



FLUXMOTOR PART FACTORY TUTORIAL N°1

CREATE NON-PARAMETERIZED PARTS

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Introduction

Via this tutorial, users will learn

- the procedure and the macros required to create non-parameterized parts (with constant dimensions)
- the constraints to consider while using these parts for the tests in FluxMotor

You will be provided as training materials

- a CAD file of an inner motor part, and
- a Flux 2D project of an SMPM to extract its outer slot part

At the end of the tutorial, you are expected to build a FluxMotor project to perform tests with the newly created non-parameterized parts.

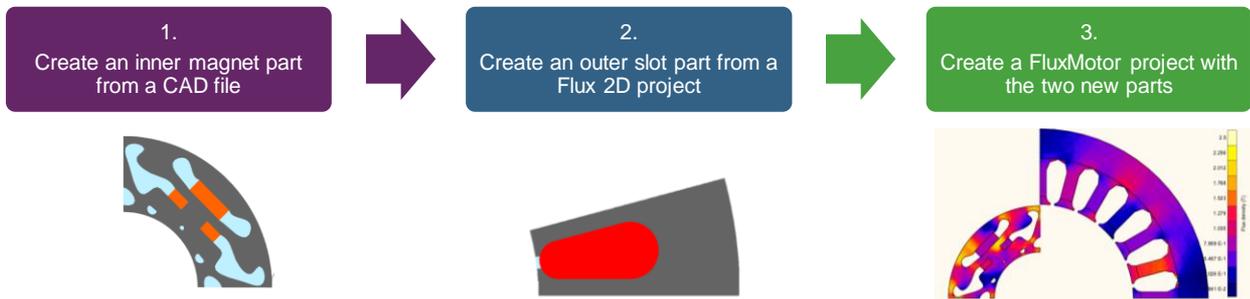
Related support documents:

- *Technical notes on the utilized macros: ...flux\Extensions\Macros\Macros_FluxMotor*
- *Tutorial for a parameterized part*
- *Tutorial for starting with a Flux model issued from the Shape Optimization: Flux 2D Supervisor Examples >> Shape Optimization of a SRM Application Note*

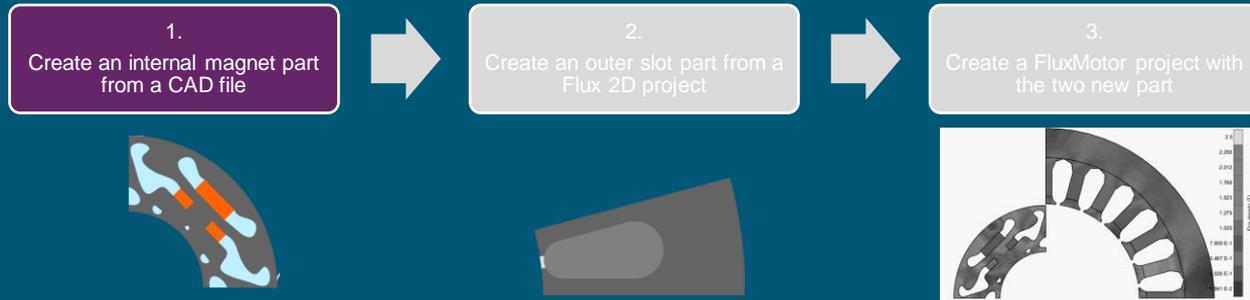
Workflow

The tutorial will be divided into three steps:

1. Create an inner magnet part from a CAD file
 - Learn all the steps to create a new part, whether the starting point is a CAD file or a Flux2D project.
 - Examine the ability of FluxMotor to process non-regular parts.
2. Create an outer slot part from a given Flux 2D project
 - Apply the procedure learned in the step 1 to another type of part with some specific properties.
3. Customize your motor with newly created part in FluxMotor
 - Learn structural constraints of non-parameterized parts and perform tests in FluxMotor



CREATE AN INNER MAGNET PART FROM A CAD FILE

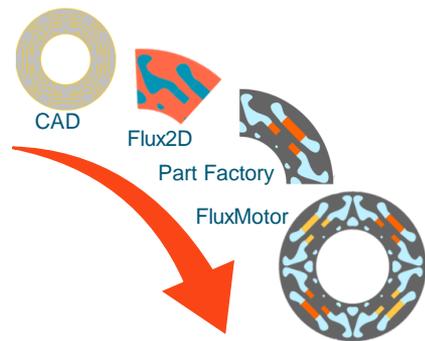


General procedure to create a new part in FluxMotor

By using macros provided in Flux 2D, you can create a non-parameterized part in FluxMotor considering 2 options

