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FOIL COIL MODELING

Flux 2D : Geometry, Mesh and Physics

Introduction

- **Foil coil :** Winding obtained from a thin, rectangular, metallic sheet folded in a spiral-like shape
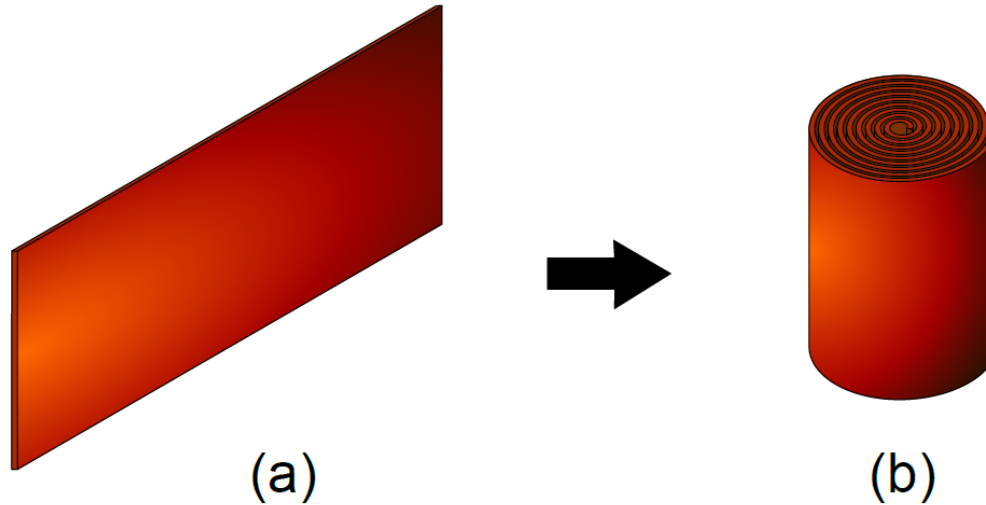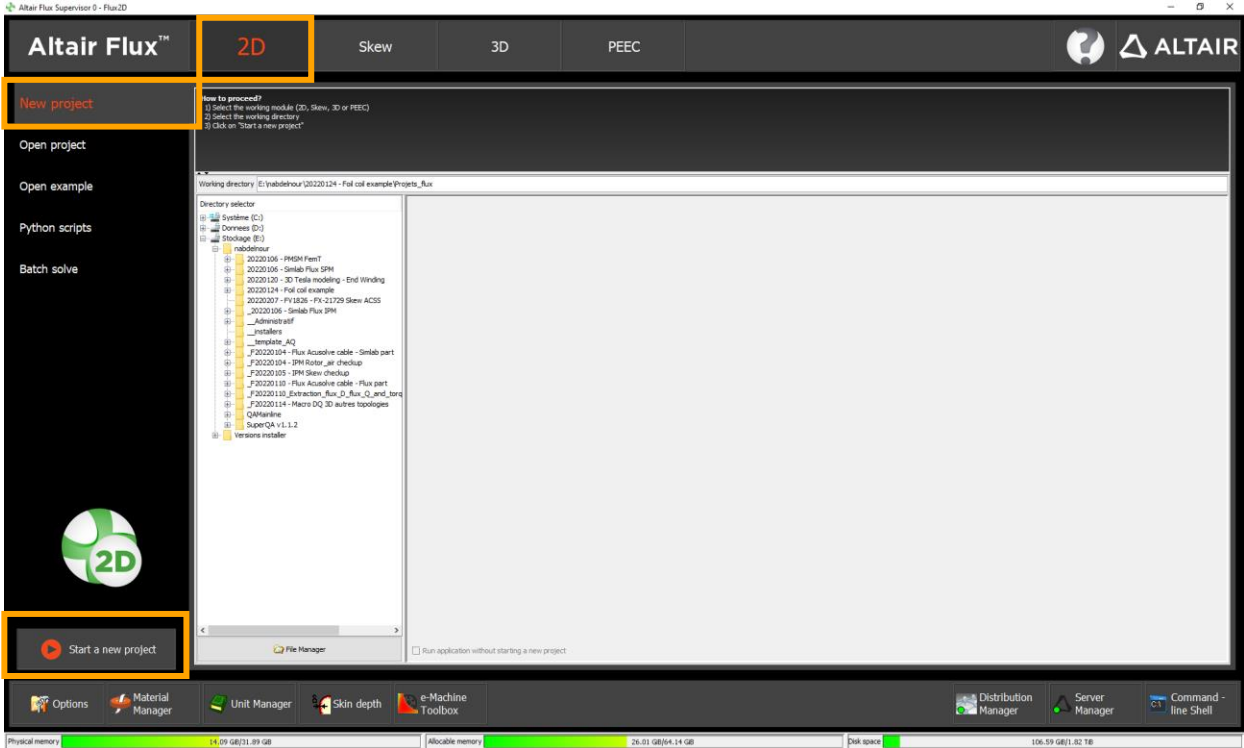

Figure 1: A thin metallic sheet (a) folded in the shape of a foil coil (b).
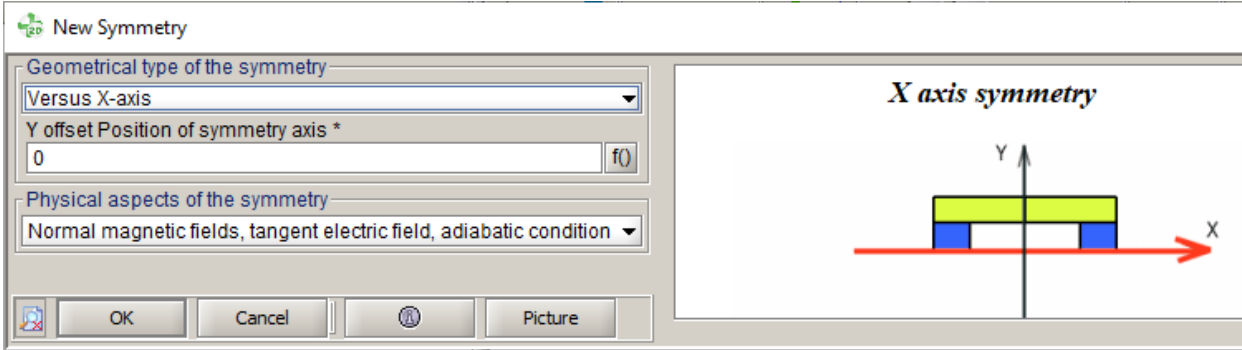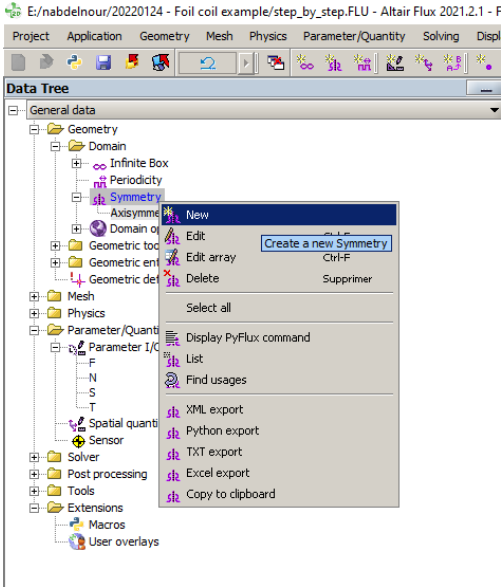
CREATE PROJECT GEOMETRY
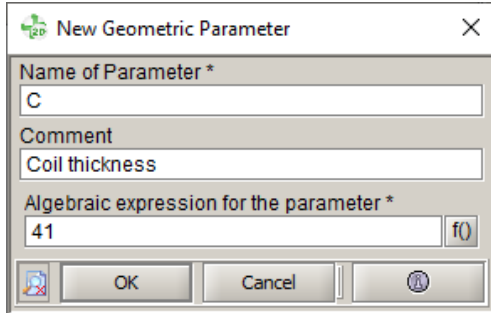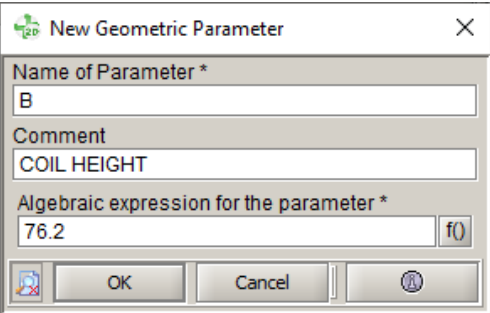
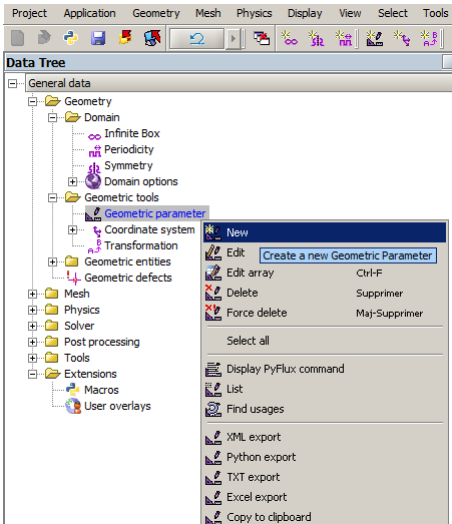# Create project geometry

