

MONOPHASE IM MOTOR WITH OUTER ROTOR

Flux 2D : Project step by step

Summary

- Introduction
- Building geometry and mesh with overlay
- Defining the physics
 - Application
 - Material
 - Circuit
- Solving scenario
- Post-processing

Starting a new project : new project

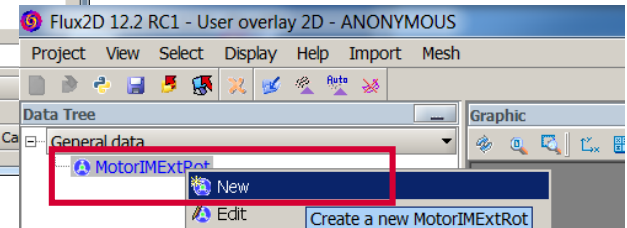
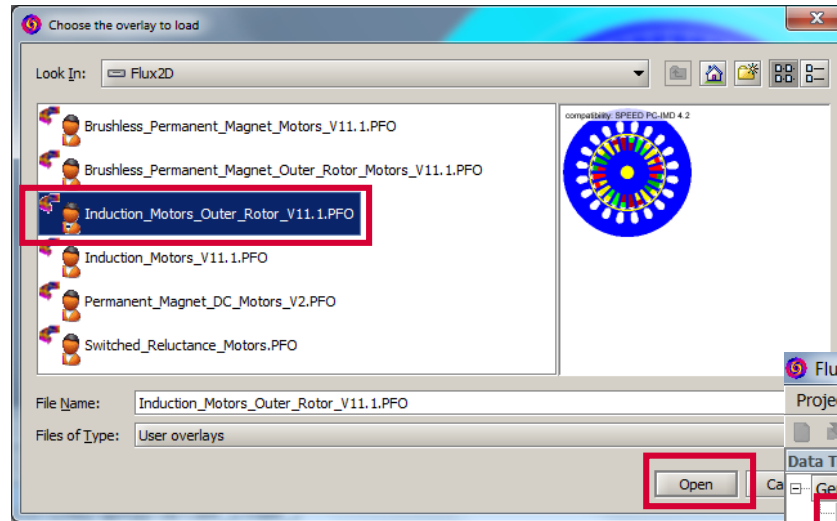
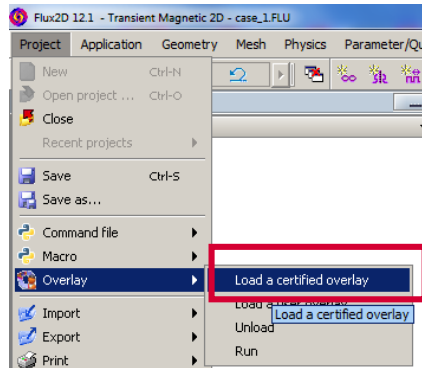
- Open Flux supervisor
- Start a new project

Start a new project

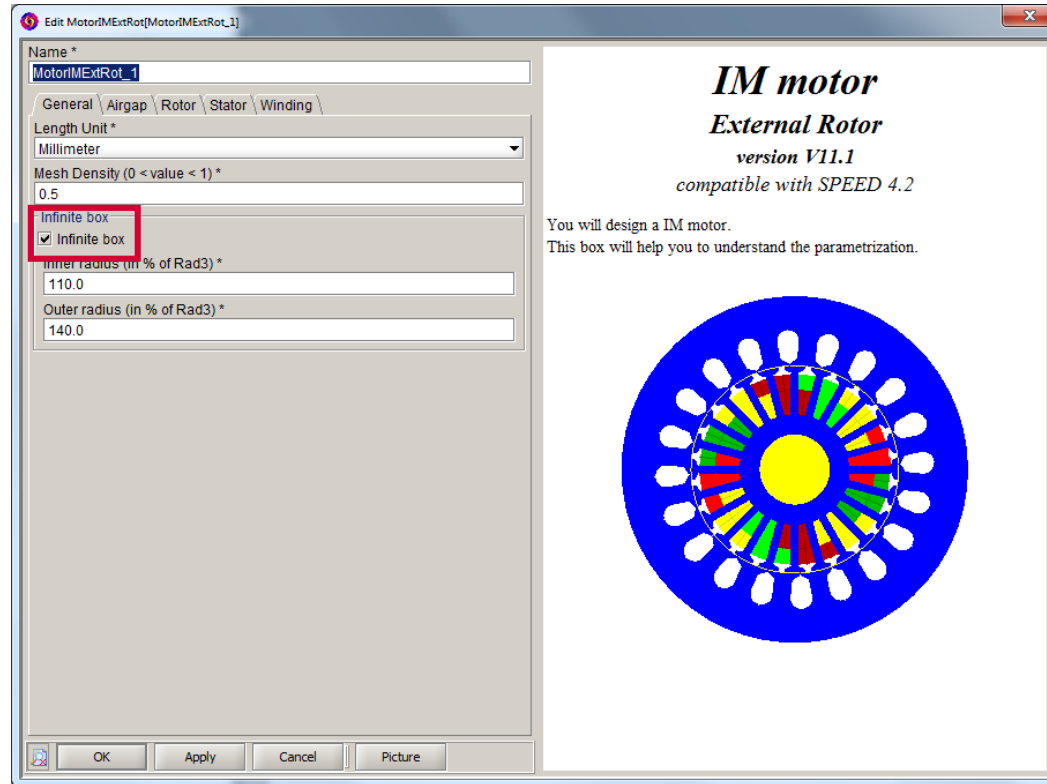


Building geometry and mesh with overlay

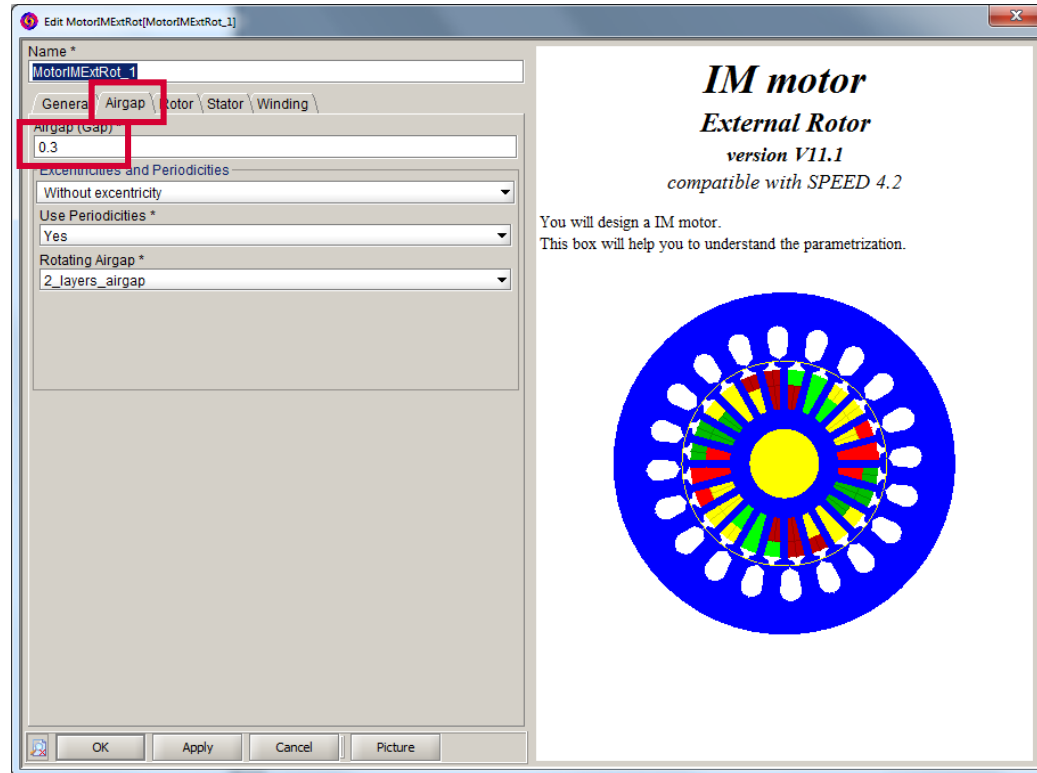
- Leave sketcher context: [project] [return to standard geometry context]
- Load the Overlay “Induction_Motor_Outer_Rotor_V11.1.PFO”, and create a new overlay



