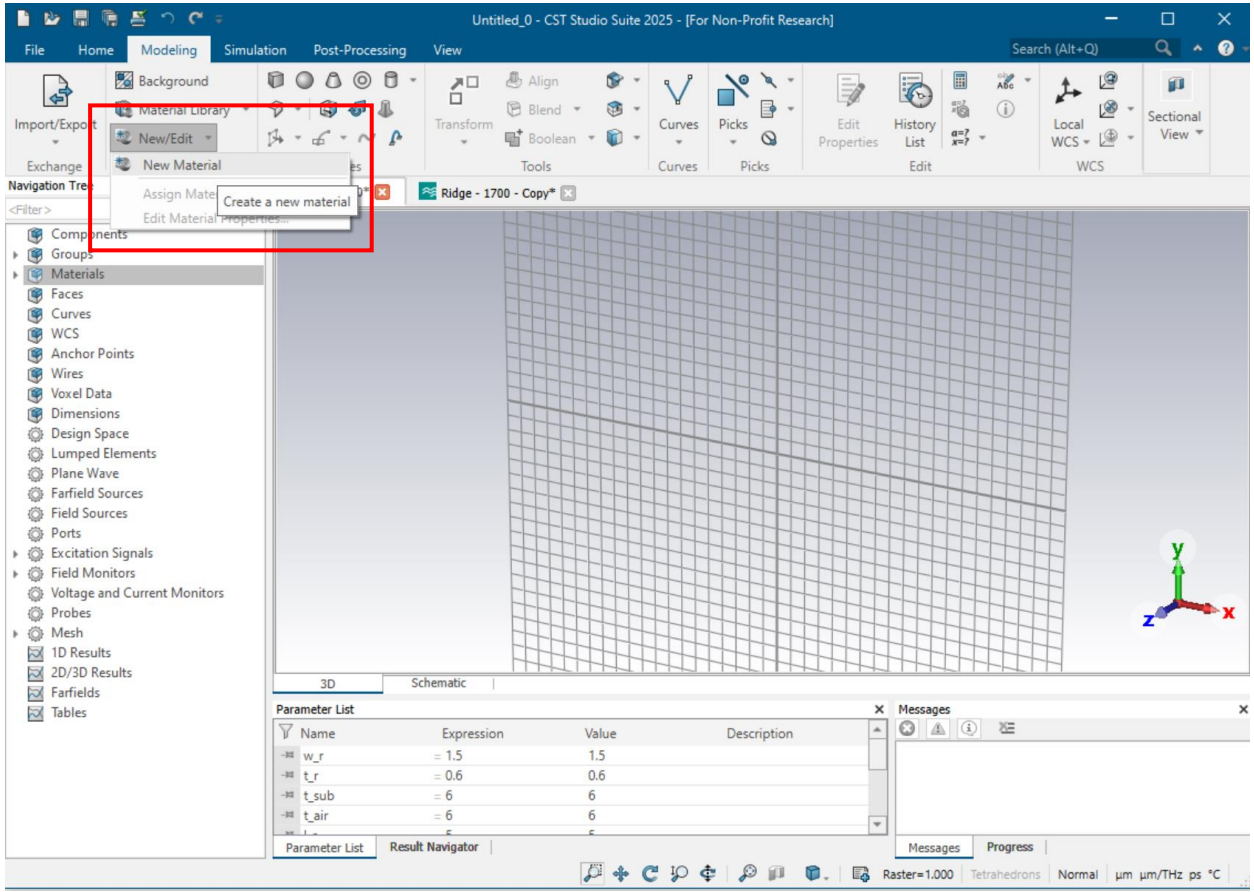
2. Build models

2.1 Define parameters



2. Build models

2.2 Create Materials



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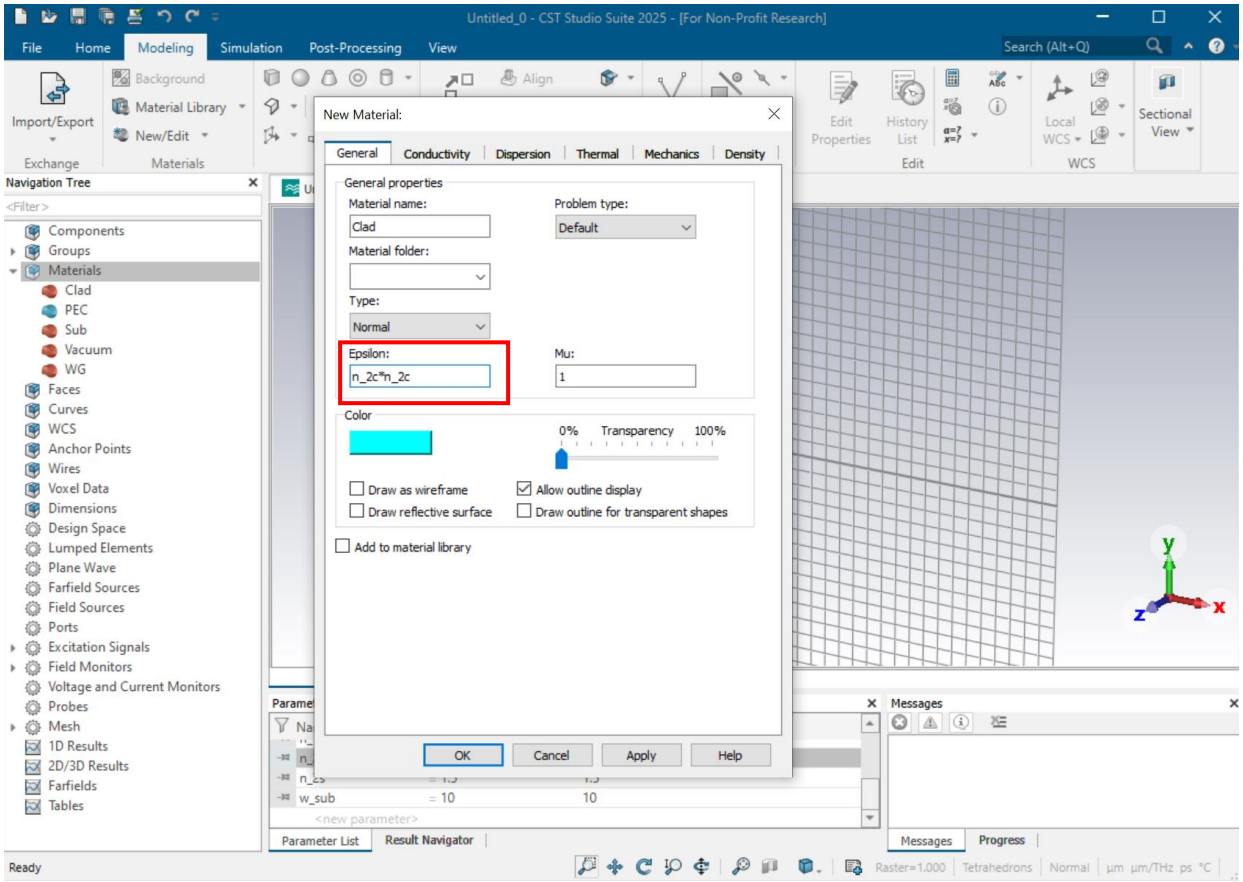
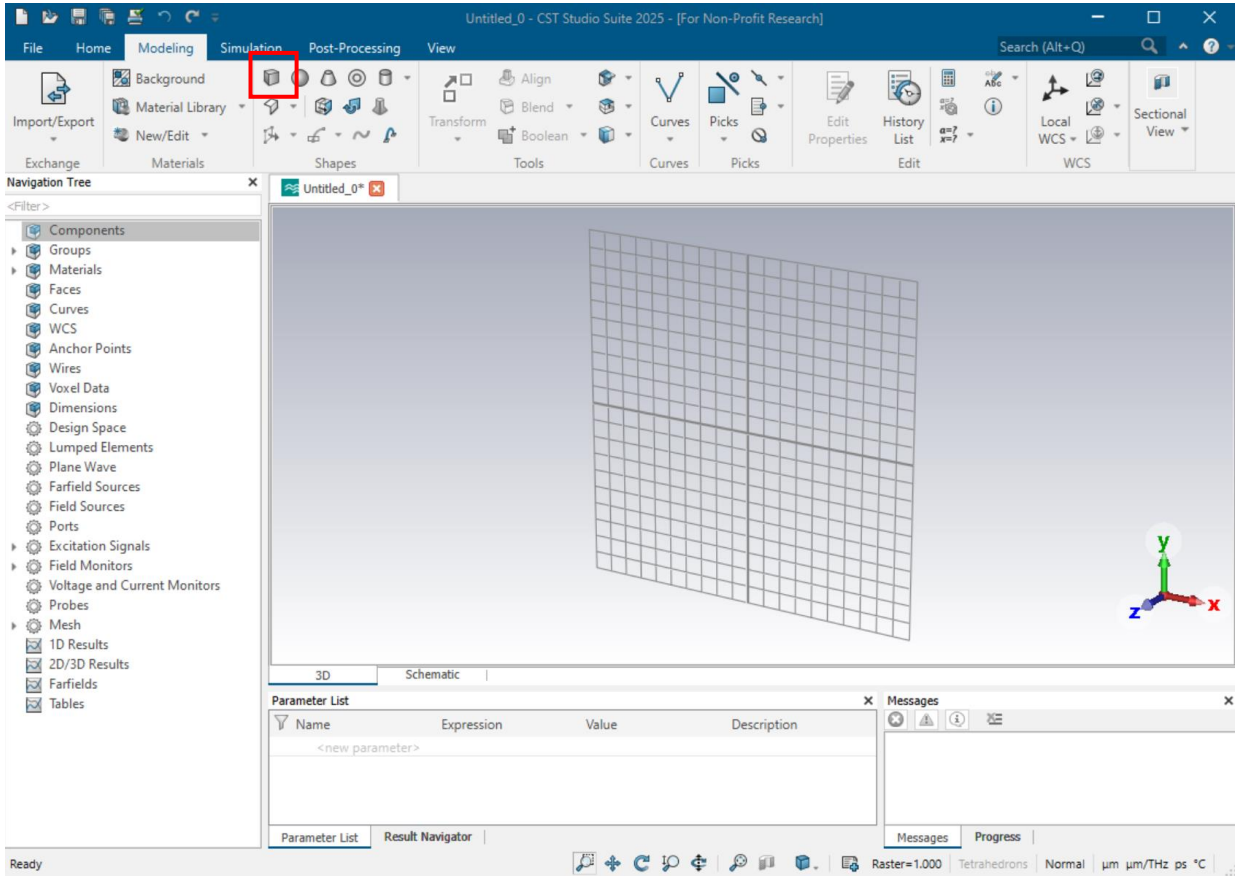
2.2 Create Materials