Create new Flux 2D project

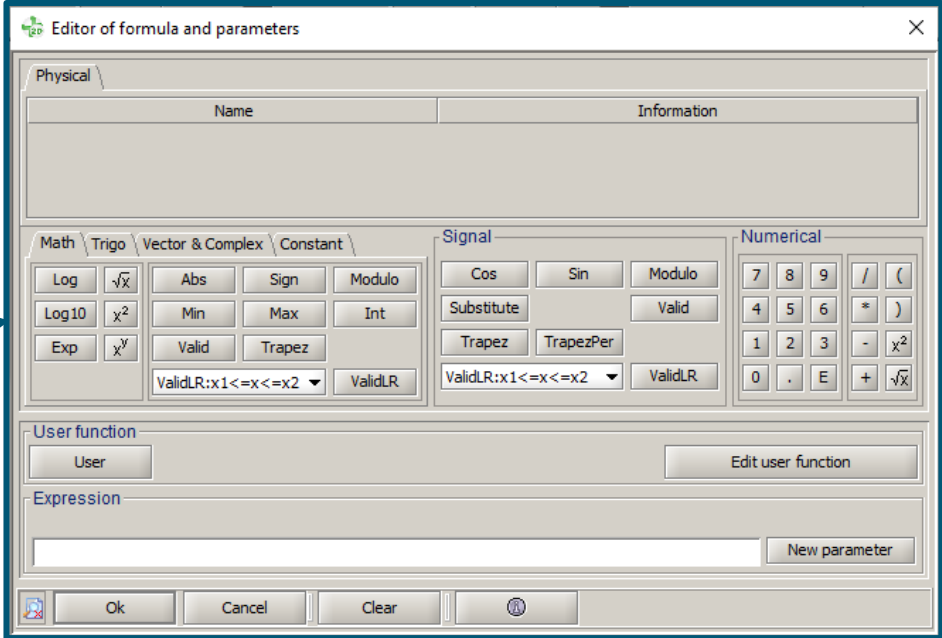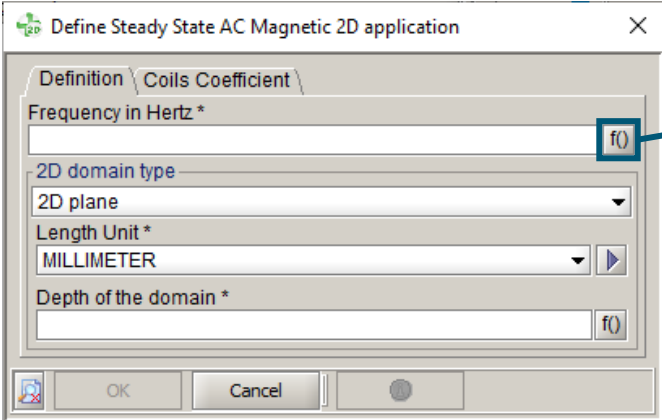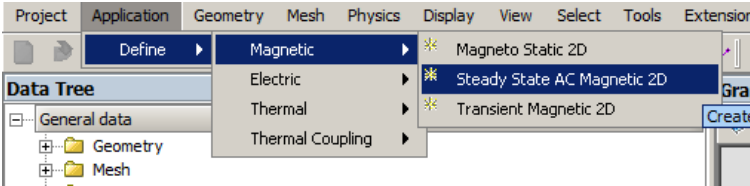# Create project geometry

Define X symmetry

Create project geometry

Create geometric parameters

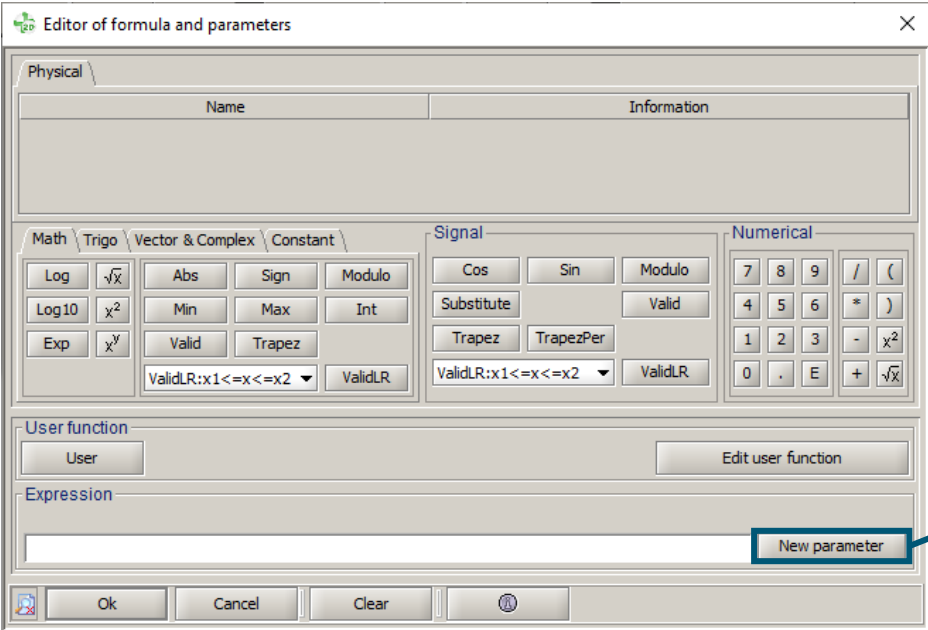| Name	Comment	Algebraic expression
B	Coil height	76.2
C	Coil thickness	41
D	Coil mean diameter	136
A	Inner radius	0.5*D-0.5*C
L	Radius of the circumference circumscribed to coil	Sqrt((A+C)^2+(B/2)^2)
R	Domain radius	6*L

6

Create project geometry
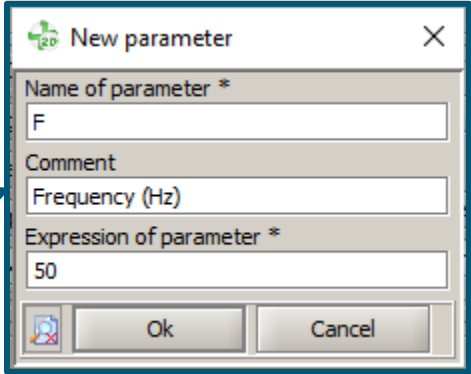
Define application : Steady State AC Magnetic 2D

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Create project geometry
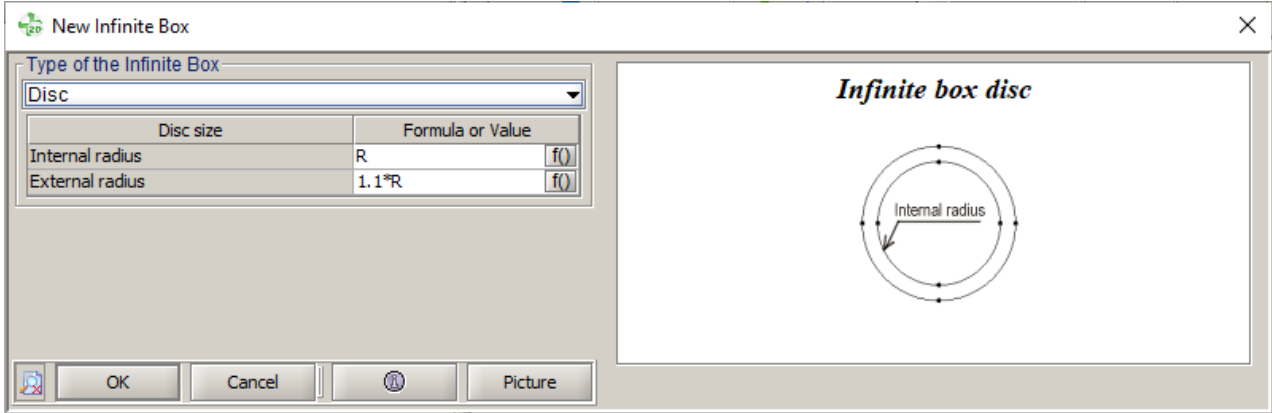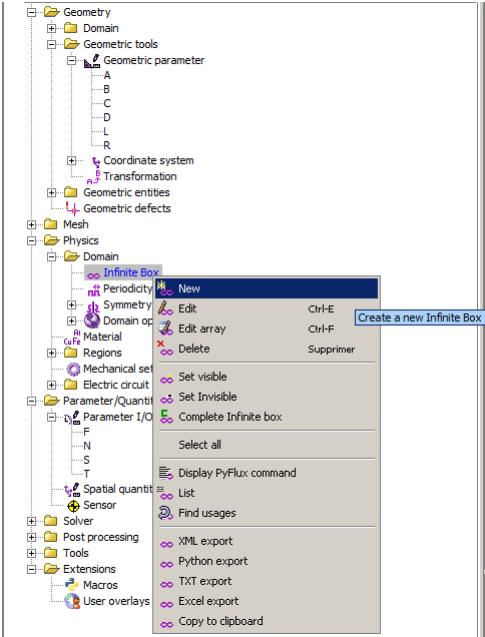
Define application variation parameters

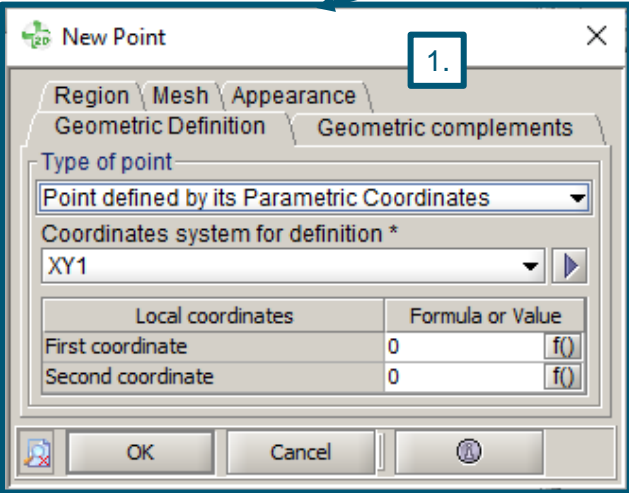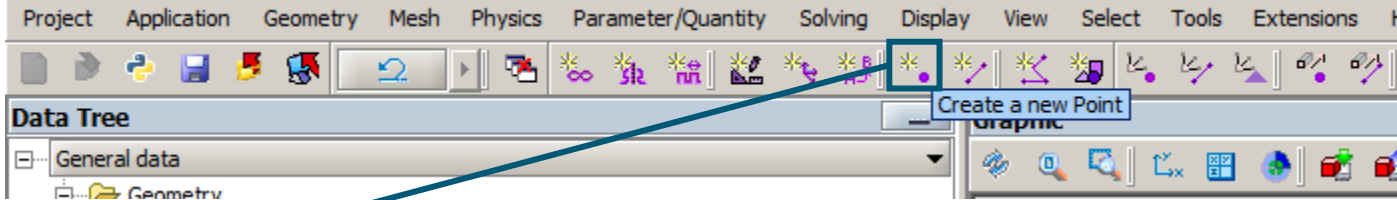| Name	Comment	Expression of parameter
F	Frequency (Hz)	50
N	Number of turns	248
T	Foil thickness	0,127
S	Space factor (or fill factor)	N*T/C