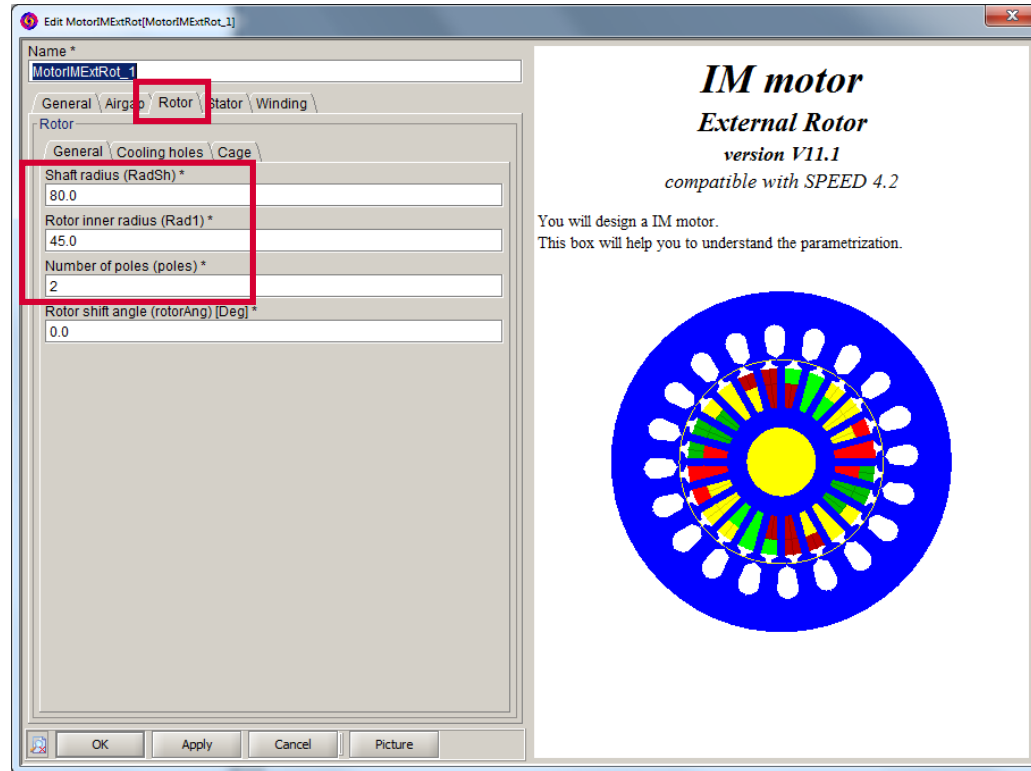
Building geometry and mesh with overlay



Building geometry and mesh with overlay

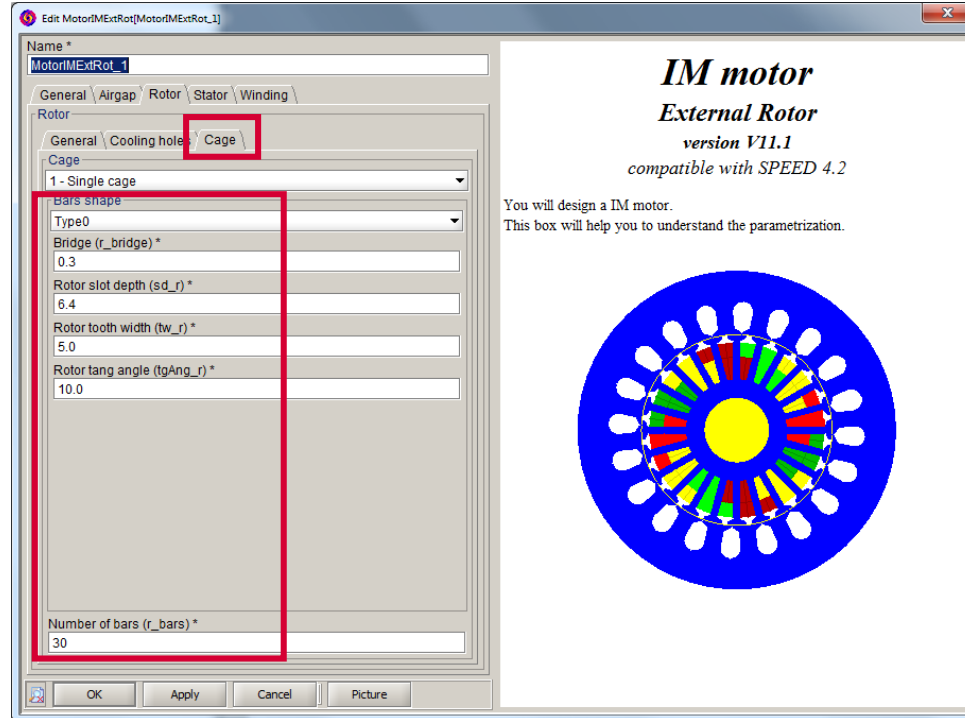


Building geometry and mesh with overlay



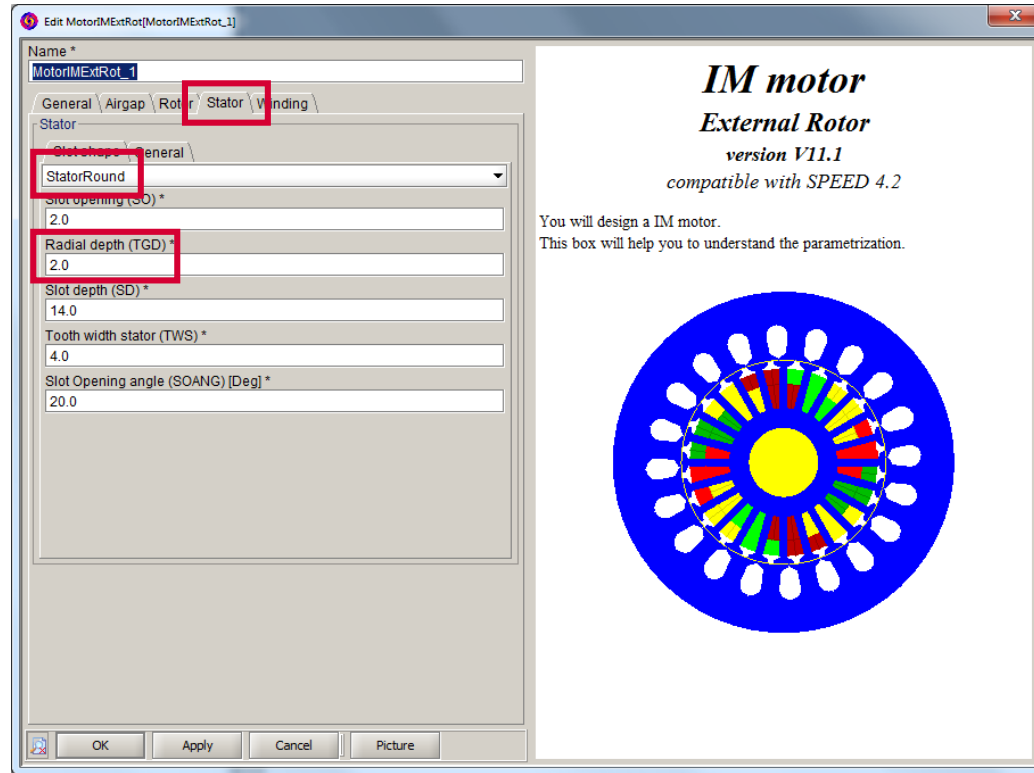
Building geometry and mesh with overlay

- Without cooling holes



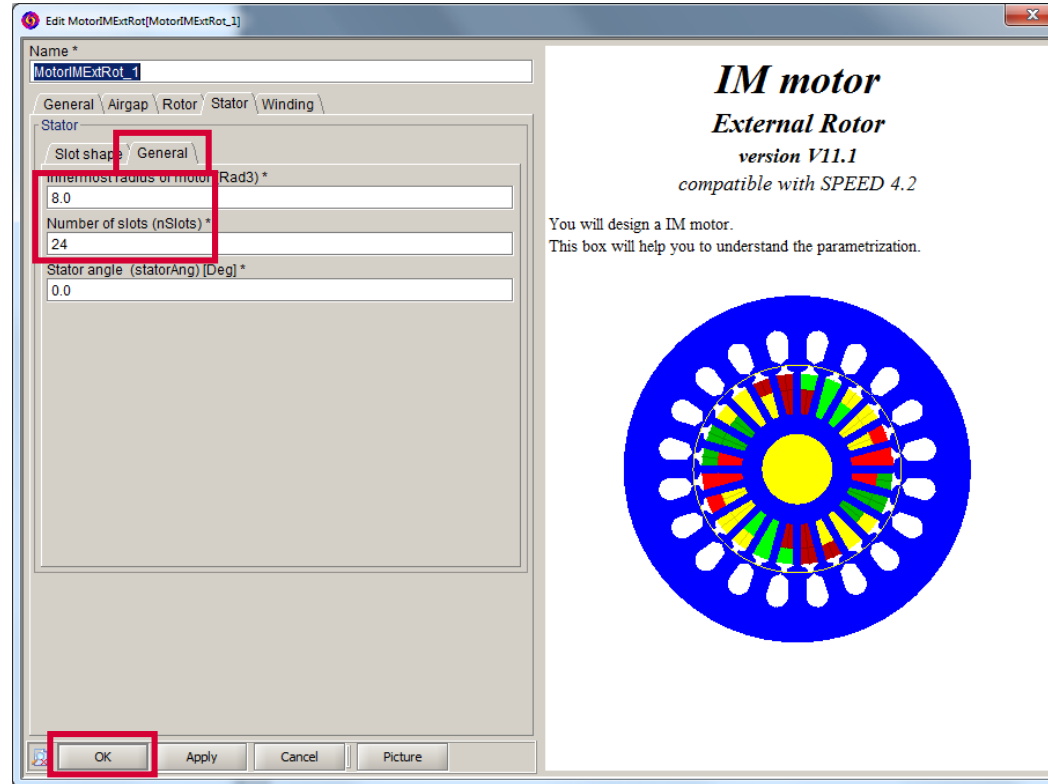
Building geometry and mesh with overlay

- Without cooling holes



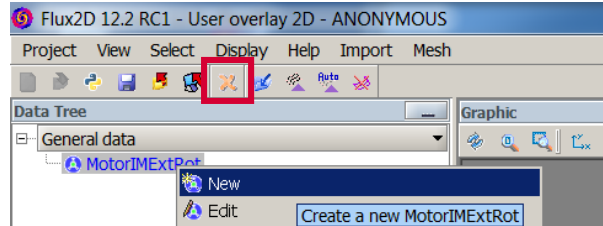
Building geometry and mesh with overlay

- No winding



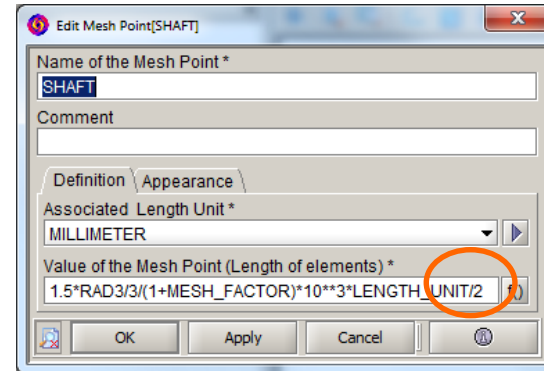