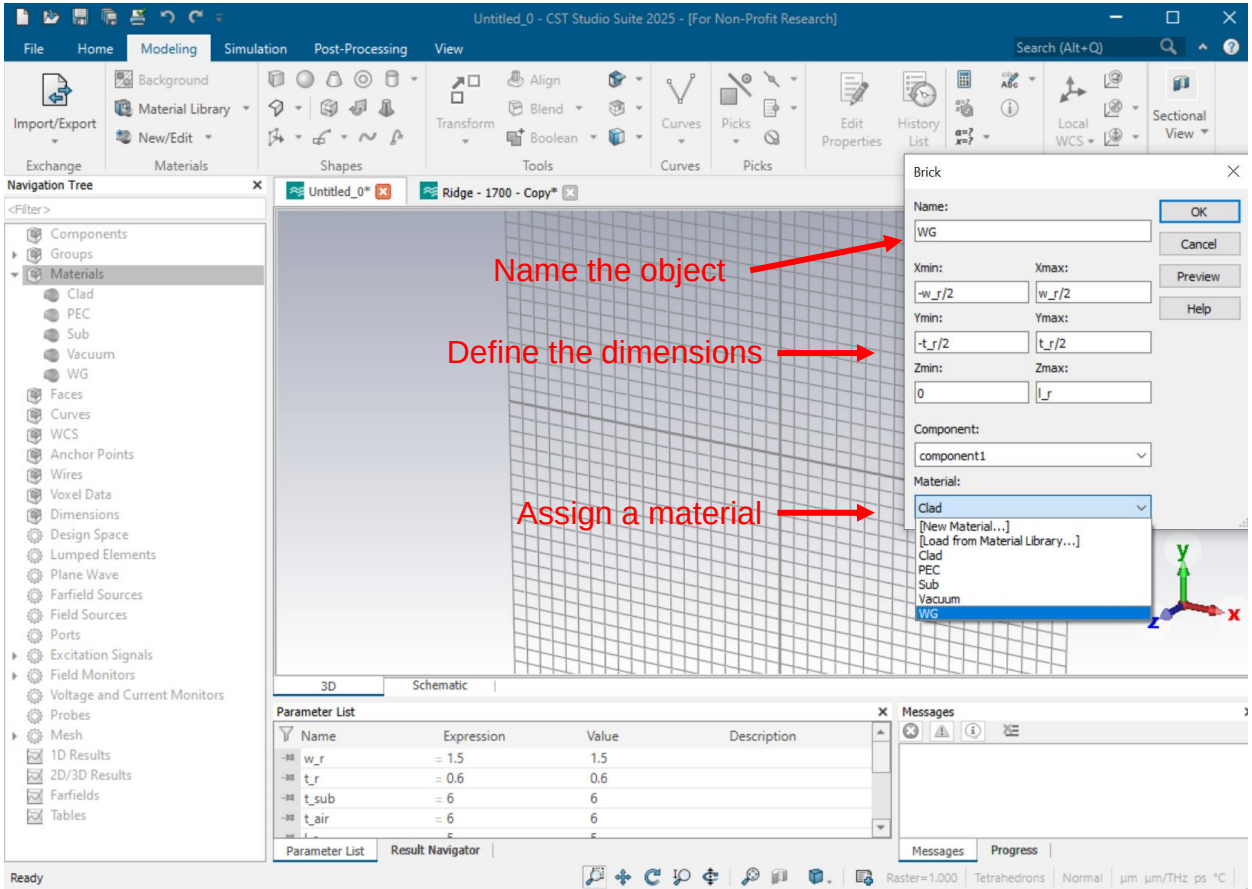
2. Build models

2.3 Using “Brick” to create waveguide



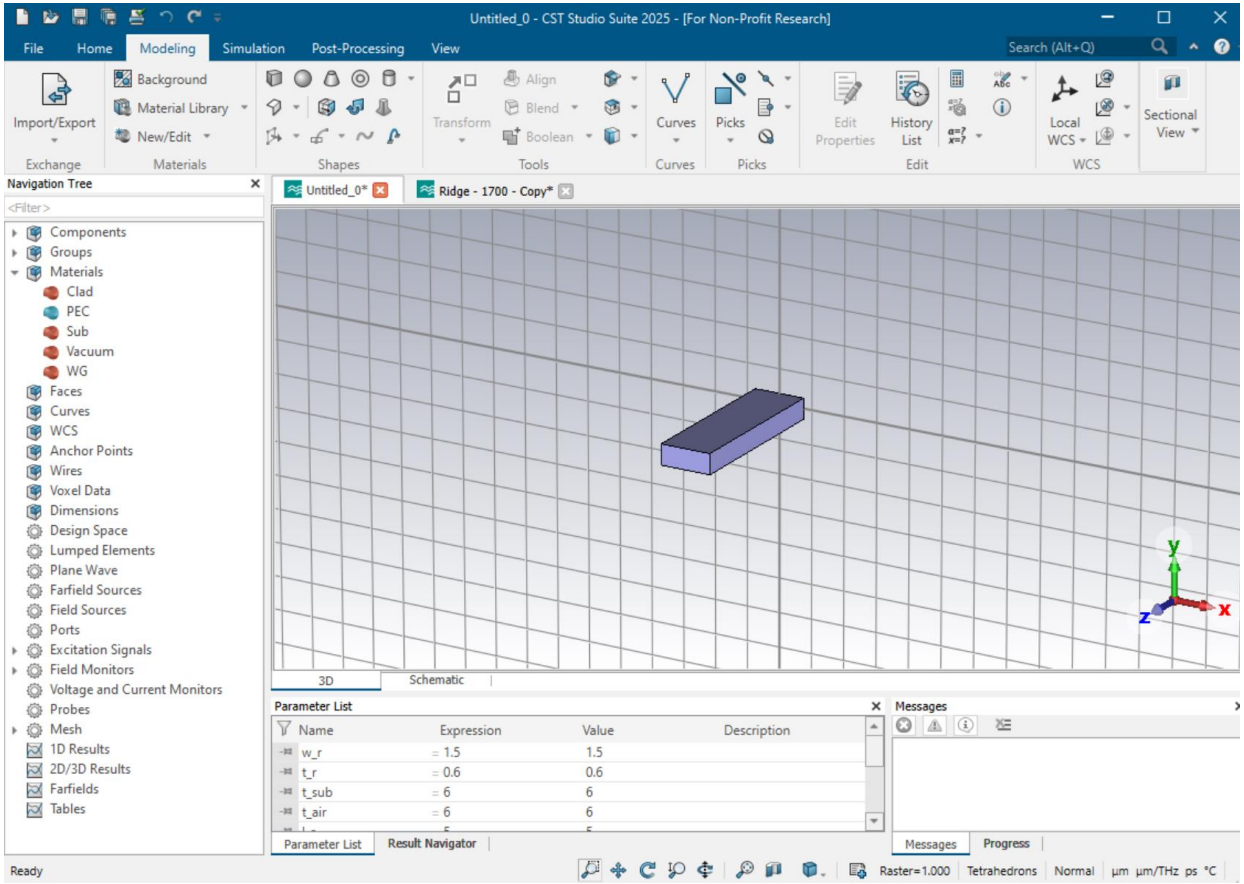
2. Build models

2.3 Using “Brick” to create waveguide



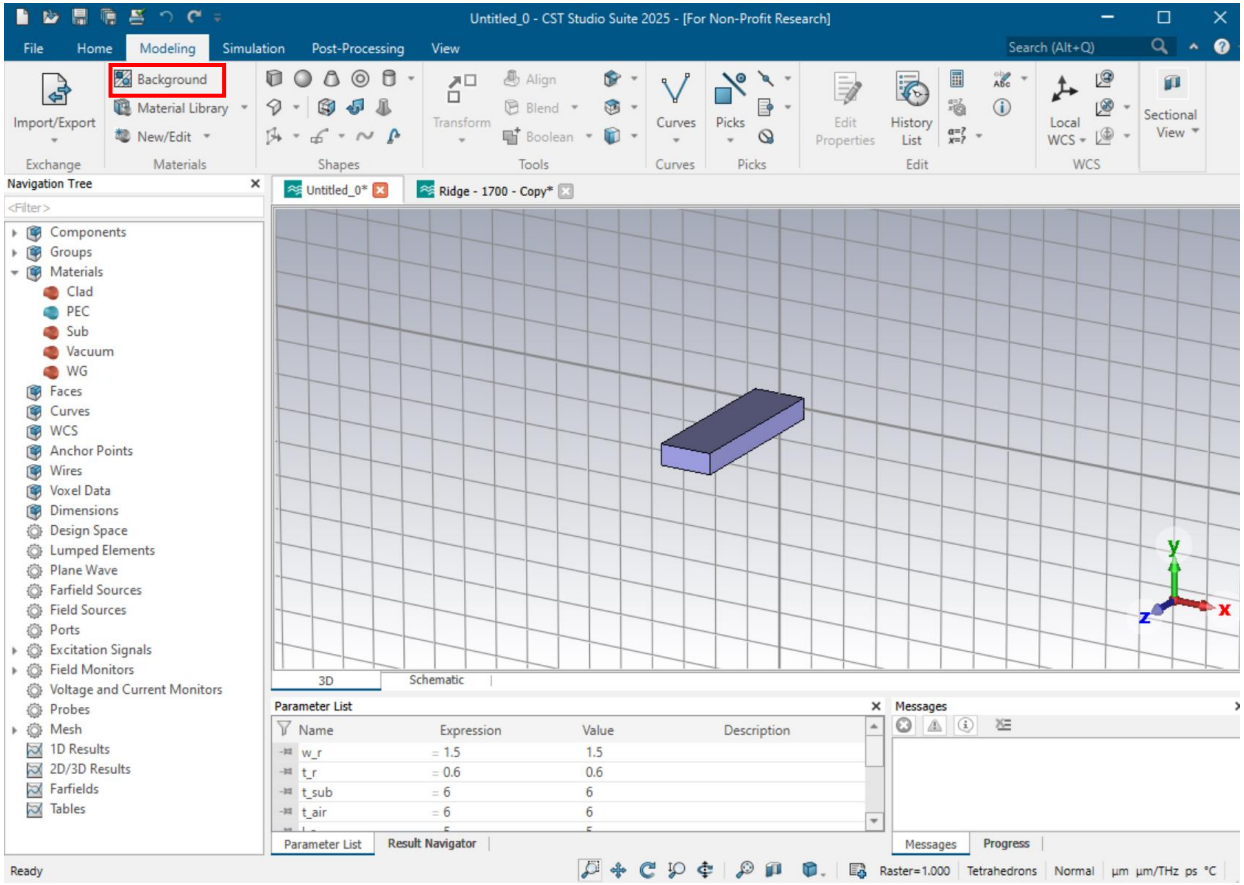