Create project geometry
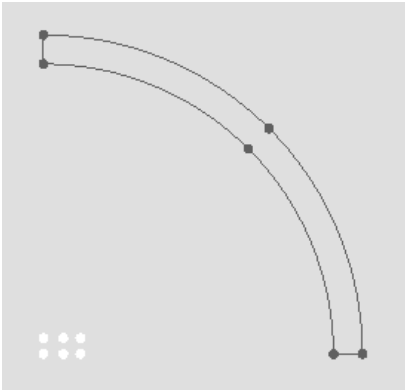
Create infinite box

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Create project geometry

Build coil points

Point n°	1st coordinate	Second Coordinate
1	0	0
2	(D/2)-(C/2)	0
3	(D/2)+(C/2)	0
4	(D/2)+(C/2)	B/2
5	(D/2)-(C/2)	B/2
6	0	B/2

1. Other tabs doesn't need modification, except if you want to change the appearance of the points

Create project geometry
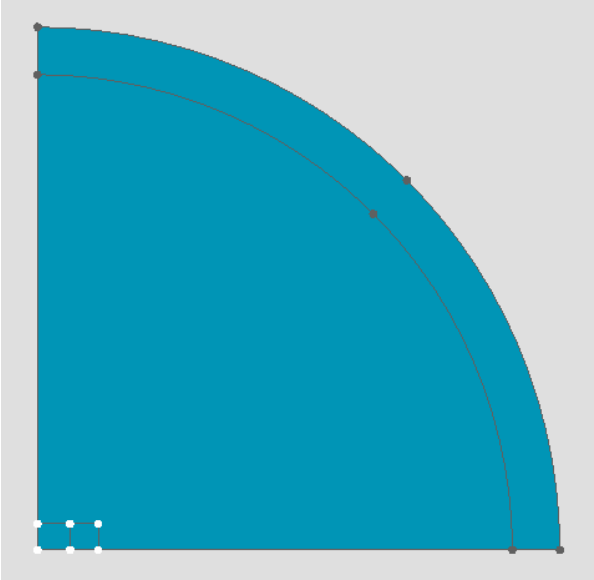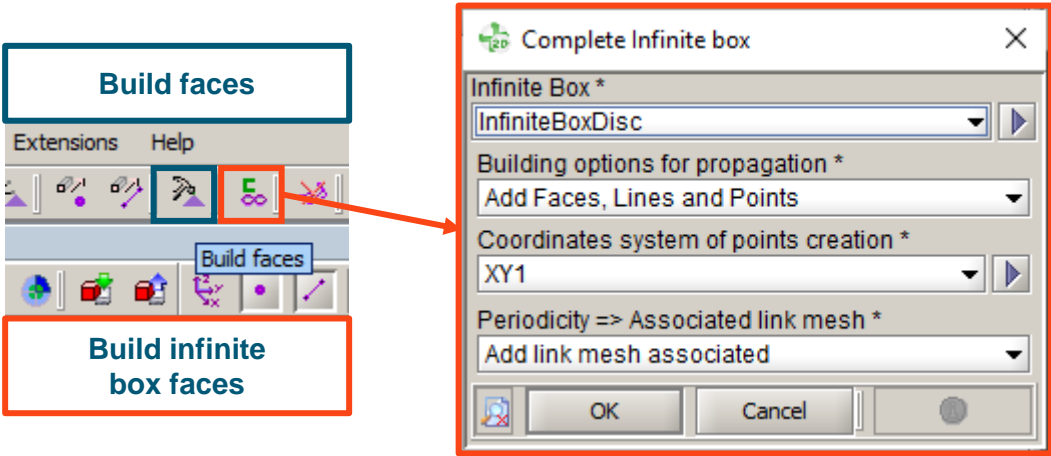
Build coil lines
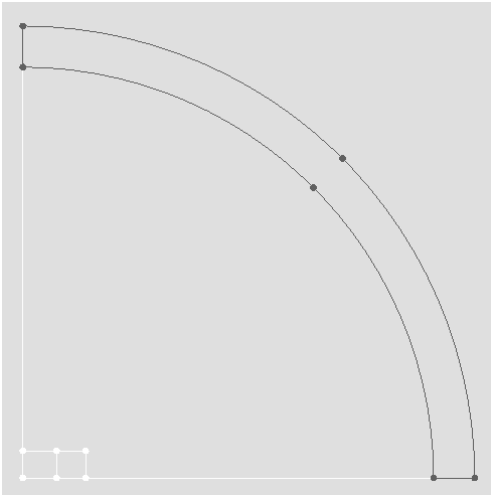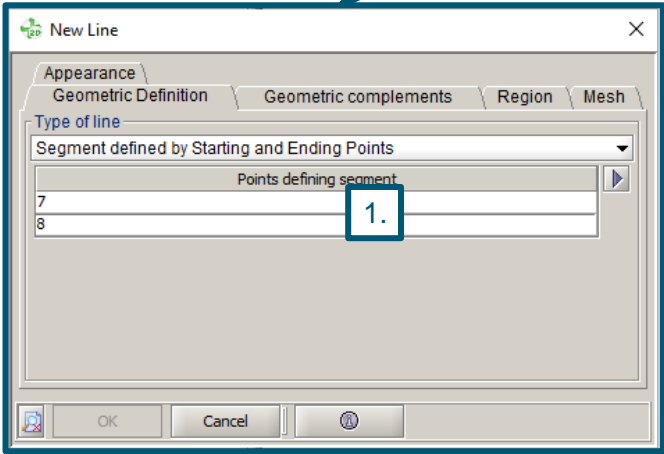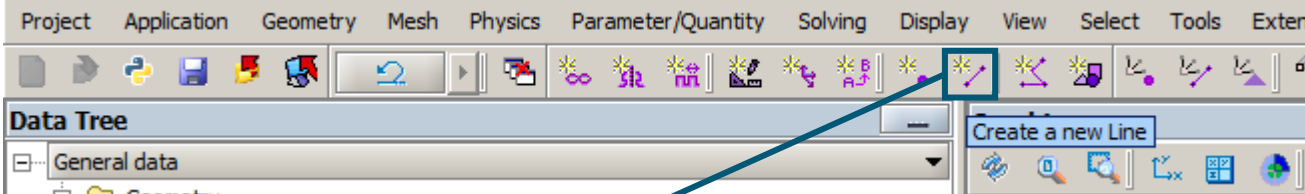
1. Select the points you want to link by clicking on them directly on the model (they might not have the same number)
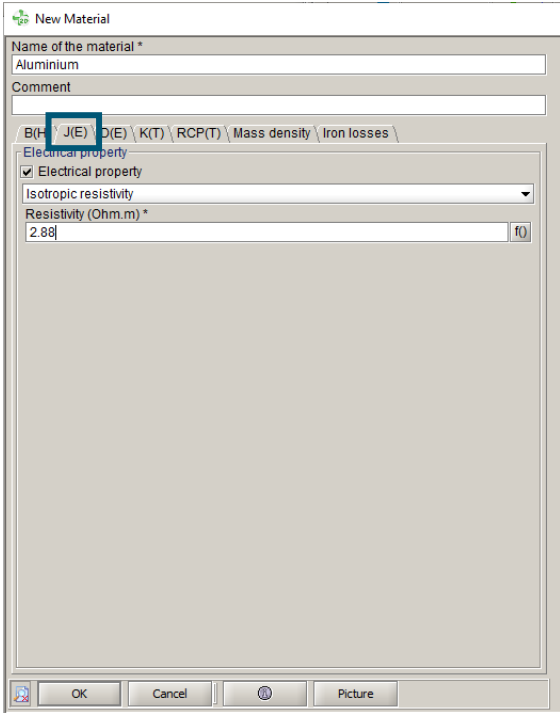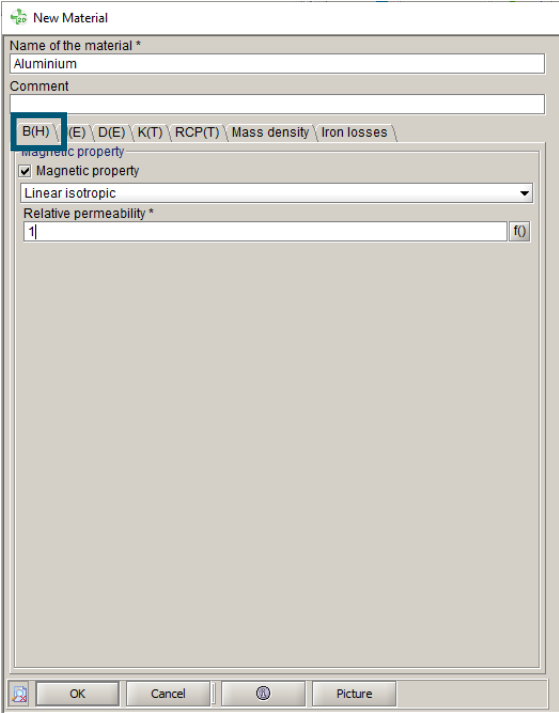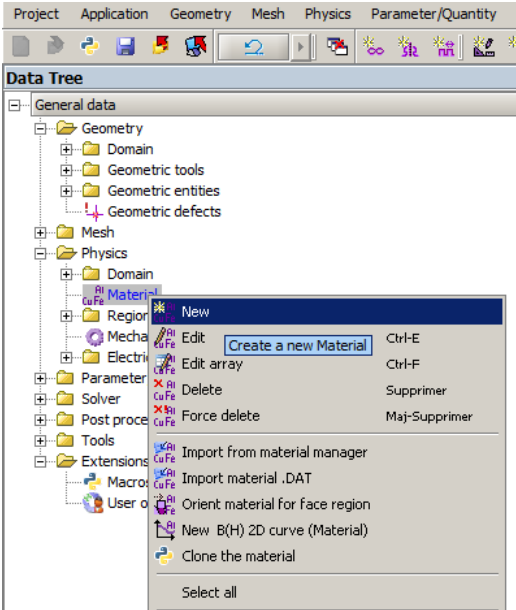
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Create project geometry
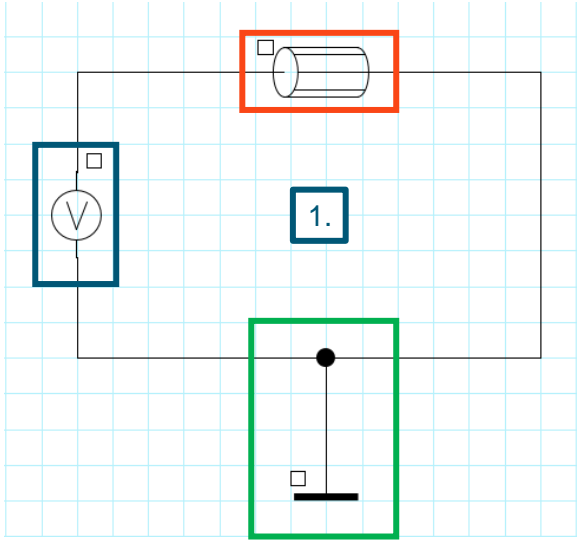
Build faces and infinite box
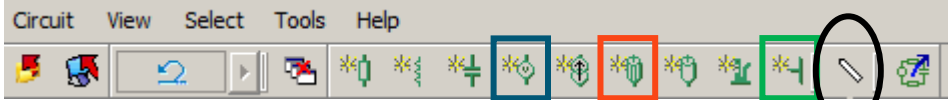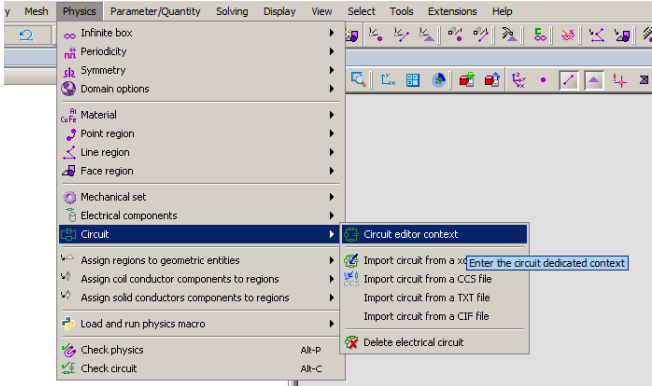
DEFINE PROJECT PHYSICS