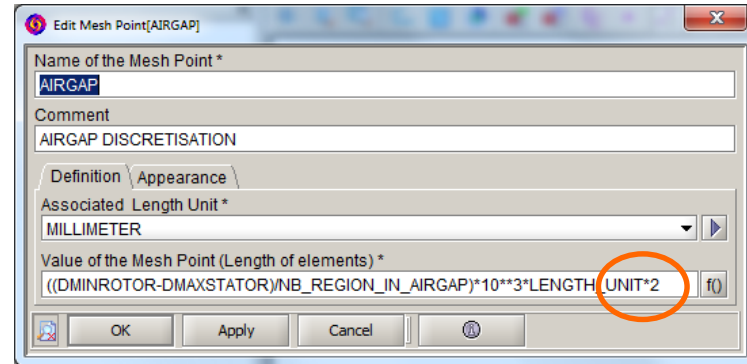
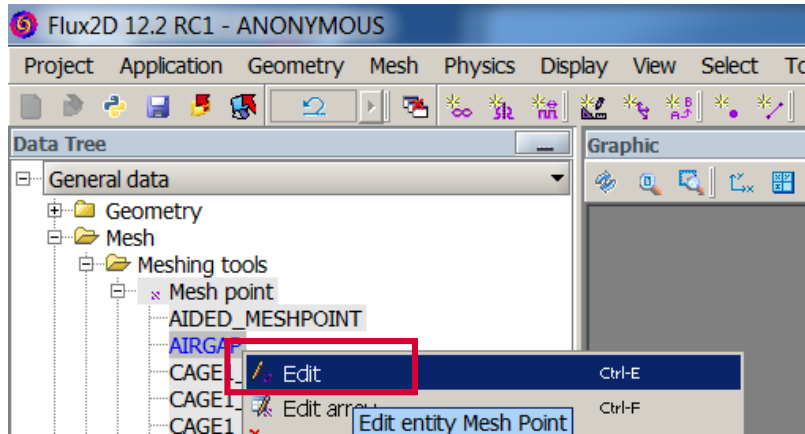
Building geometry and mesh with overlay

- Leave the overlay



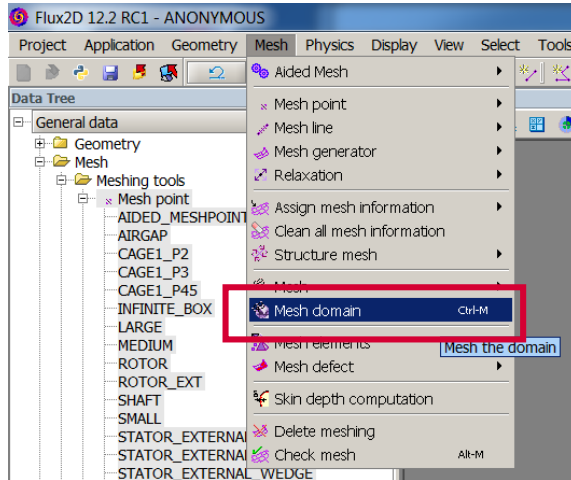
Building geometry and mesh with overlay

- Edit meshpoints



Building geometry and mesh with overlay

- Mesh the geometry



Surface elements :

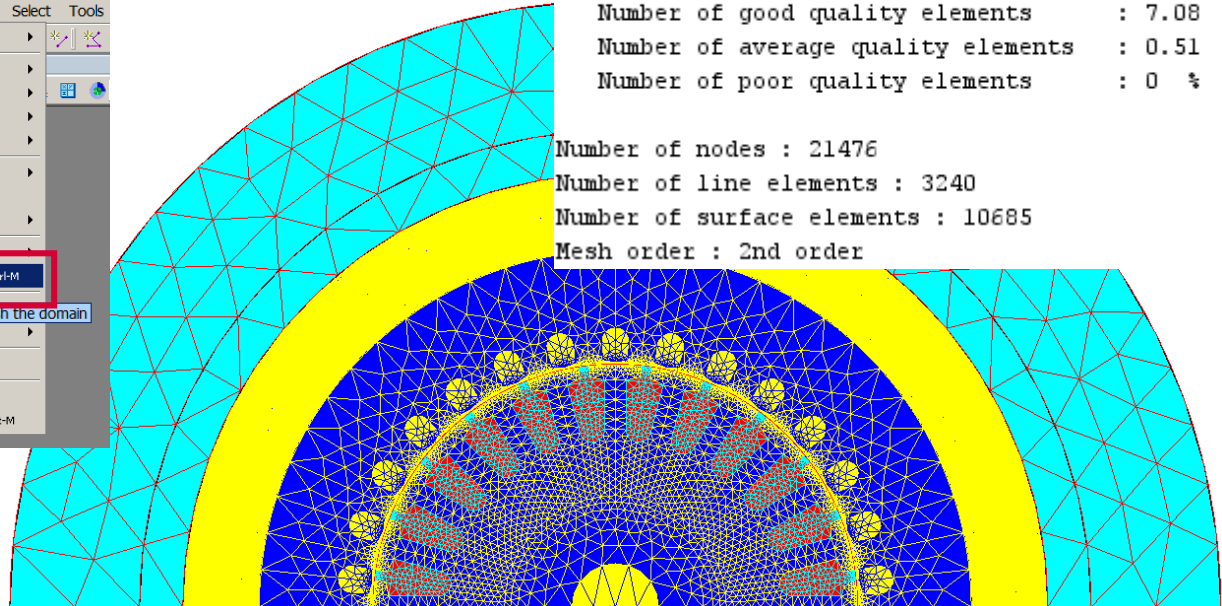
Number of elements not evaluated	: 0 %
Number of excellent quality elements	: 92.42 %
Number of good quality elements	: 7.08 %
Number of average quality elements	: 0.51 %
Number of poor quality elements	: 0 %