2. Build models

2.3 Using “Brick” to create waveguide

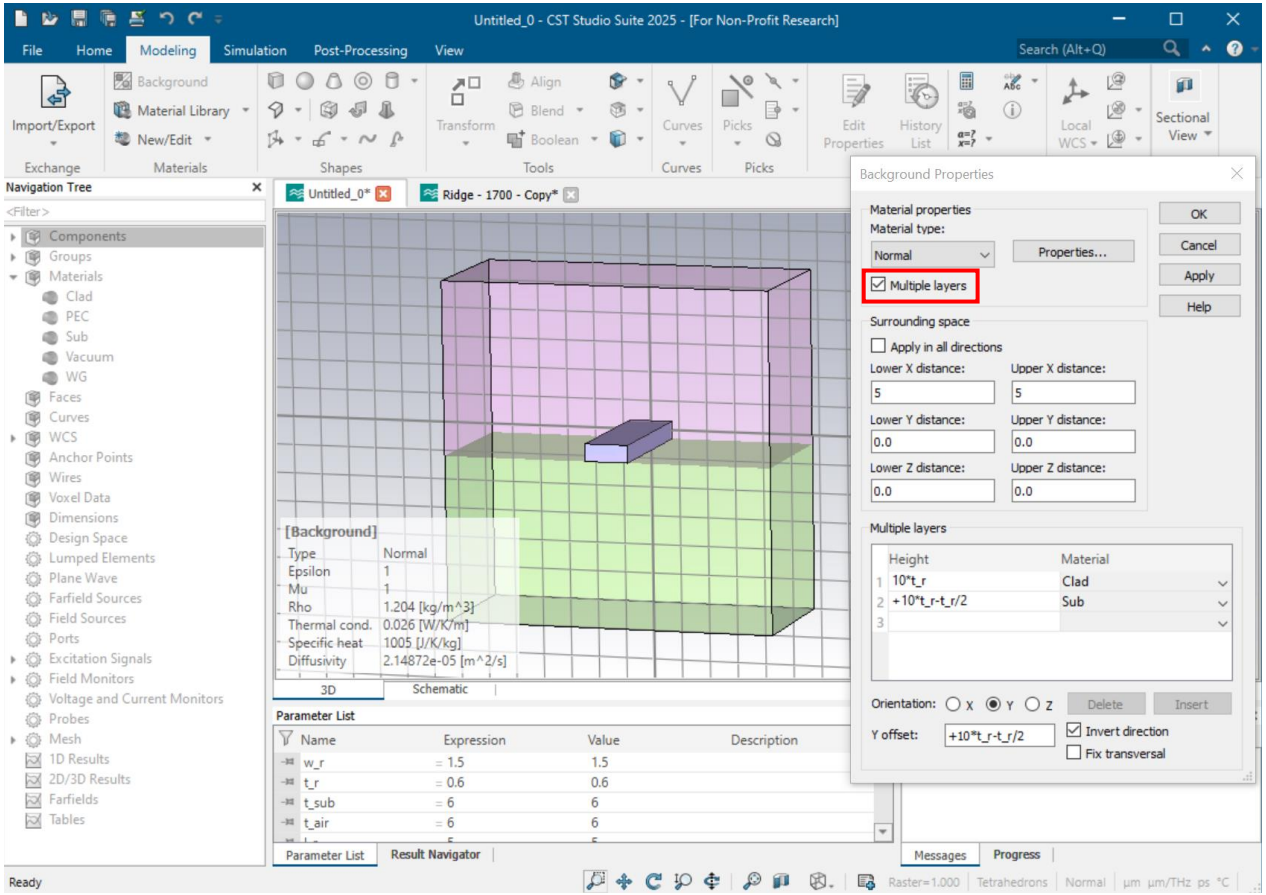


2. Build models

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

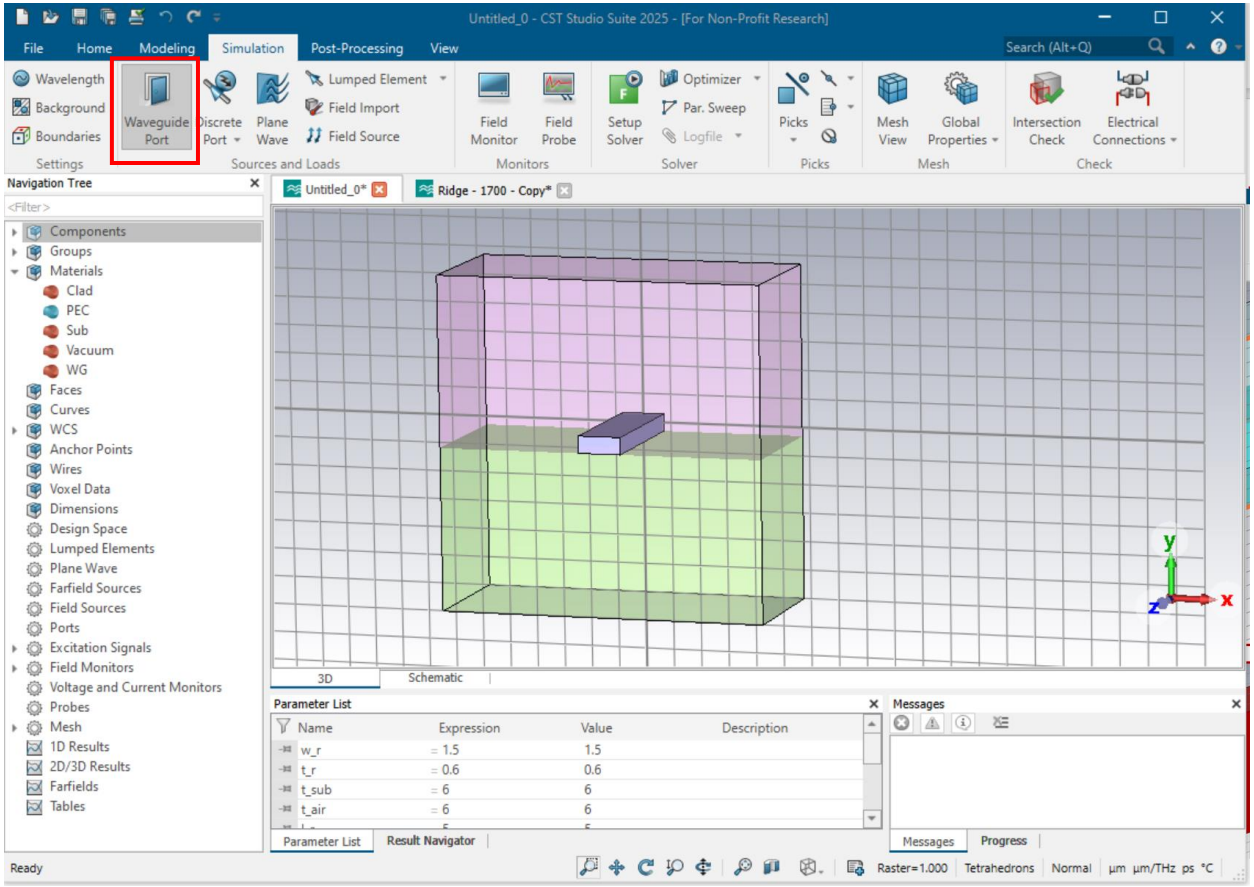