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Define project physics

Create Aluminum material

Define project physics

Create foil coil circuit components

Draw routing potential lines

1. You can press R to rotate a component
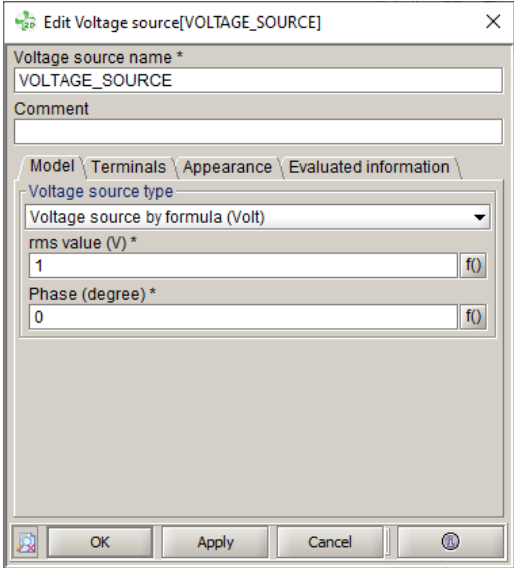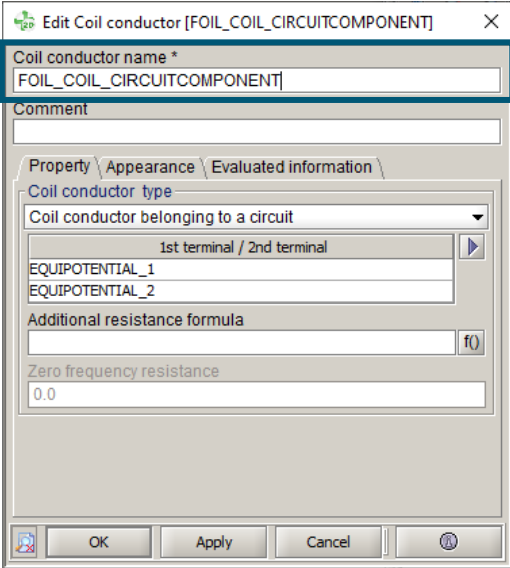
Define project physics

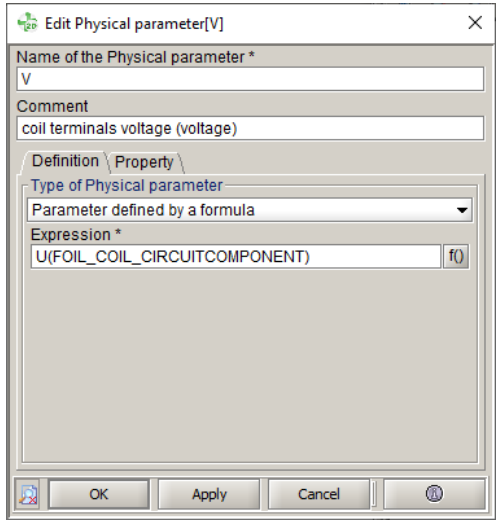Circuit components definition

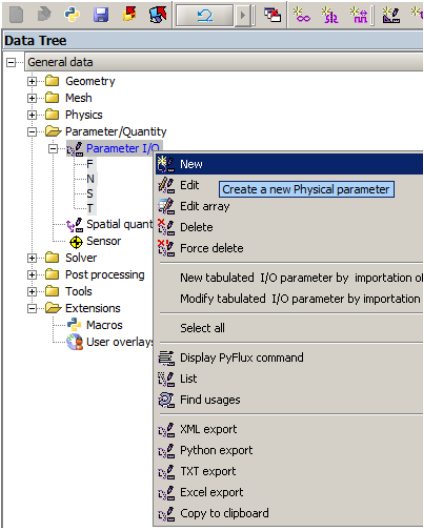Double click on voltage source

Double click on coil component

Rename it
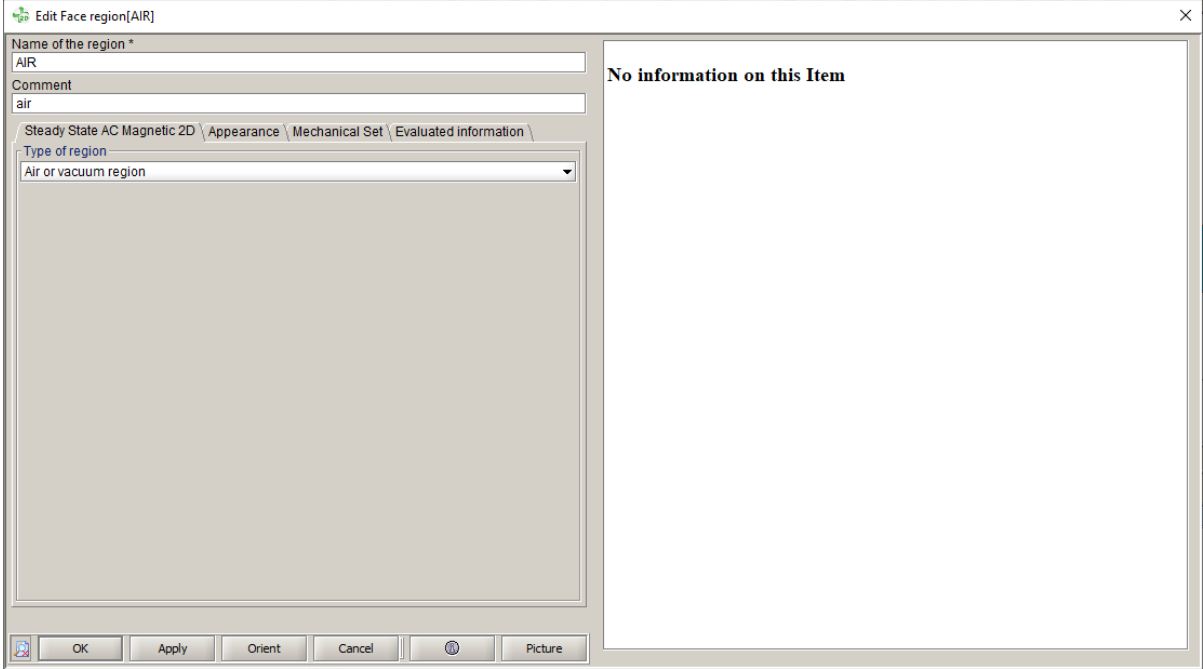FOIL_COIL_CIRCUITCOMPONENT

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Define project physics

Create coil parameters

Name	Comment	Expression
V	Coil terminals voltage (volt)	U(FOIL_COIL_CIRCUITCOMPONENT)
I	Coil terminals current (ampere)	I(FOIL_COIL_CIRCUITCOMPONENT)
Resistance	Coil resistance (ohms)	(ModC(V)/ModC(I))*Cos(Arg(V)-Arg(I))
Reactance	Coil reactance (ohms)	(ModC(V)/ModC(I))*Sin(Arg(V)-Arg(I))
Impedance_Modulus	Coil impedance modulus (ohms)	(ModC(V)/ModC(I))
Impedance_angle	Coil impedance angle (degrees)	(Arg(V)-Arg(I))*180/Pi()