Number of nodes : 21476

Number of line elements : 3240

Number of surface elements : 10685

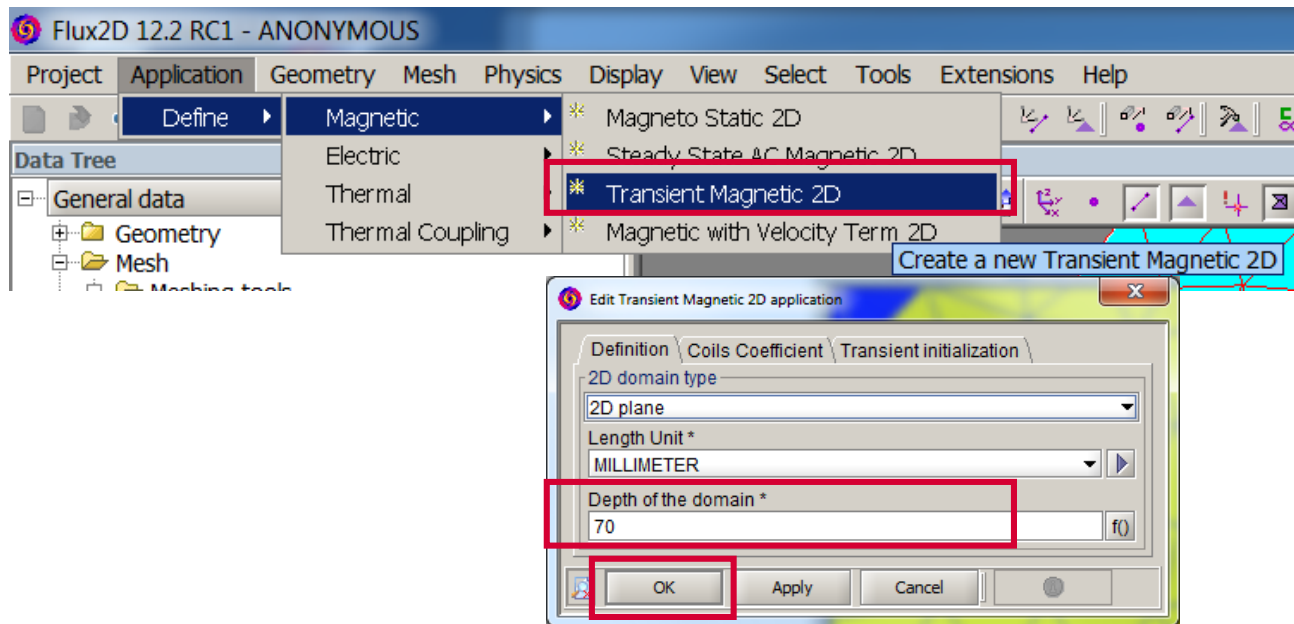
Mesh order : 2nd order



- Save project as “Geomesh.FLU” [Project] [Save as]