2.4 Using “Background” to create Cladding layer and Substrate layer



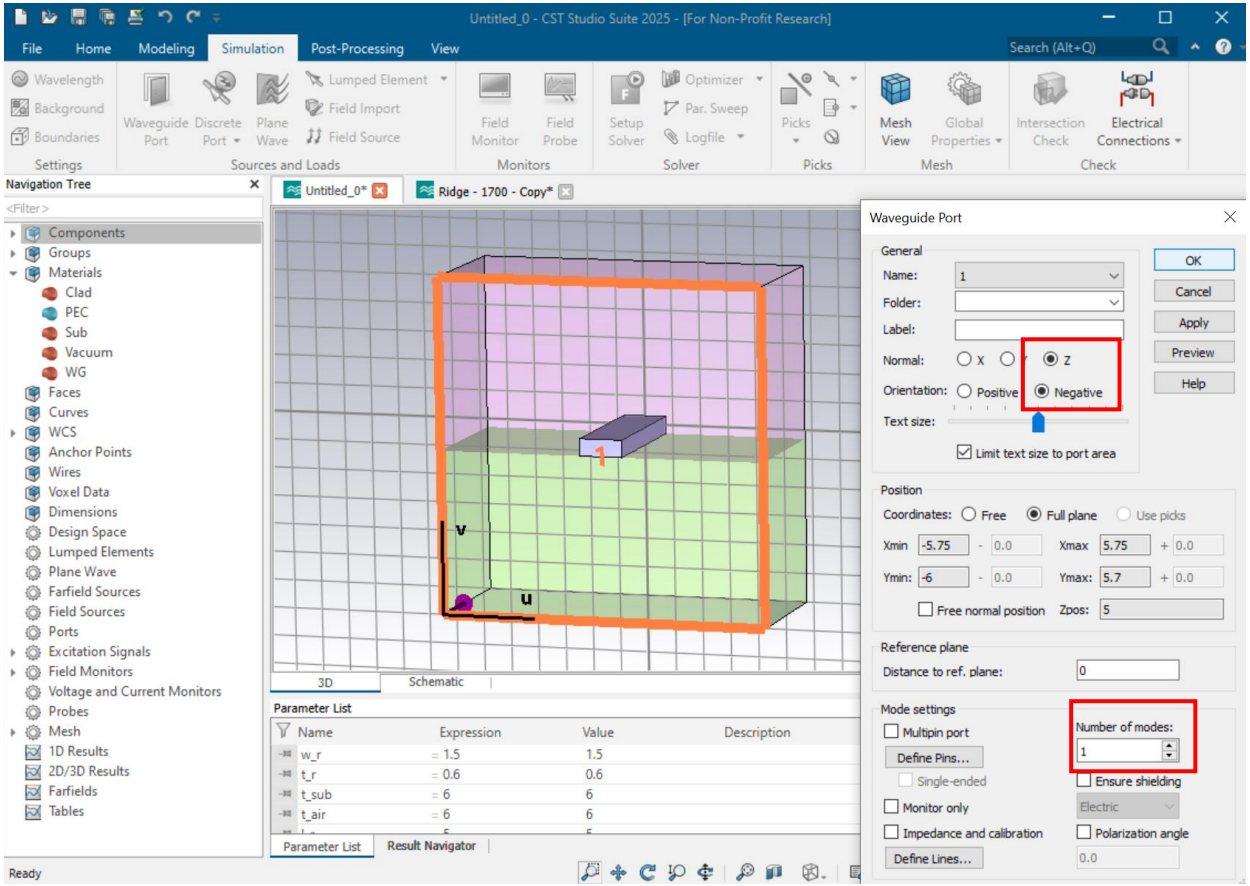
2. Build models

2.5 Create Waveguide Port



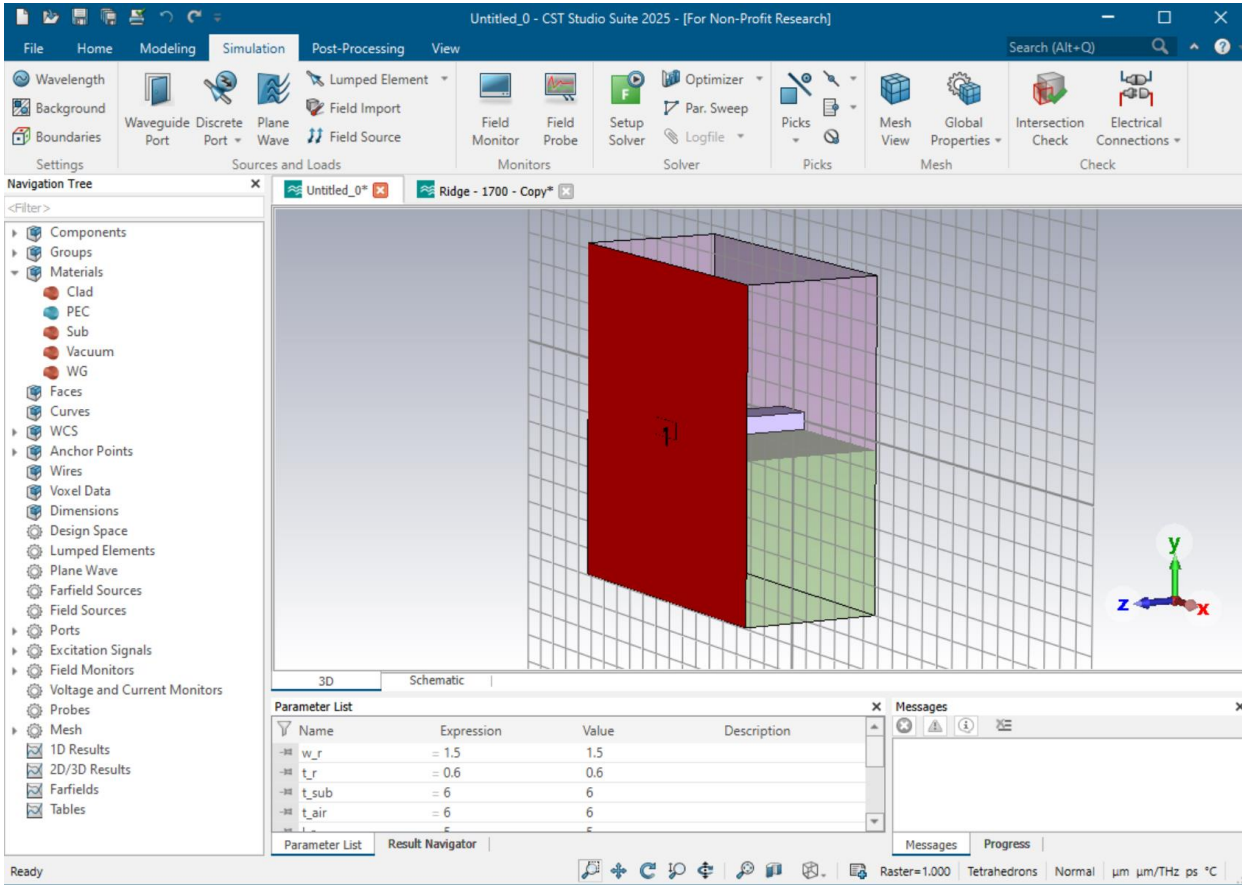
2. Build models