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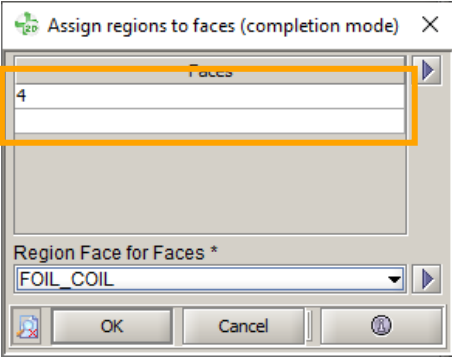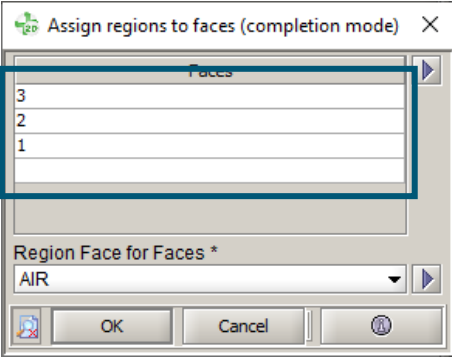
Define project physics

Create regions : Air
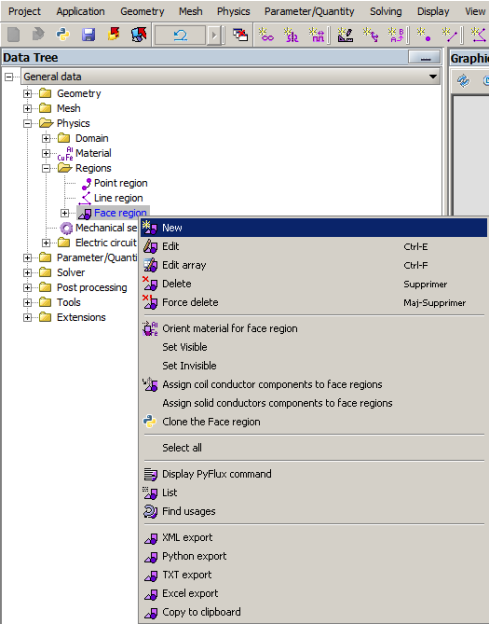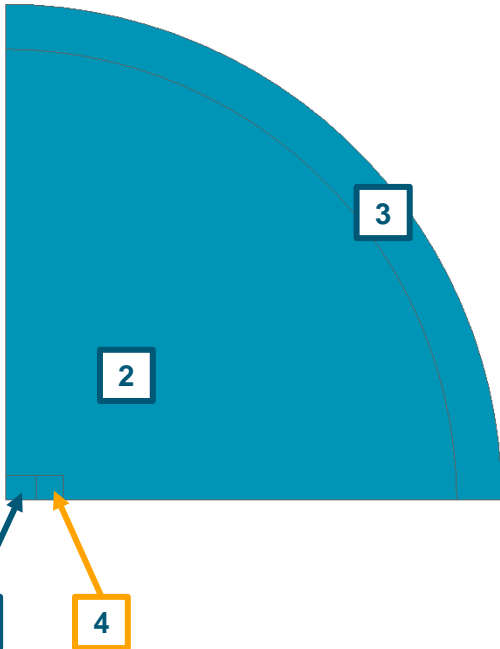
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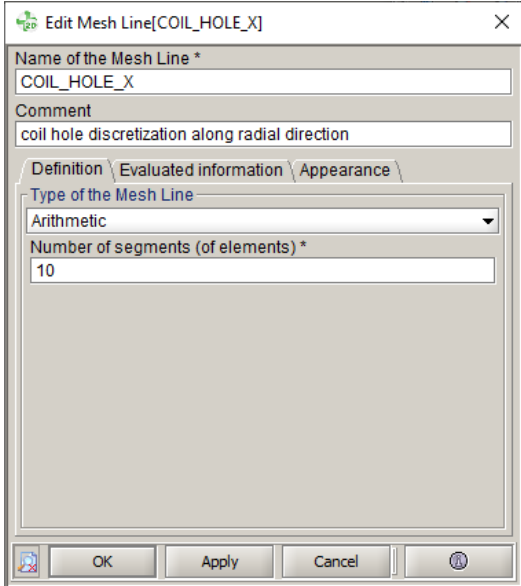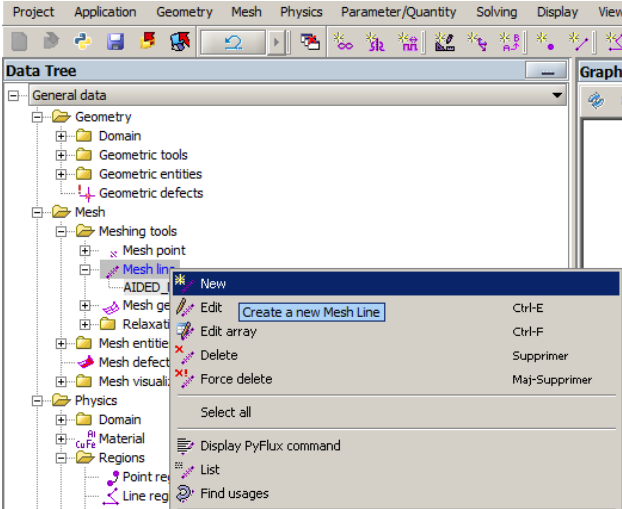
Define project physics

Create regions : **Foil coil**

Define project physics

Assign faces to region
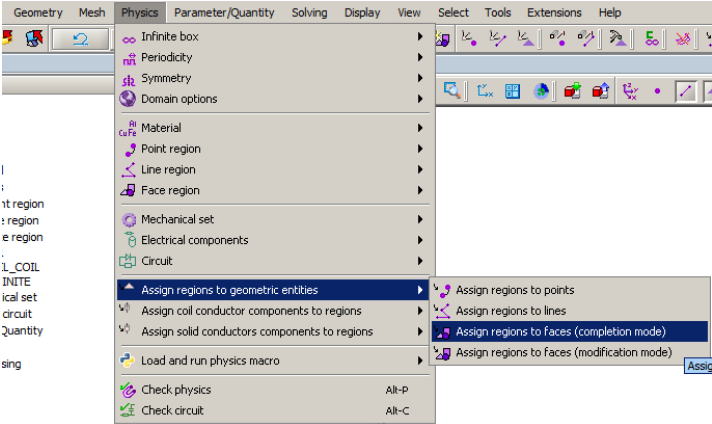
Define project physics

Create mesh lines – Arithmetic lines

Edit Mesh Line[COIL_HOLE_X]

Name of the Mesh Line *
COIL_HOLE_X

Comment
coil hole discretization along radial direction

Definition | Evaluated information | Appearance

Type of the Mesh Line
Arithmetic

Number of segments (of elements) *
10

OK | Apply | Cancel

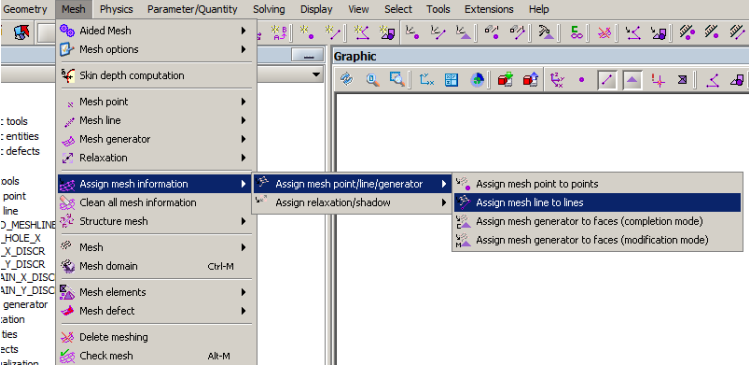| Name	Comment	Number of segments
COIL_HOLE_X	Coil hole discretization along radial direction	10
COIL_X_DISCR	Coil arithmetic discretization along radial direction	10
COIL_Y_DISCR	Coil arithmetic discretization along axial direction	15

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Define project physics

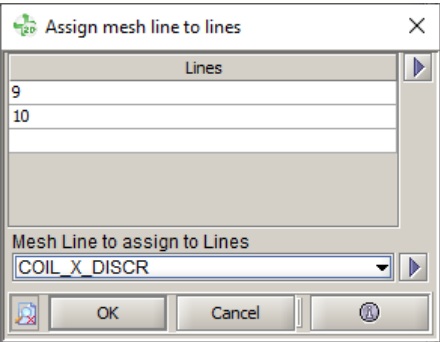Create mesh lines – Geometric with imposed number of elements

Edit Mesh Line[DOMAIN_X_DISCR]