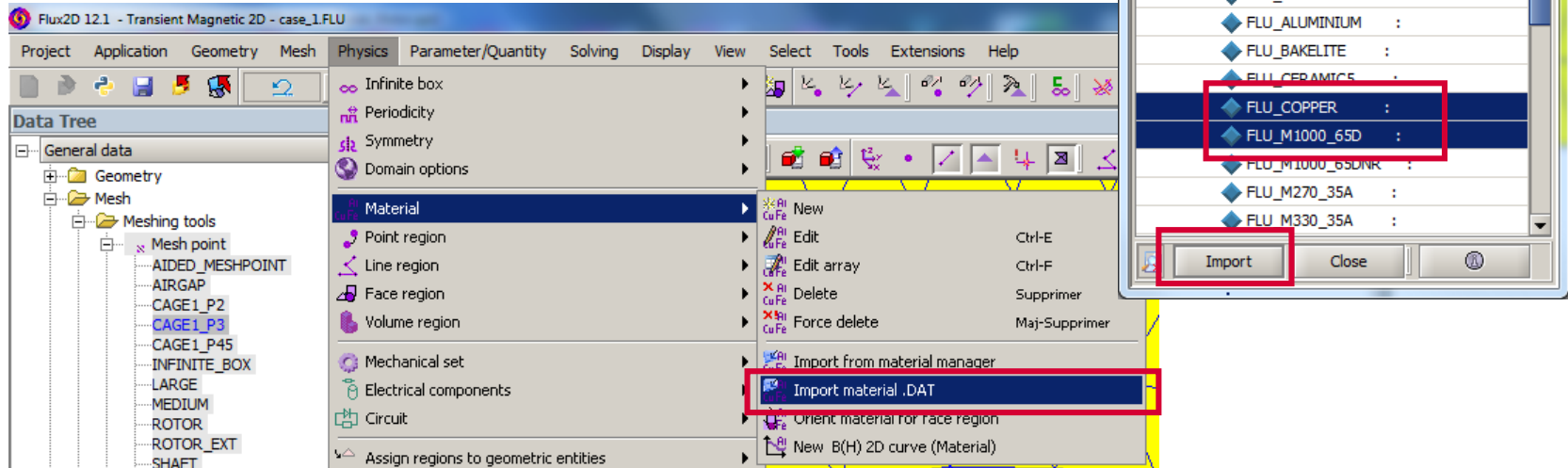
Physics

- Create a transient magnetic application



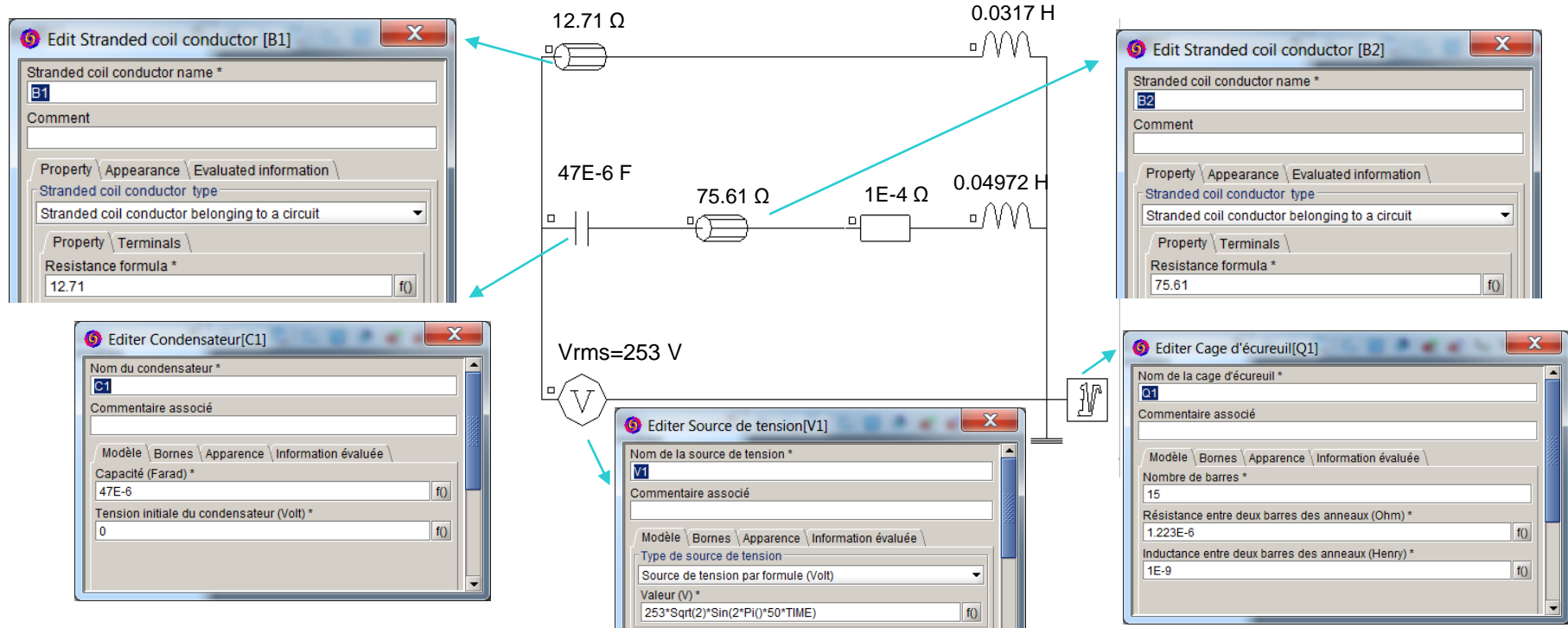
Physics

- Import material
 - Flux_copper
 - Flux_M1000_65D



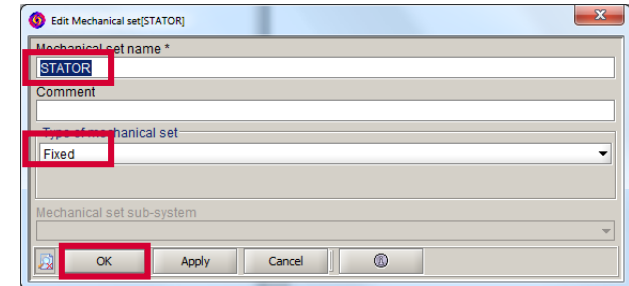
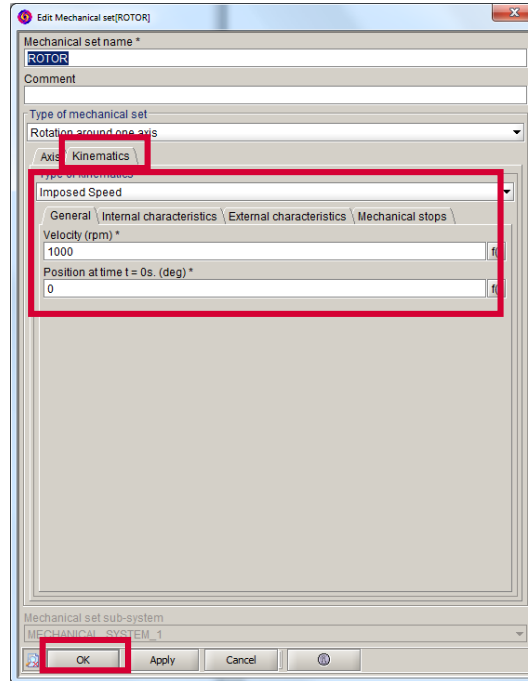
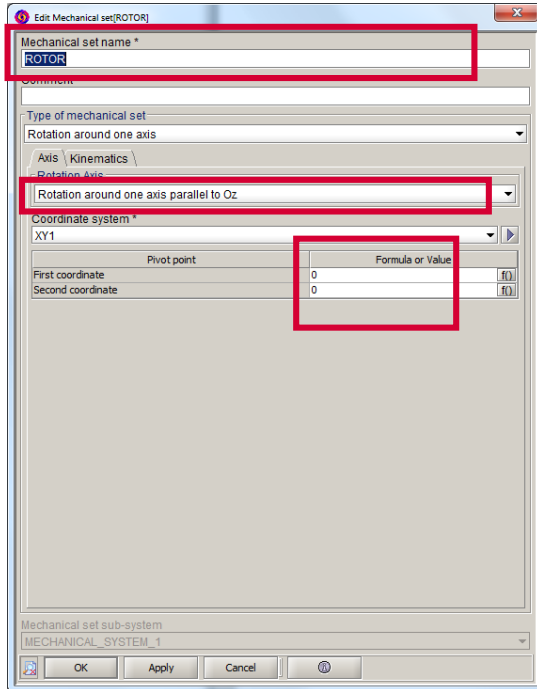
Physics

- Create an electric circuit [physics] [circuit] [circuit editor context]



Physics

- Create two mechanical sets for rotor and stator [Physics] [Mechanical set] [New]



- | Entities | Modify all | ROTOR_CAGE1_BAR1 | ROTOR_CAGE1_BAR10 | ROTOR_CAGE1_BAR11 | ROTOR_CAGE1_BAR12 | ROTOR_CAGE1_BAR13 | ROTC |
|--------------------------------|----------------|-------------------------------|----------------------------------|---------------------------------|---------------------------------|---------------------------------|---------|
| [-] Face region | | | | | | | |
| [-] Name * | | ROTOR_CAGE1_BAR1 | ROTOR_CAGE1_BAR10 | ROTOR_CAGE1_BAR11 | ROTOR_CAGE1_BAR12 | ROTOR_CAGE1_BAR13 | ROTC |
| [-] Comment | Initial values | | | | | | |
| [-] Transientmagnet * | | | | | | | |
| [-] Sub types | Initial values | | | | | | |
| [-] Solid conductor region | Initial values | Solid conductor region | Solid conductor region | Solid conductor region | Solid conductor region | Solid conductor region | Solid c |
| [-] material * | Initial values | FLU_COPPER | FLU_COPPER | FLU_COPPER | FLU_COPPER | FLU_COPPER | FLU_C |
| [-] type_circuit * | | | | | | | |
| [-] Sub types | Initial values | Circuit | Circuit | Circuit | Circuit | Circuit | Circuit |
| [-] Circuit | Initial values | Circuit | Circuit | Circuit | Circuit | Circuit | Circuit |
| [-] Associated solid conductor | Initial values | BAR_1_SQUIRRELCAGE_1 | BAR_10_SQUIRRELCAGE_1 | BAR_11_SQUIRRELCAGE_1 | BAR_12_SQUIRRELCAGE_1 | BAR_13_SQUIRRELCAGE_1 | BAR_ |
| [-] Orientation type * | Initial values | Positive orientation for t... | Positive orientation for the ... | Positive orientation for the... | Positive orientation for the... | Positive orientation for the... | Positi |
| [-] Sub types | Initial values | Positive orientation for t... | Positive orientation for the ... | Positive orientation for the... | Positive orientation for the... | Positive orientation for the... | Positi |
| [-] Color * | Initial values | White | White | White | White | White | White |
| [-] Visibility * | Initial values | VISIBLE | VISIBLE | VISIBLE | VISIBLE | VISIBLE | VISIBL |
| [-] Mechanical set | Initial values | ROTOR | ROTOR | ROTOR | ROTOR | ROTOR | ROTC |



Physics

- Create 8 new face regions to describe the auxiliary phase [Physics] [Face region] [New] , as following

Edit Face region[AUX_M_1,AUX_M_2,AUX_M_3,AUX_M_4,AUX_P_1,AUX_P_2,AUX_P_3,AUX_P_4]

Entities	Modify all	AUX_M_1	AUX_M_2	AUX_M_3	AUX_M_4	AUX_P_1	AUX_P_2	AUX_P_3	AUX_P_4
[-] Face region		AUX_M_1	AUX_M_2	AUX_M_3	AUX_M_4	AUX_P_1	AUX_P_2	AUX_P_3	AUX_P_4
[-] Name *									
[-] Comment	Initial values								
[-] Transientmagnet *									
[-] Sub types	Initial values	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...
[-] Coil conductor region		Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...	Coil cond...
[-] material	Initial values								
[-] conductor *									
[-] Component	Initial values	B2	B2	B2	B2	B2	B2	B2	B2
[-] Turn number *	Initial values	105	92	72	59	105	92	72	59
[-] Fill factor (0 < Cf < 1)	Initial values	false	false	false	false	false	false	false	false
[-] Series or parallel *									
[-] Sub types	All the symmetrical and periodical conductors are in series	All the sy...	All the sy...	All the sy...	All the sy...	All the sy...	All the sy...	All the sy...	All the sy...
[-] All the symmetrical and periodical c		All the sy	All the sy	All the sy	All the sy	All the sy	All the sy	All the sy	All the sy
[-] Sub types	Initial values	Negative ...	Negative ...	Negative ...	Negative ...	Positive o...	Positive o...	Positive o...	Positive o...
[-] Positive orientation for the current						Positive o...	Positive o...	Positive o...	Positive o...
[-] Negative orientation for the current		Negative	Negative	Negative	Negative				
[-] Color *	Initial values	Green	Green	Green	Green	Green	Green	Green	Green
[-] Visibility *	Initial values	VISIBLE	VISIBLE	VISIBLE	VISIBLE	VISIBLE	VISIBLE	VISIBLE	VISIBLE
[-] Mechanical set	Initial values	STATOR	STATOR	STATOR	STATOR	STATOR	STATOR	STATOR	STATOR

OK Apply Cancel

Physics

- Create 4 new face regions to describe the main phase, as following:

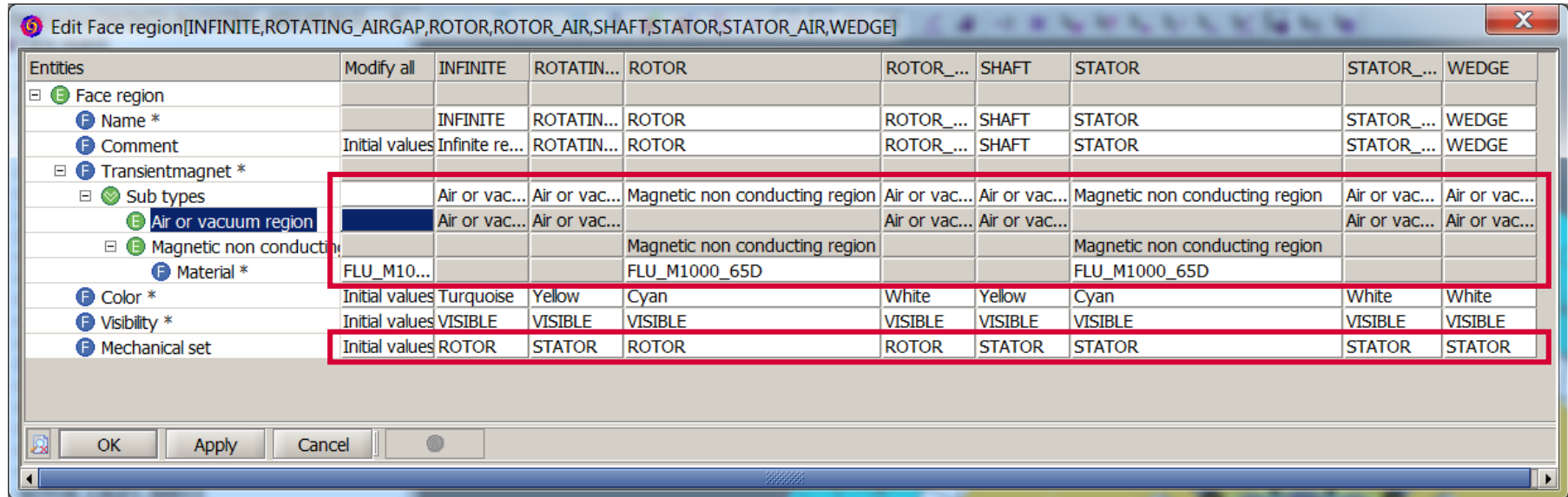
Edit Face region[MAIN_P_1,MAIN_P_2,MAIN_P_3,MAIN_P_4]