2.5 Create Waveguide Port

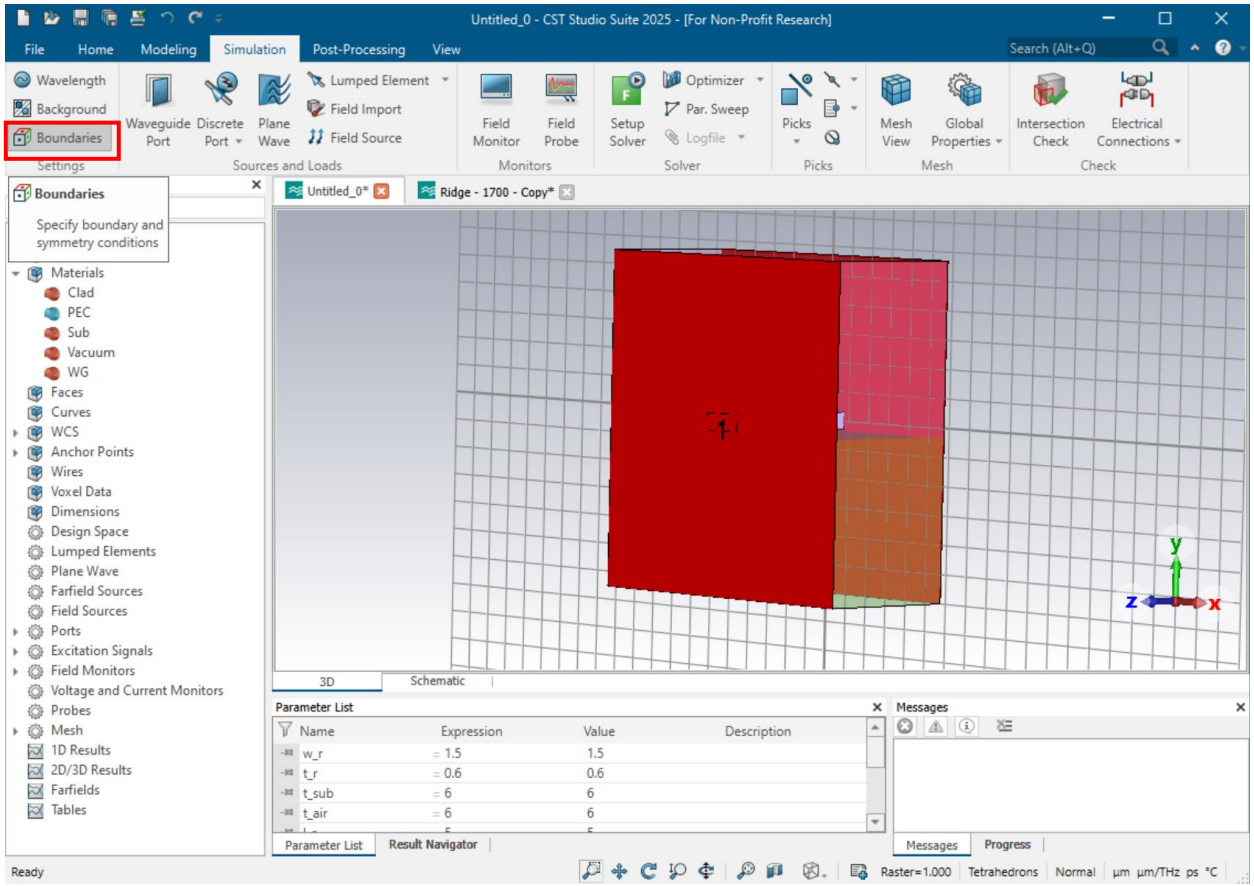


2. Build models

2.5 Create Waveguide Port



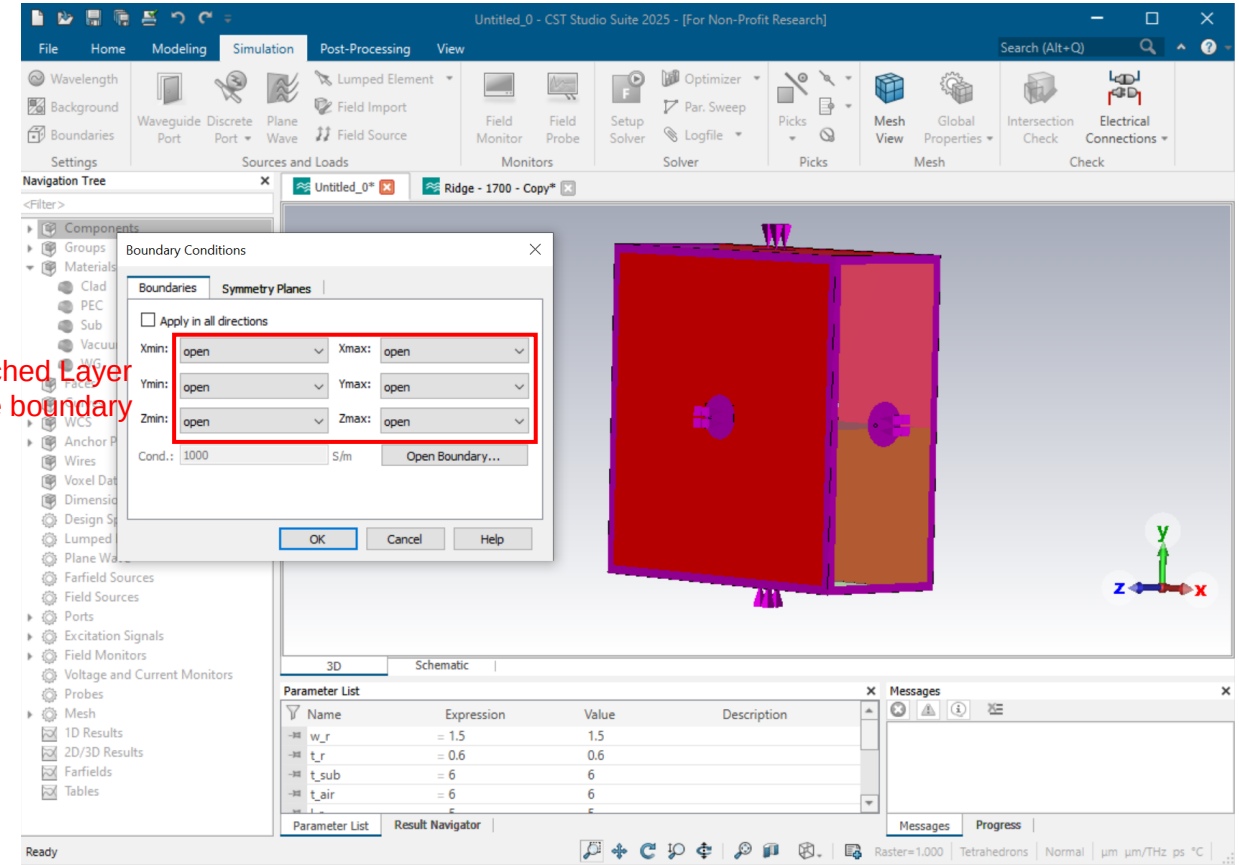
2.6 Boundary Condition



2. Build models