Name of the Mesh Line *

DOMAIN_X_DISCR

Comment

discretization of the radial horizontal boundary of the domain

Definition | Evaluated information | Appearance

Type of the Mesh Line

Geometric with Imposed Number of Elements

Number of segments (of elements) *

15

Ratio R of the progression (1 < R < 2) *

1.25

OK | Apply | Cancel
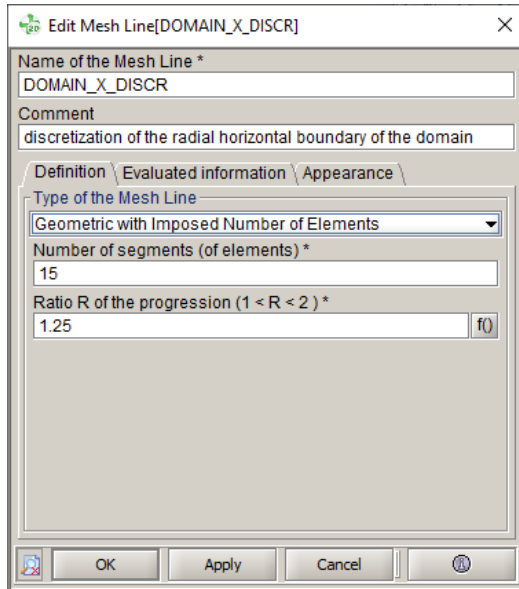
Name	Comment	Number of segments	Ratio R of the progression
DOMAIN_X_DISCR	Discretization of the radial horizontal boundary of the domain	15	1.25
DOMAIN_Y_DISCR	Discretization of the radial vertical boundary of the domain	15	1.25

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© Altair Engineering, Inc. Proprietary and Confidential. All rights reserved.
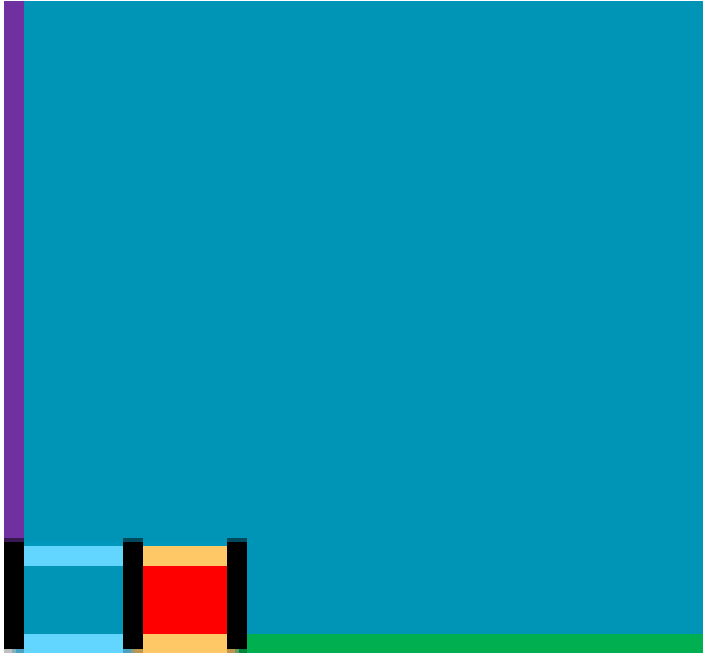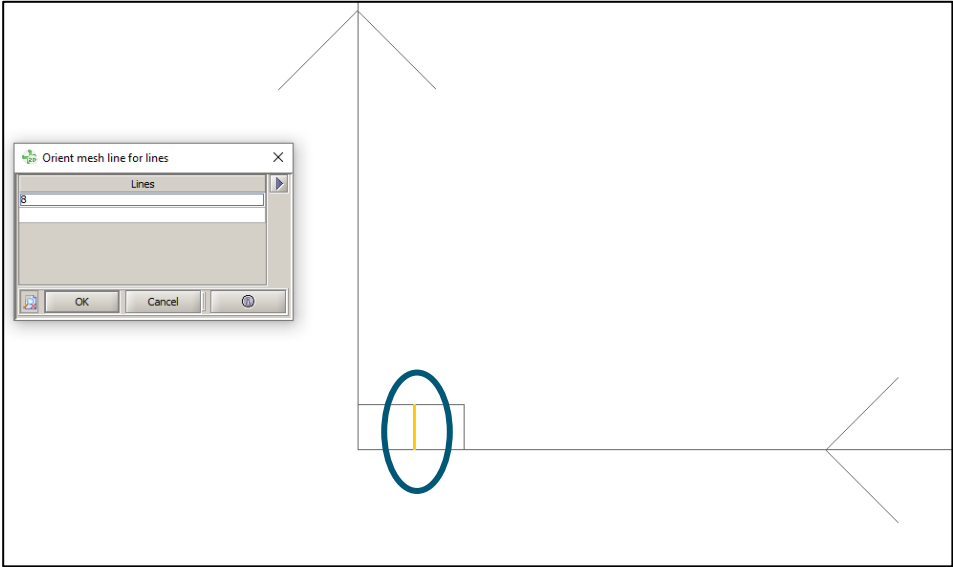
Define project physics

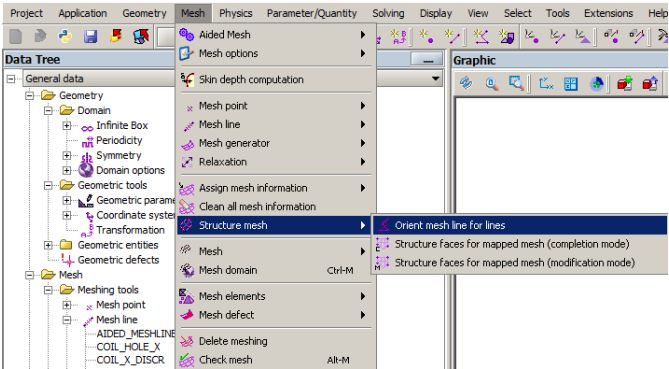## Assign mesh lines

DOMAIN_Y_DISCR
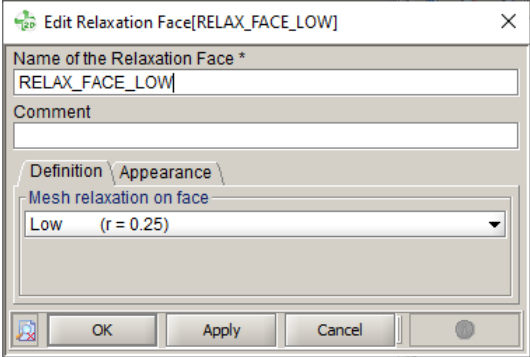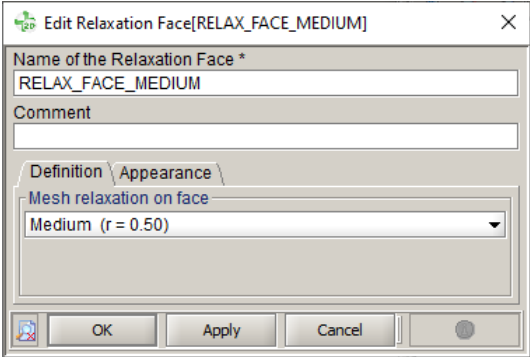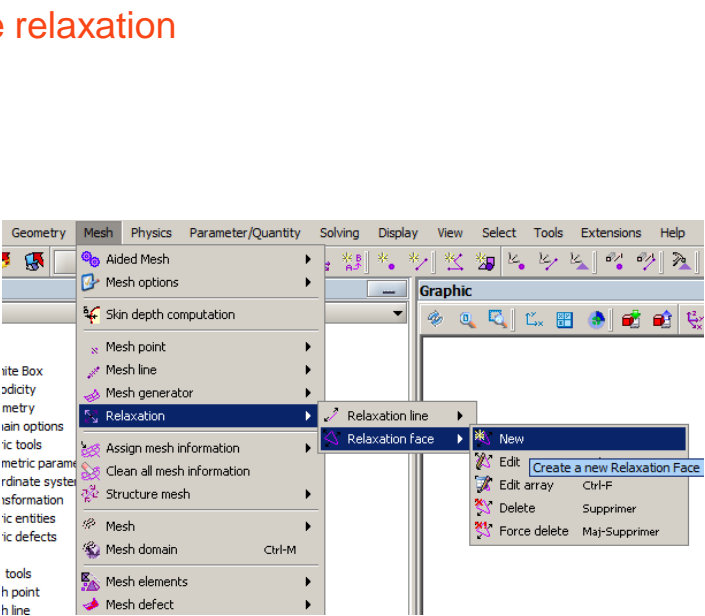
COIL_Y_DISCR

COIL_HOLE_X

COIL_X_DISCR   DOMAIN_X_DISCR
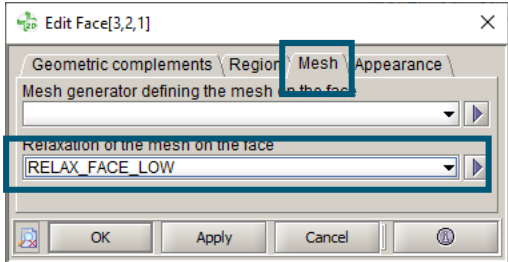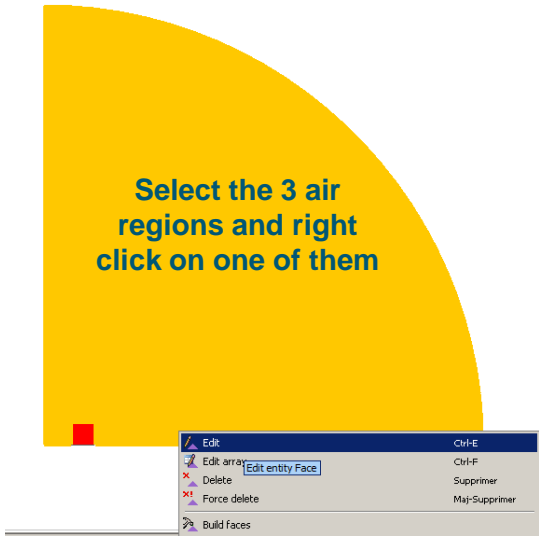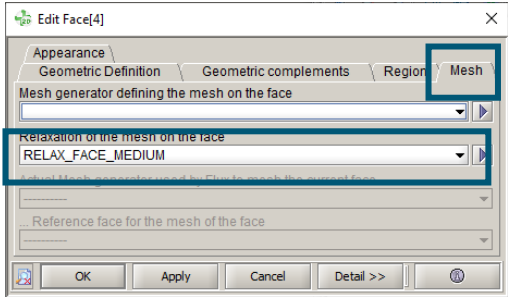
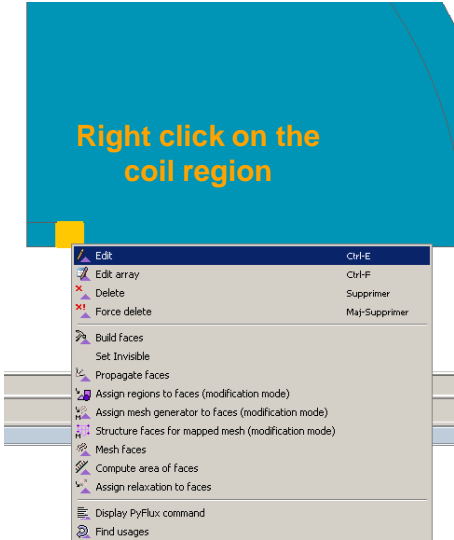23