Entities	Modify all	MAIN_P_1	MAIN_P_2	MAIN_P_3	MAIN_P_4
<input checked="" type="checkbox"/> Face region					
<input checked="" type="checkbox"/> Name *		MAIN_P_1	MAIN_P_2	MAIN_P_3	MAIN_P_4
<input checked="" type="checkbox"/> Comment	Initial values				
<input checked="" type="checkbox"/> Transientmagnet *					
<input checked="" type="checkbox"/> Sub types	Initial values	Coil conductor r...	Coil conductor r...	Coil conductor r...	Coil conductor r...
<input checked="" type="checkbox"/> Coil conductor region		Coil conductor r...	Coil conductor r...	Coil conductor r...	Coil conductor r...
<input checked="" type="checkbox"/> material	Initial values				
<input checked="" type="checkbox"/> conductor *					
<input checked="" type="checkbox"/> Component	Initial values	B1	B1	B1	B1
<input checked="" type="checkbox"/> Turn number *	Initial values	4*75	54	43	33
<input checked="" type="checkbox"/> Fill factor (0 < Cf < 1)	Initial values	false	false	false	false
<input checked="" type="checkbox"/> Series or parallel *					
<input checked="" type="checkbox"/> Sub types	Initial values	All the symmetri...	All the symmetri...	All the symmetri...	All the symmetri...
<input checked="" type="checkbox"/> All the symmetri...		All the symmetri...	All the symmetri...	All the symmetri...	All the symmetri...
<input checked="" type="checkbox"/> Sub types	Initial values	Positive orienta...	Positive orienta...	Positive orienta...	Positive orienta...
<input checked="" type="checkbox"/> Positive orientation fo		Positive orienta...	Positive orienta...	Positive orienta...	Positive orienta...
<input checked="" type="checkbox"/> Color *	Initial values	Red	Red	Red	Red
<input checked="" type="checkbox"/> Visibility *	Initial values	VISIBLE	VISIBLE	VISIBLE	VISIBLE
<input checked="" type="checkbox"/> Mechanical set	Initial values	STATOR	STATOR	STATOR	STATOR

OK Apply Cancel

Physics

- Edit the 8 following face regions to describe the other parts of the device, as following:
[CTRL+Click on all face to edit][Righth click on one of the selected faces] [Edit Array]



Physics

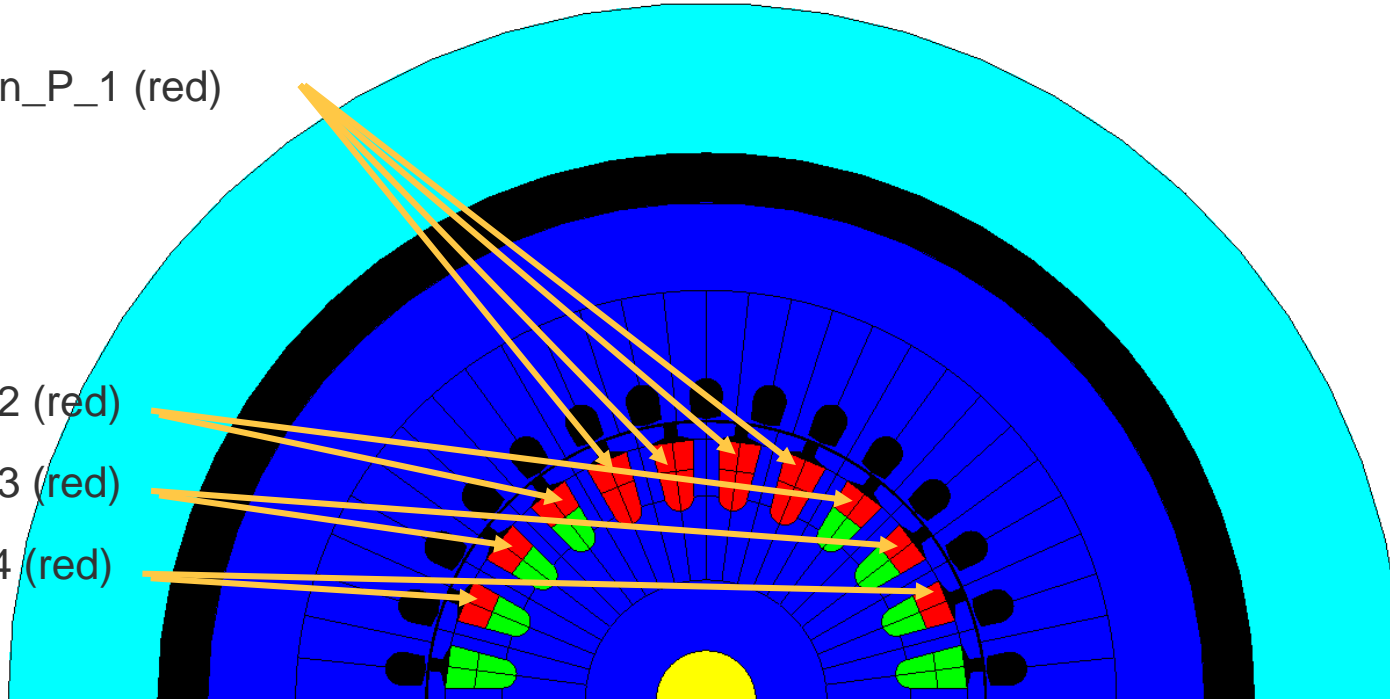
- Assign face region to face of the main phase [CTRL + click on all faces with the same face region to assign] [Right click on one of the selected region] [Edit] [Set the region in the corresponding tab]

Main_P_1 (red)

Main_P_2 (red)

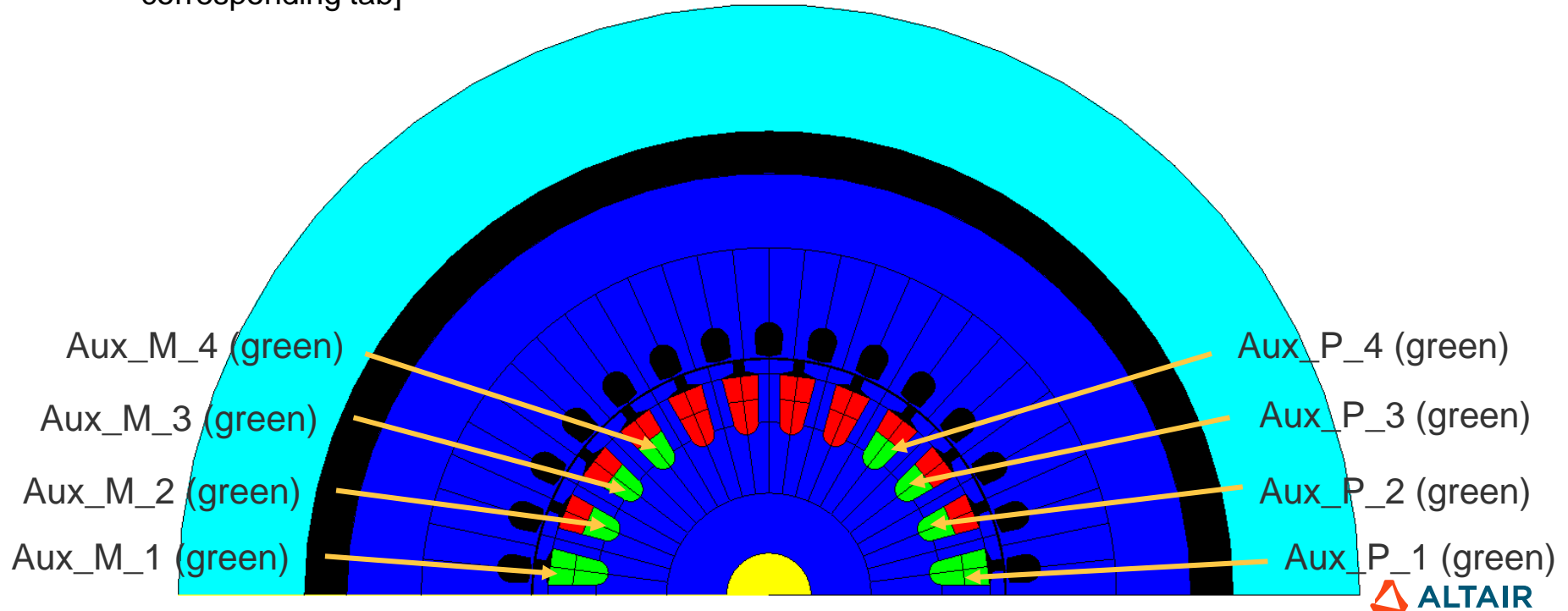
Main_P_3 (red)