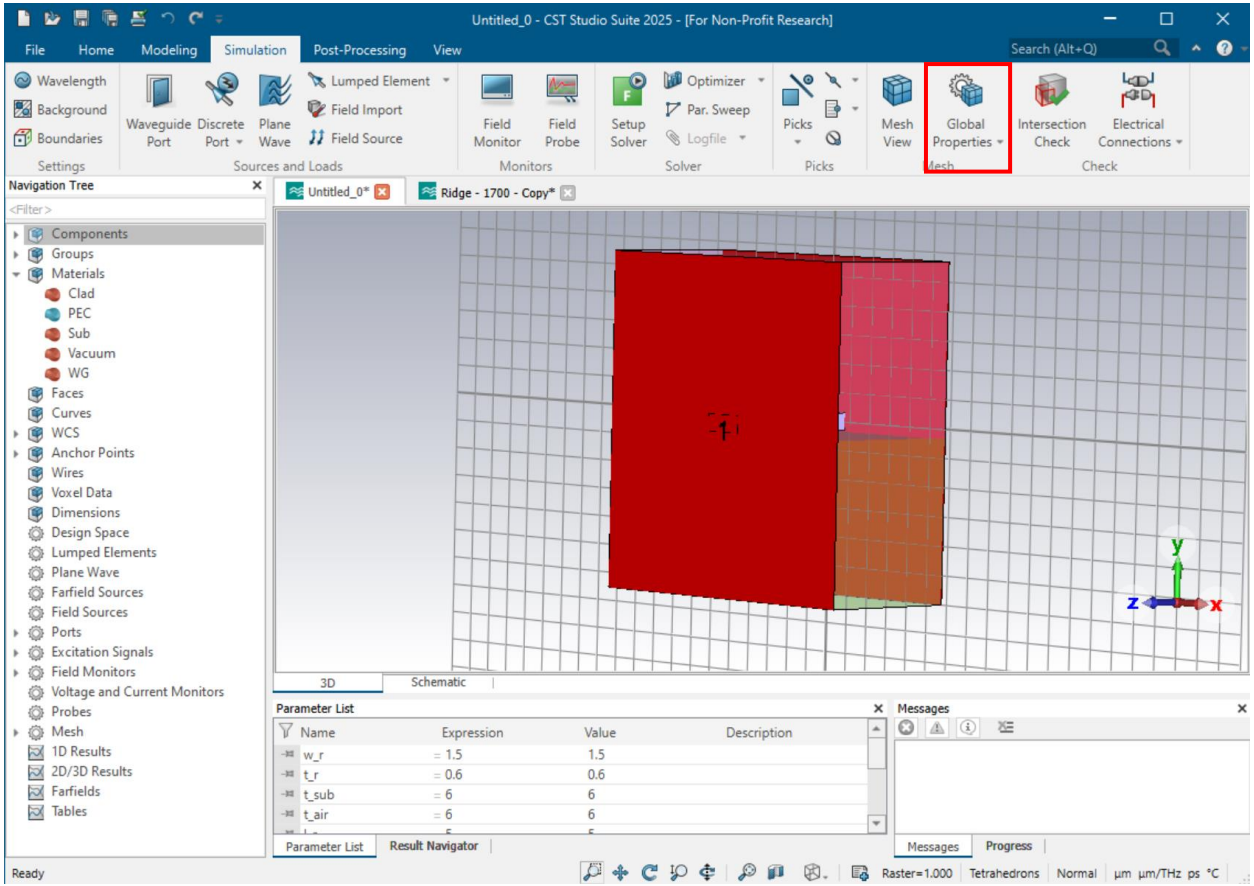
2.6 Boundary Condition

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



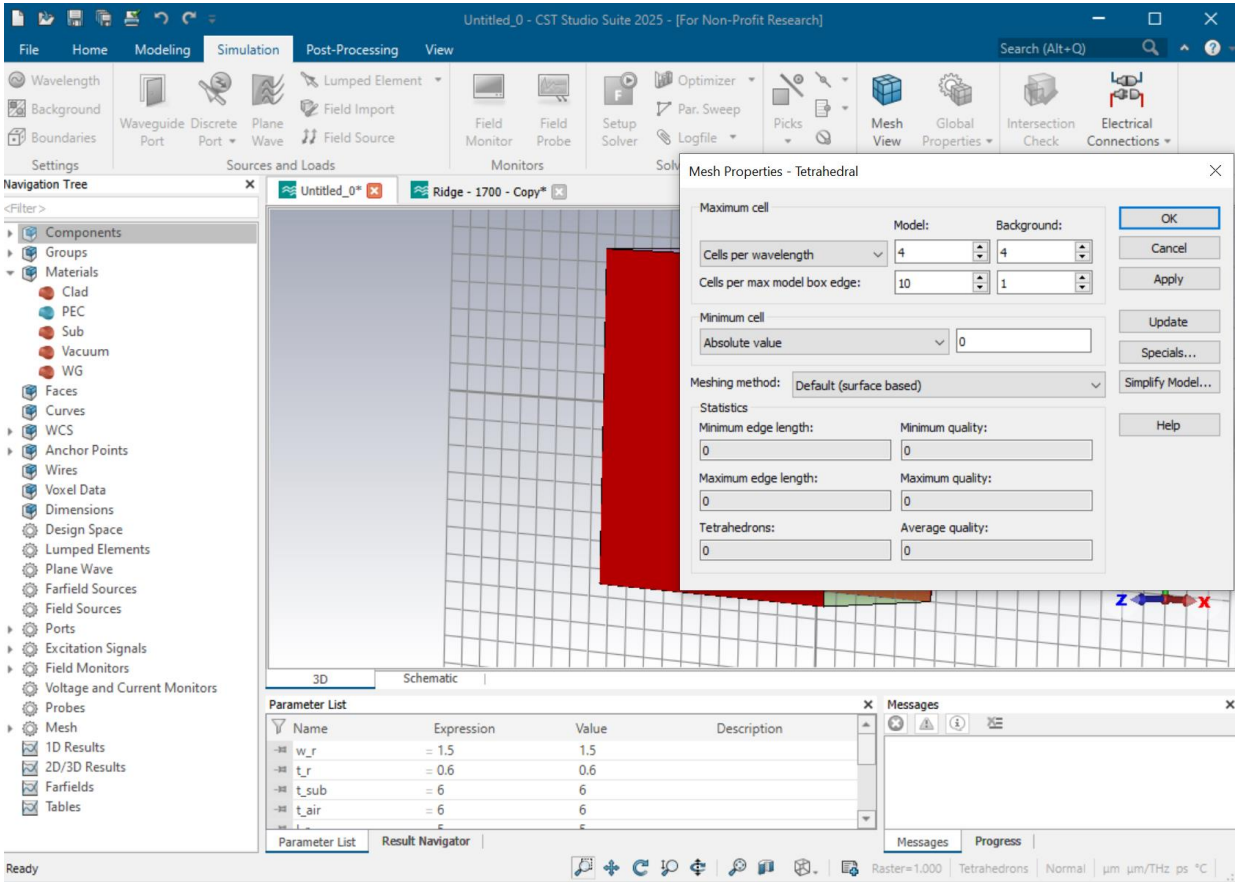
2. Build models

2.7 Mesh



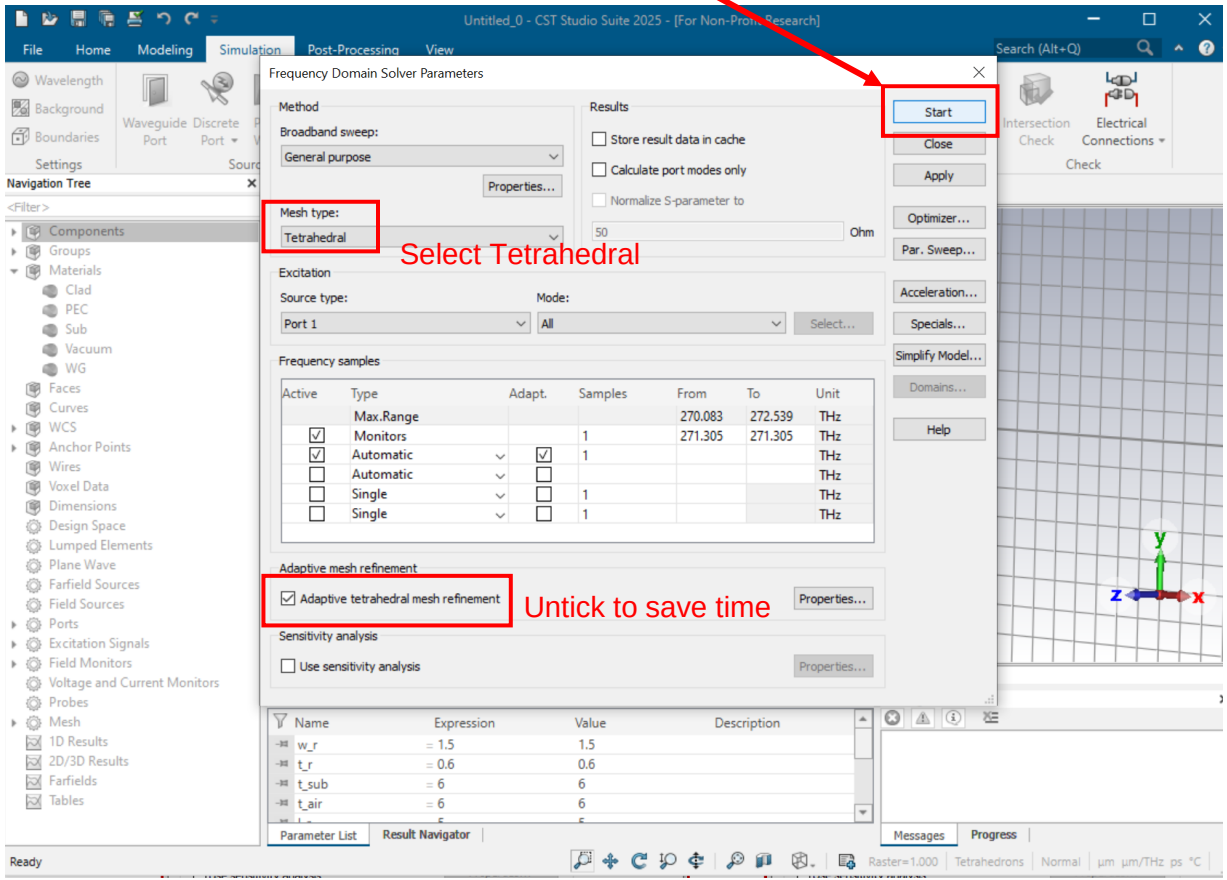