Define project physics
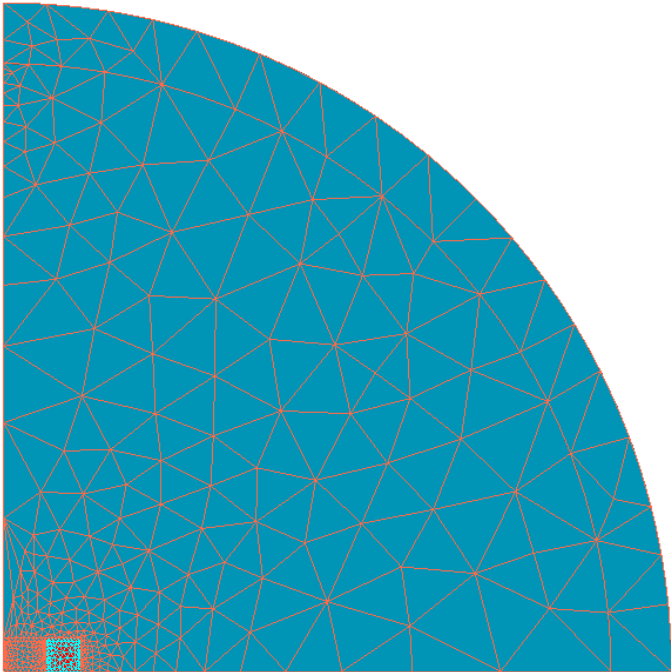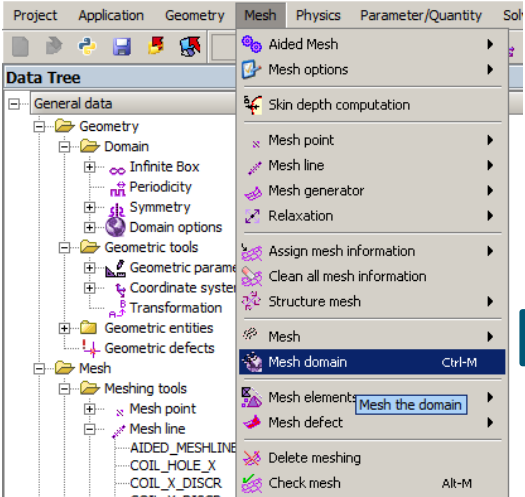
Orient mesh line

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Define project physics

Create face relaxation

Define project physics

Assign face relaxation

Right click on the coil region

Select the 3 air regions and right click on one of them

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Define project physics

Mesh domain

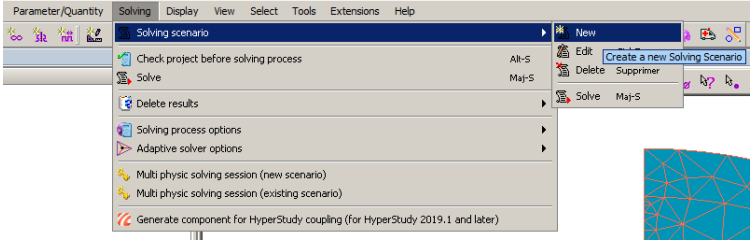1. You can also use the "ctrl+M" shortcut to mesh your geometry
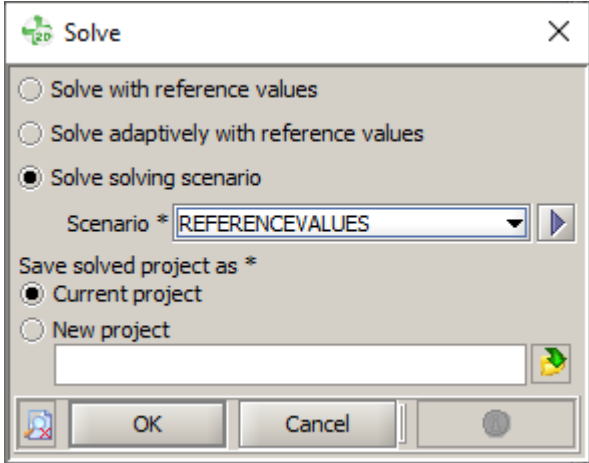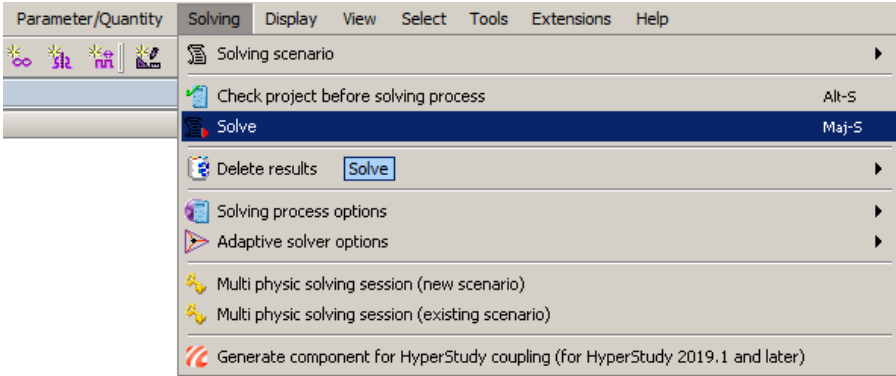
POST-PROCESSING