Main_P_4 (red)



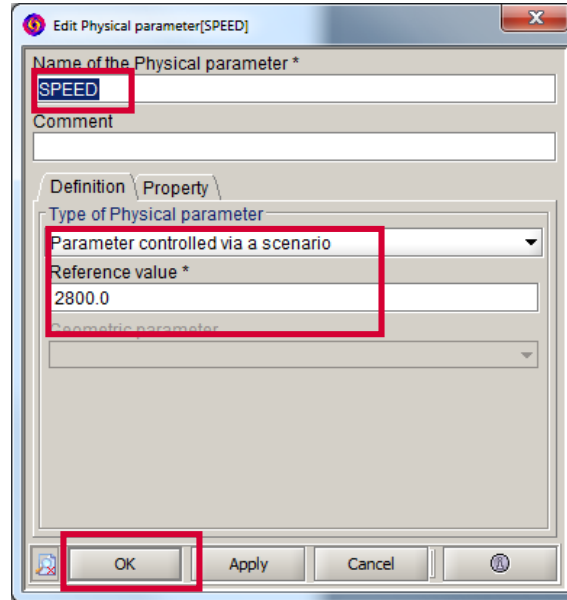
Physics

- Assign face region to face of the auxiliary phase [CTRL + click on all faces with the same face region to assign] [Right click on one of the selected region] [Edit] [Set the region in the corresponding tab]



Physics

- Create a new I/O parameter for speed [Parameter/Quantity] [I/O Parameter] [New]



- Check Physic [Physics] [Check Physic]
- Save project as “Phys.FLU” [Project] [Save as]

Solving scenario

- Create a solving scenario [Solving] [Solving Scenario][New]

New Solving Scenario

Name of the solving scenario * Comment

☐ Distributed computing

Control of transient state | Control of parameters | Result storage

Control type of transient solving process

☐ Control by time

☒ Control by position of mechanical set

Parameter control | List of resulting values

Interval definition

Lower limit

Higher limit

Variation method

Step value

>>

Intervals table

Lower limit	Higher limit	Method	Values
0.0	1800.0	Step value	3.0

Solving scenario

Edit Solving Scenario[ALL]

Name of the solving scenario * Comment

State of the scenario: ✖ Scenario unprocessed ☐ Distributed computing

Control of transient state | Control of parameters | Result storage

Controllable parameters

Geometric | **Physic**

Parameter name	Reference value
SPEED	2800.0

>>

<<

Controlled parameters

Parameter name	Synthesis
SPEED	Multi-values : [500.0,2900.0]

Parameter control : SPEED (Reference value : 2800.0)

Control type

Parameter control | List of resulting values

Interval definition

Lower limit

Higher limit

Variation method

Step value

>>

Intervals table

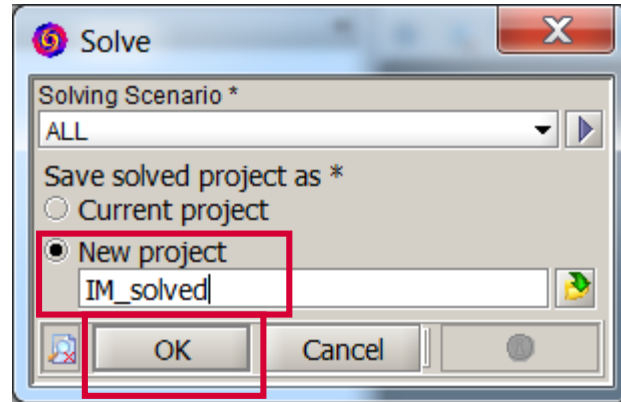
Lower limit	Higher limit	Method	Values
500.0	2500.0	Step value	500.0
2500.0	2900.0	Step value	200.0

Clear last interval

OK Apply Cancel

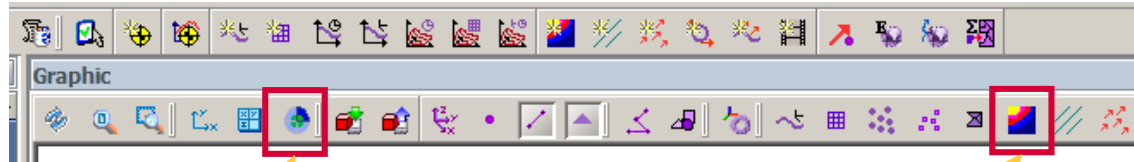
Solving scenario

- Create a solving scenario [Solving] [Solve]



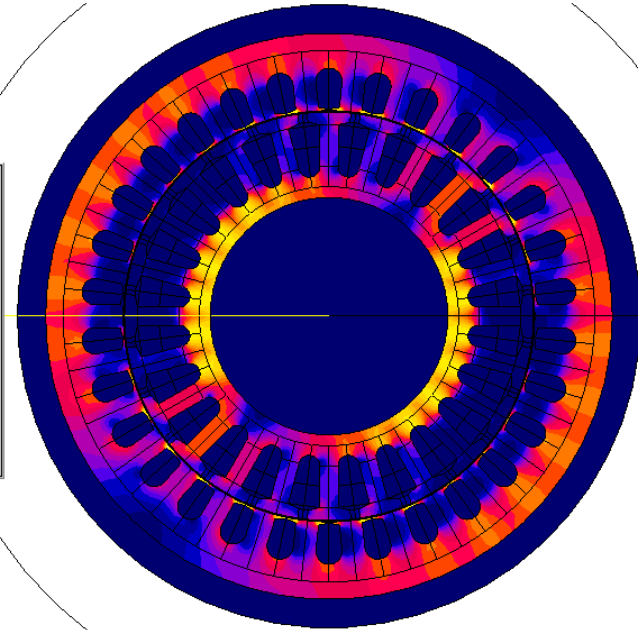
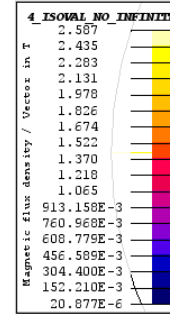
Post-Processing