2. Build models

2.7 Mesh



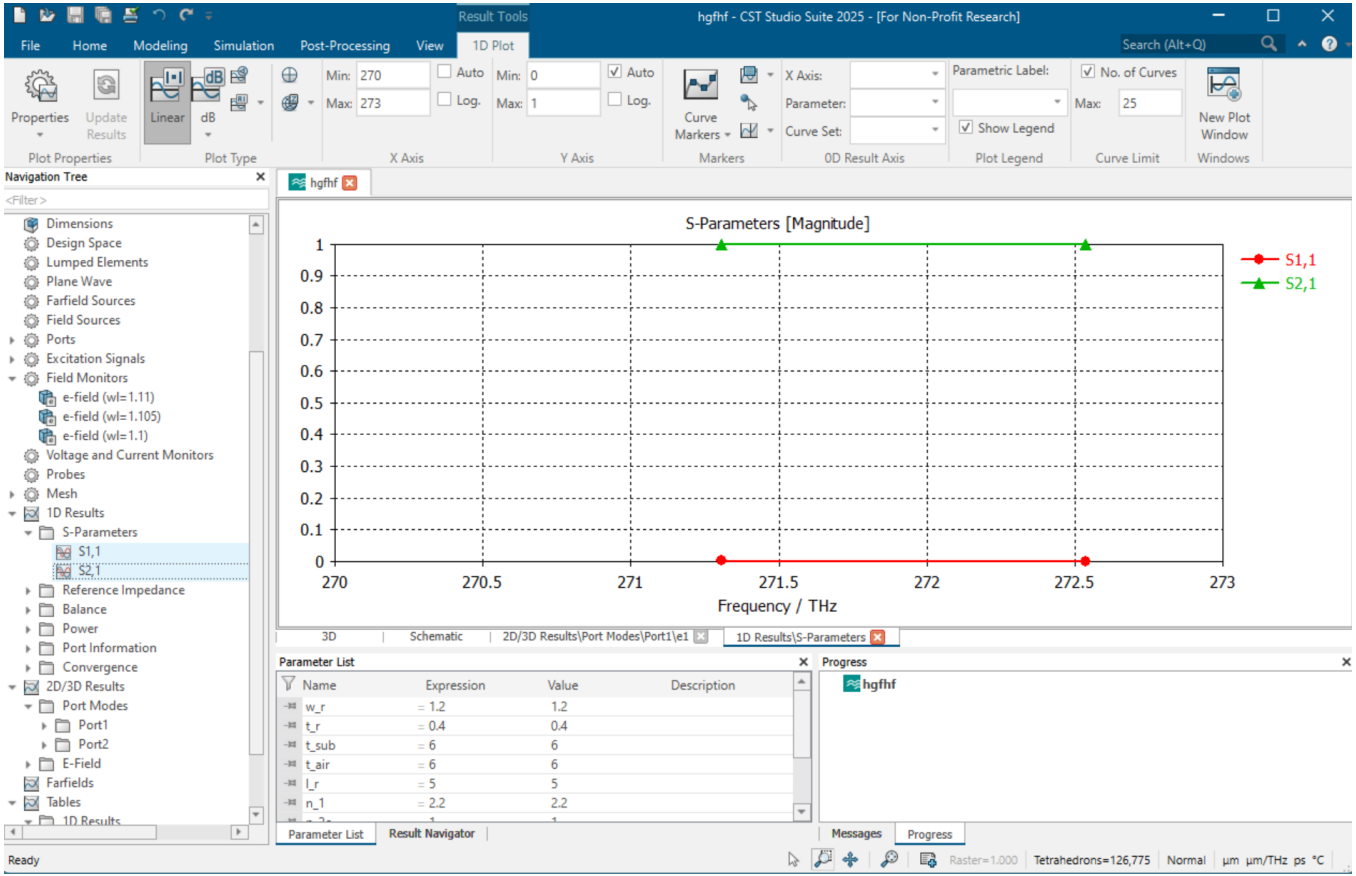
2. Build models

2.8 Setup Frequency domain Solver, and start simulation



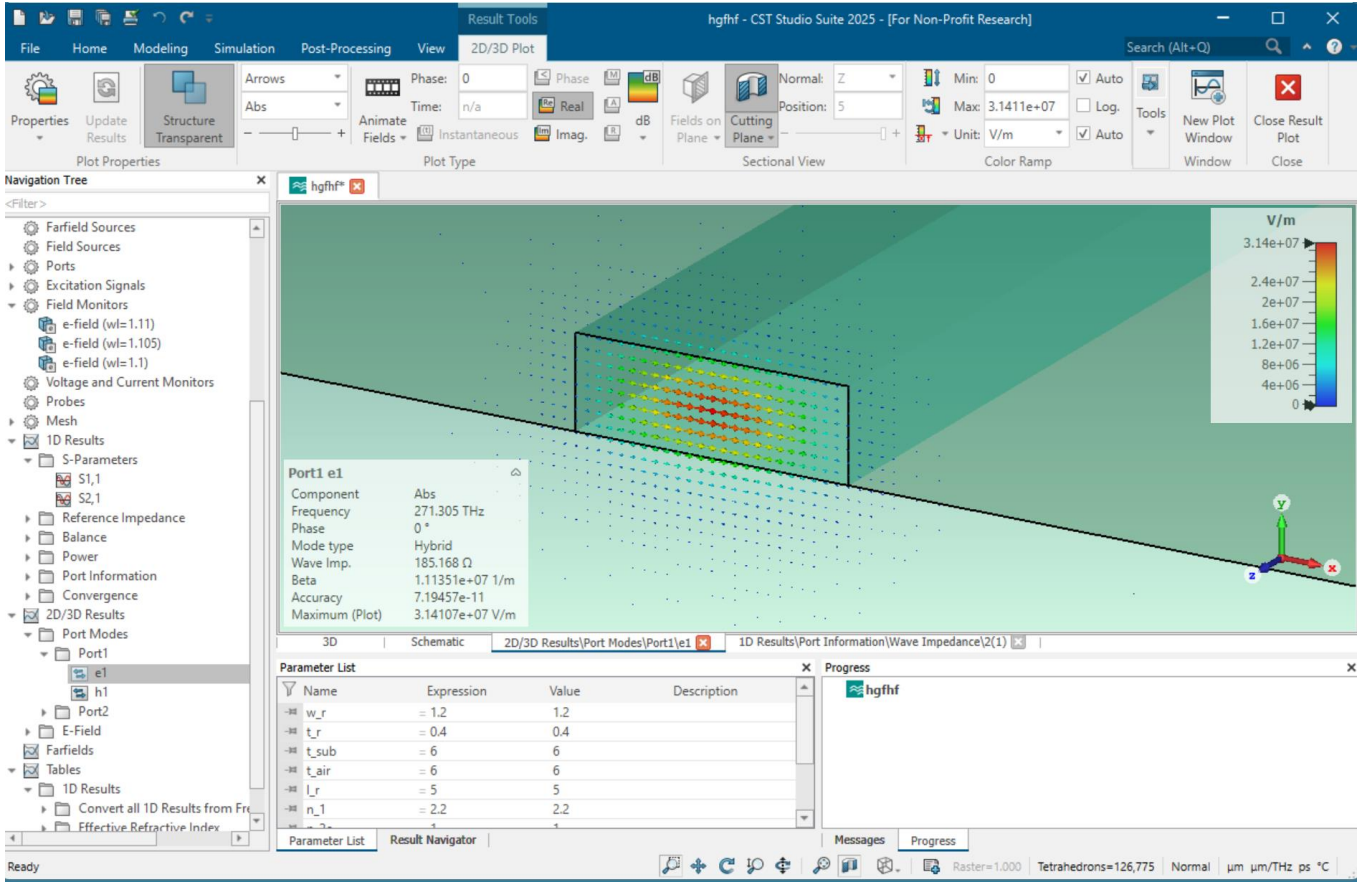
3. Results visualization