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Define project physics
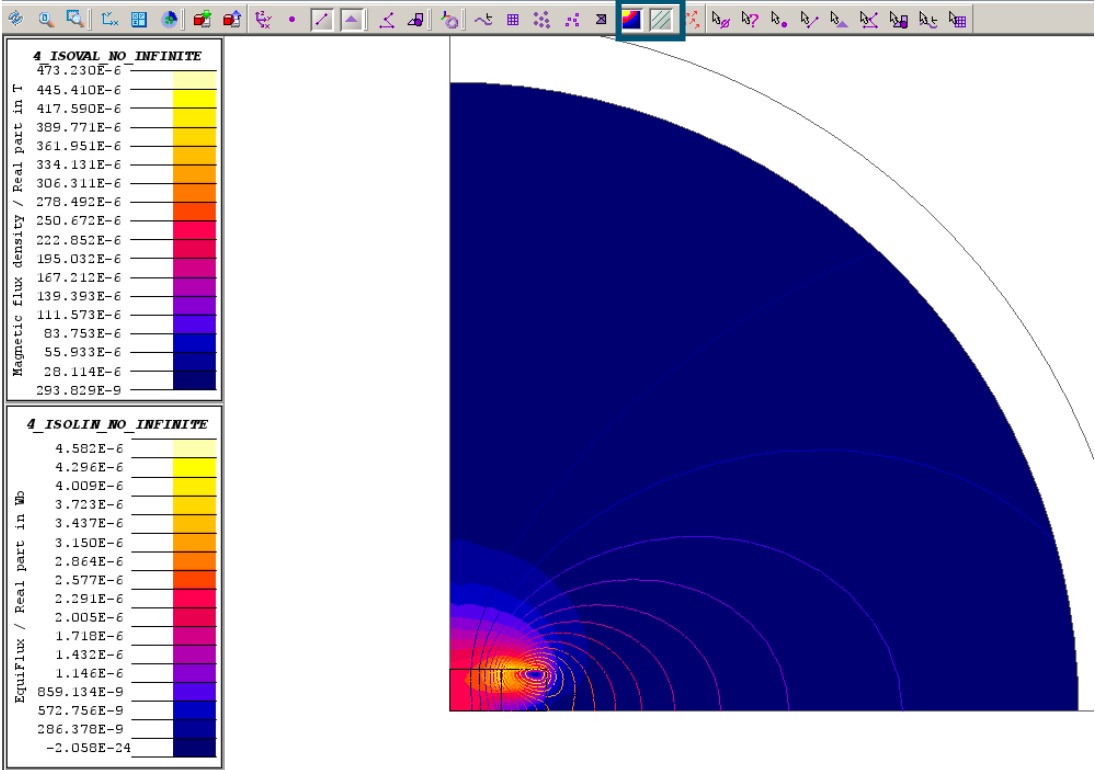
Create solving Scenario ReferenceValues: Get reference values
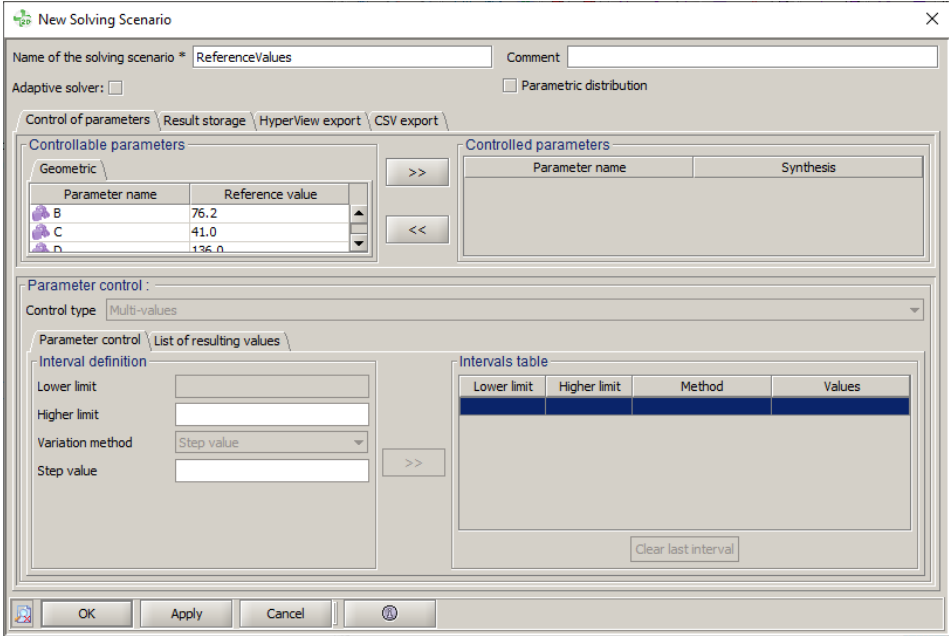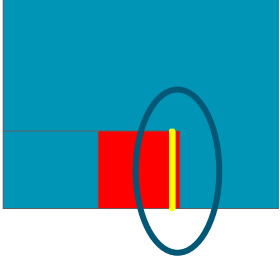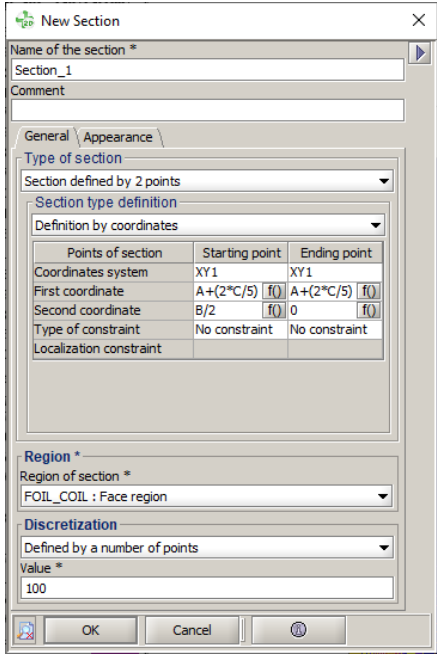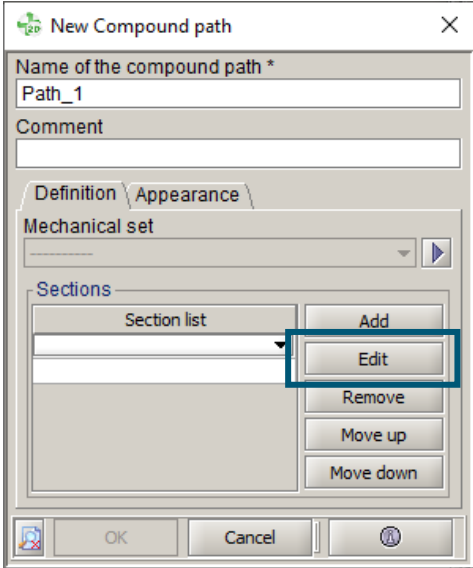
Define project physics
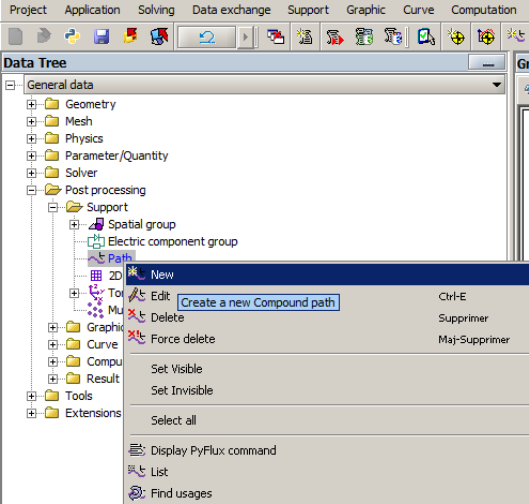
Solve scenario ReferenceValues

Post-processing

Display Isovalues

Post-processing

Create post processing support path

Post-processing

Plot current density on 1st path
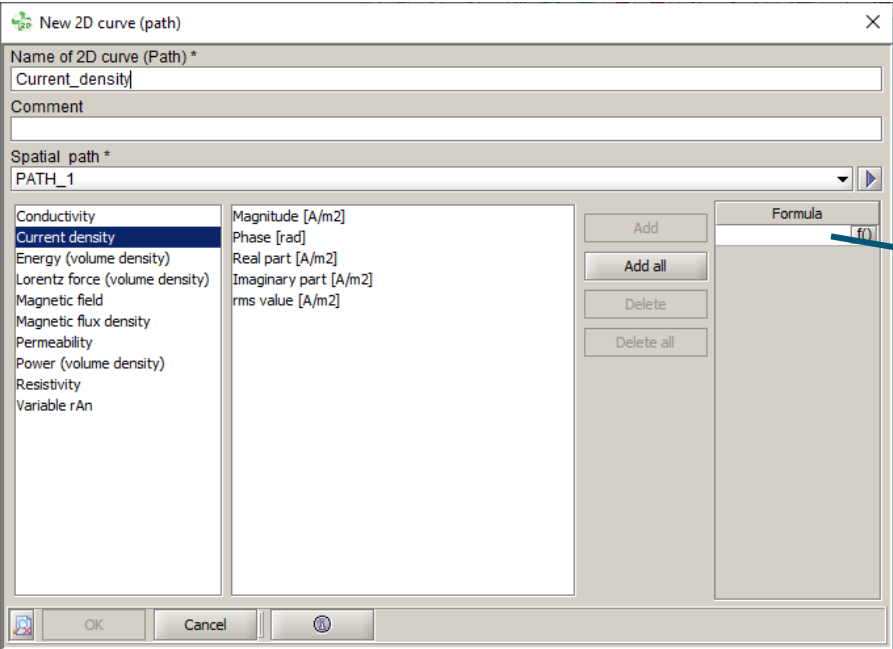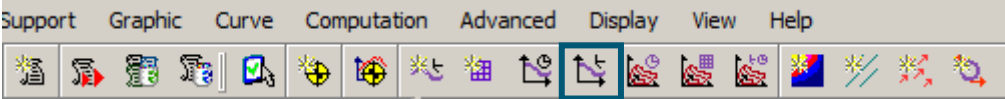
Post-processing

Current density on chosen path
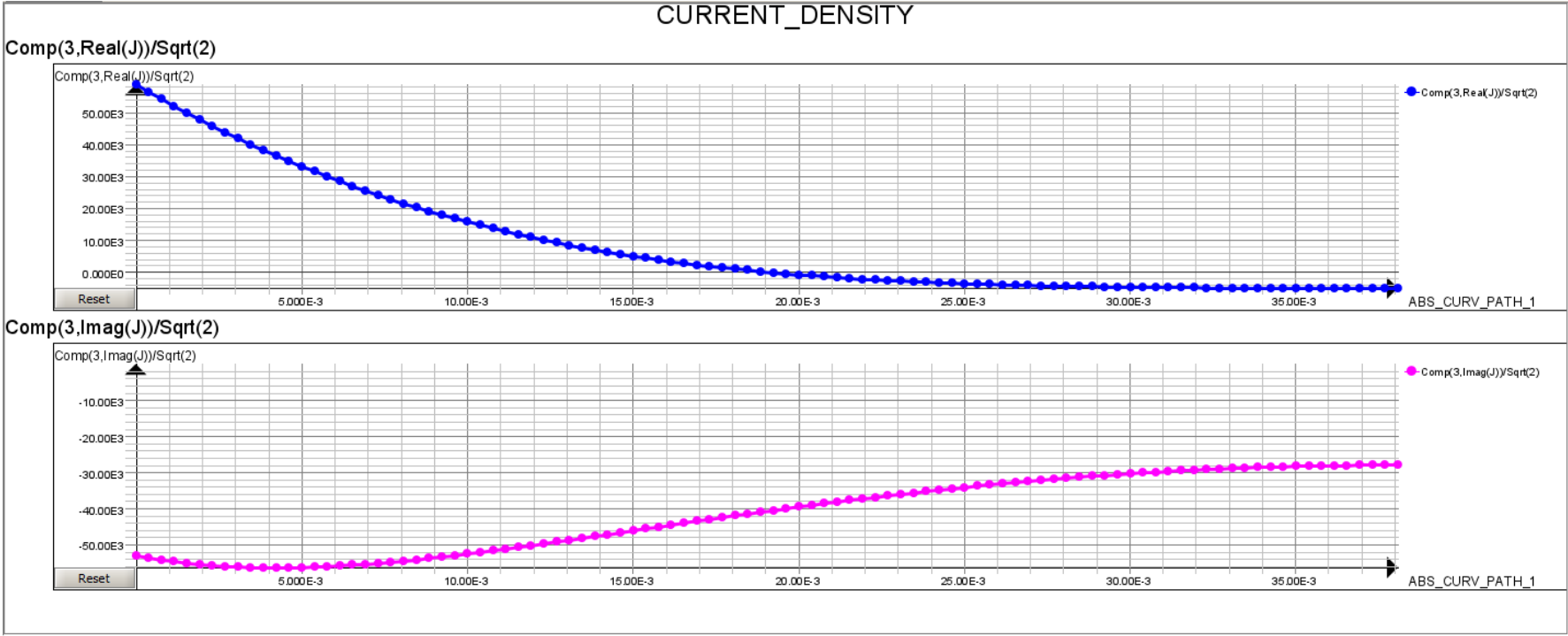
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