- Display a color shape for the magnetic Flux density



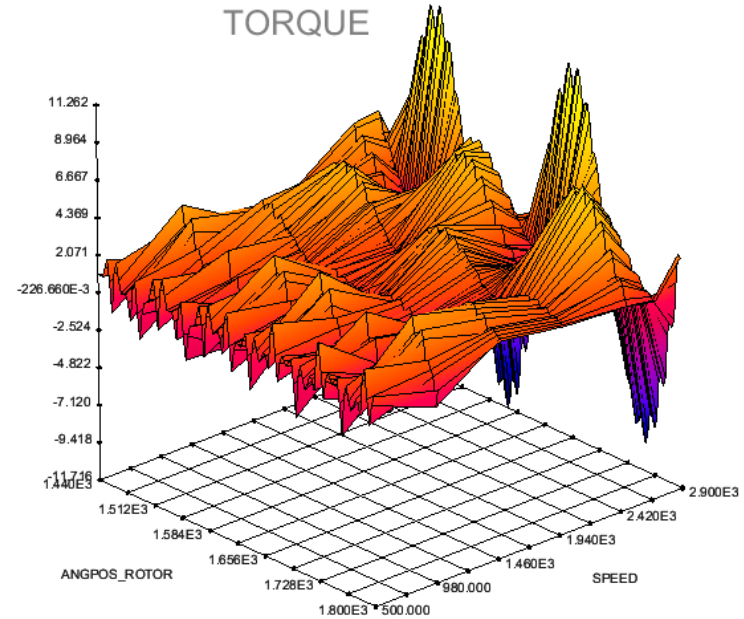
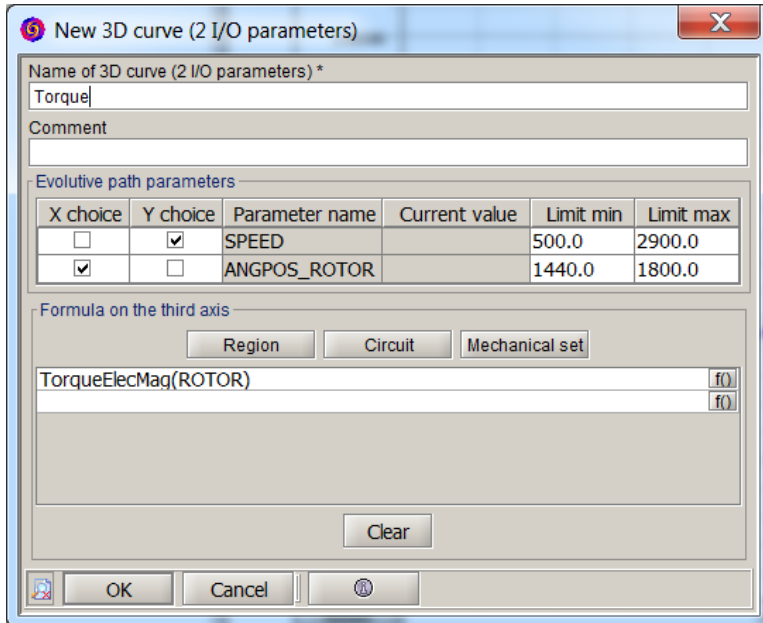
Display all the device

Display magnetic flux density colorshade



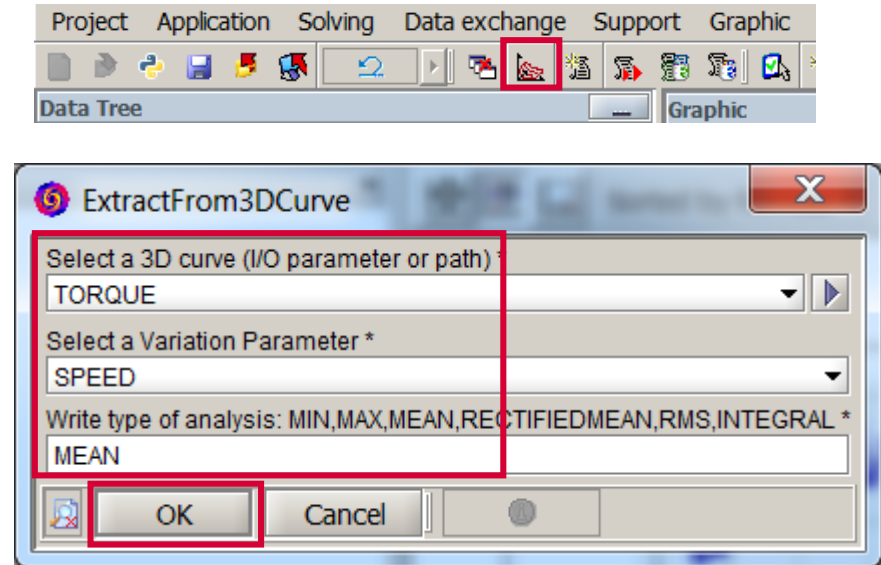
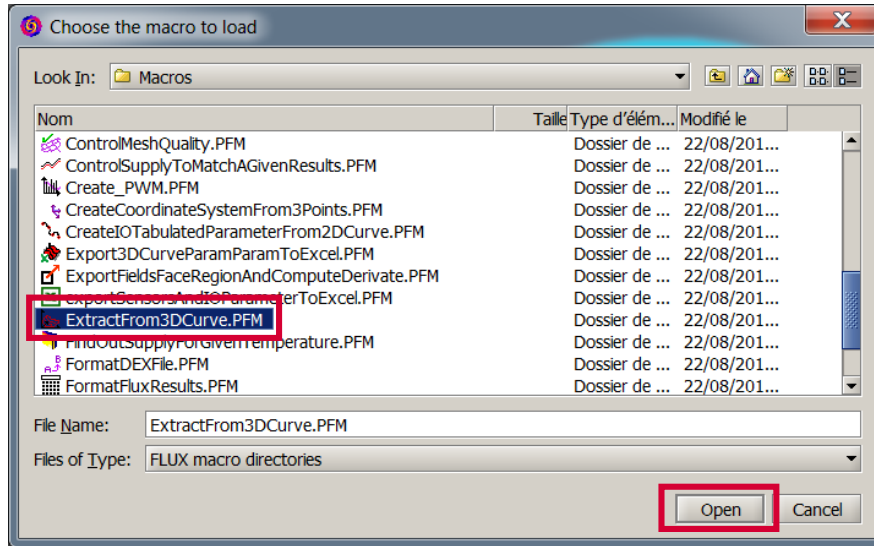
Post-Processing

- Create a 3D curve to display the torque versus angular position and speed [Curve] [3D curve (2 I/O parameters)] [New 3D curve (2 I/O parameters)]
- Choose to display the electromagnetic torque



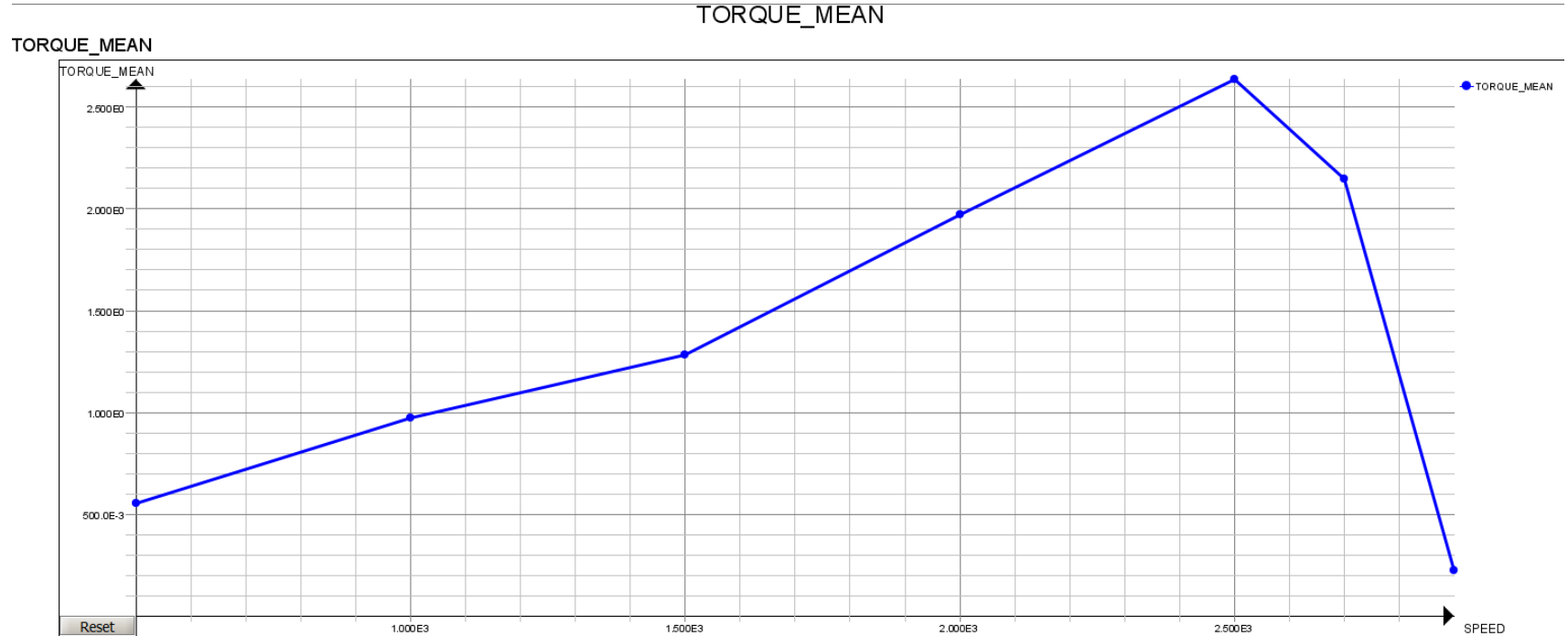
Post-Processing

- Create a 2D curve to display the mean value of the torque for each speed.
 - Load the macro “Extractfrom3Dcurve” [Project][Macro][Load]
 - Run the macro



Post-Processing

- Results of the macro





THANK YOU

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#ONLYFORWARD