1D results: S-Parameters



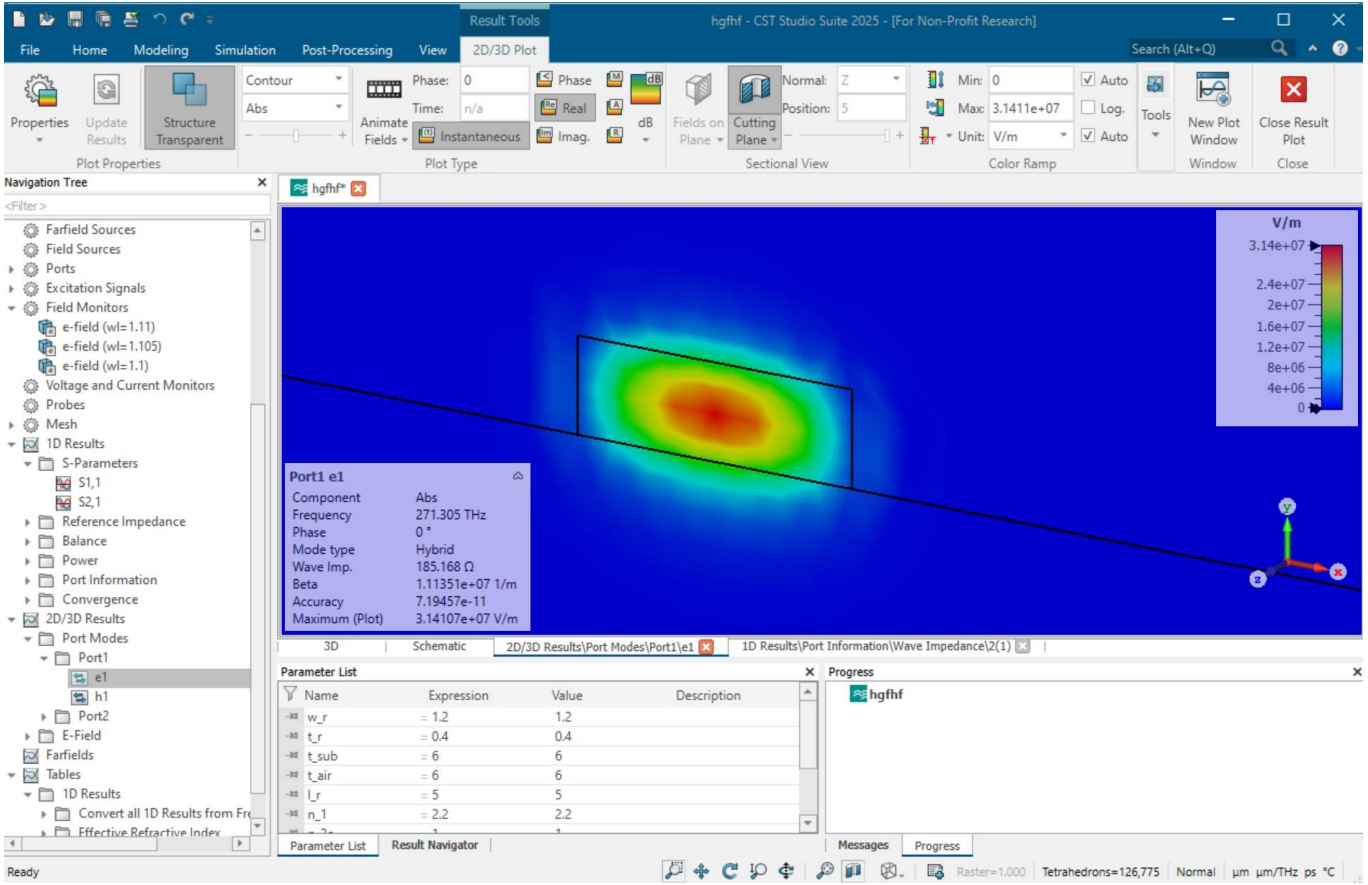
3. Results visualization

2D results: mode profile.



3. Results visualization

2D results: mode profile.



3. Results visualization

2D results: mode profile.