- a CAD file
- a Flux model, that can be
 - a standard model, or
 - a model issued from the shape optimization

Below is the general procedure to follow:

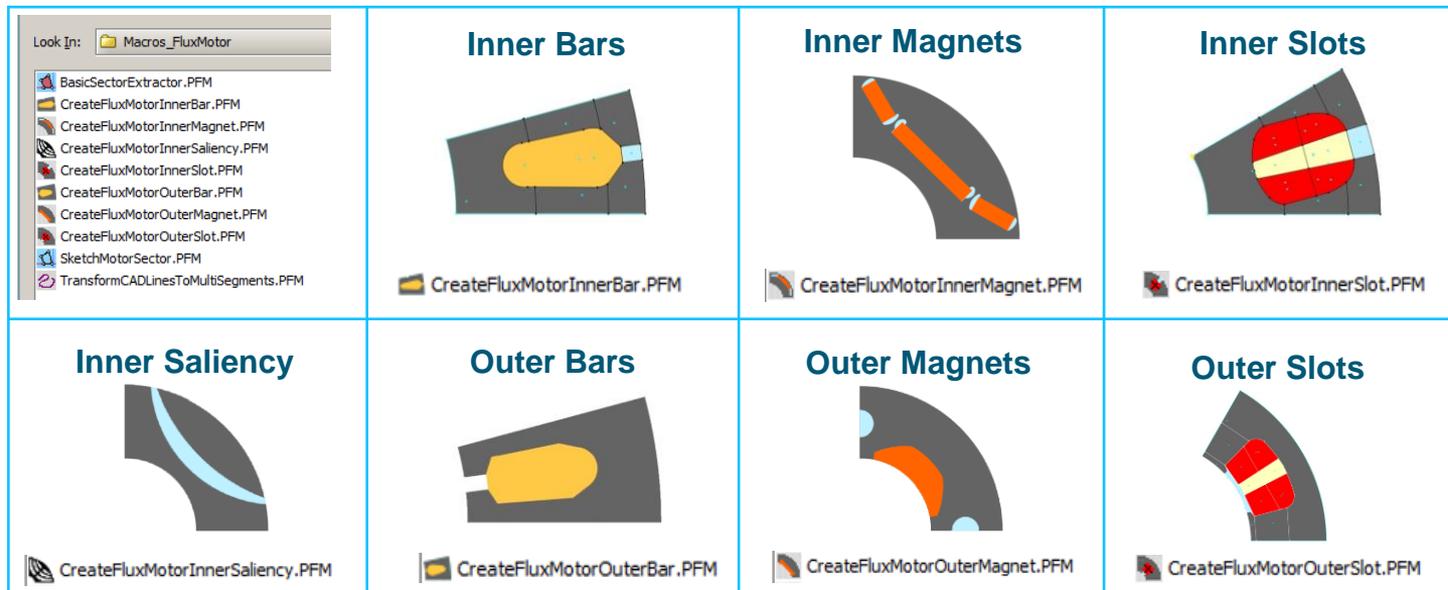


Important notes

- If the starting point is a Flux model, you can neglect the first step.
- A part is a sector of the stator or rotor of a machine, and only one part can be created at a time.
- For any types of parts, you can change the macro used in the step 3, the other steps remain applicable.

Type of Parts in FluxMotor

- As of today, there are 7 types of part in FluxMotor.
- Each type comes with a macro in Flux2D allowing the export of the part from Flux2D to FluxMotor.



Consult the technical notes of macros found in *Macros_FluxMotor* directory of Flux 2D for more details



Create a New Flux 2D Project

- A new Flux 2D project is created to import the CAD of a SMPM inner rotor with non-standard geometry.
- The procedure remains the same for any type of part.

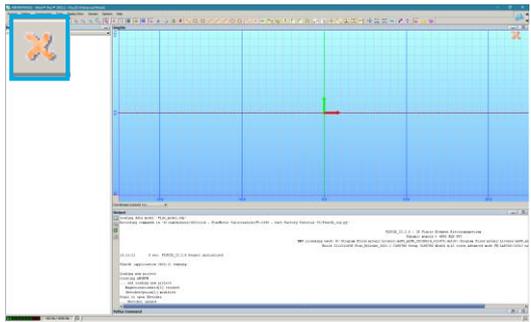
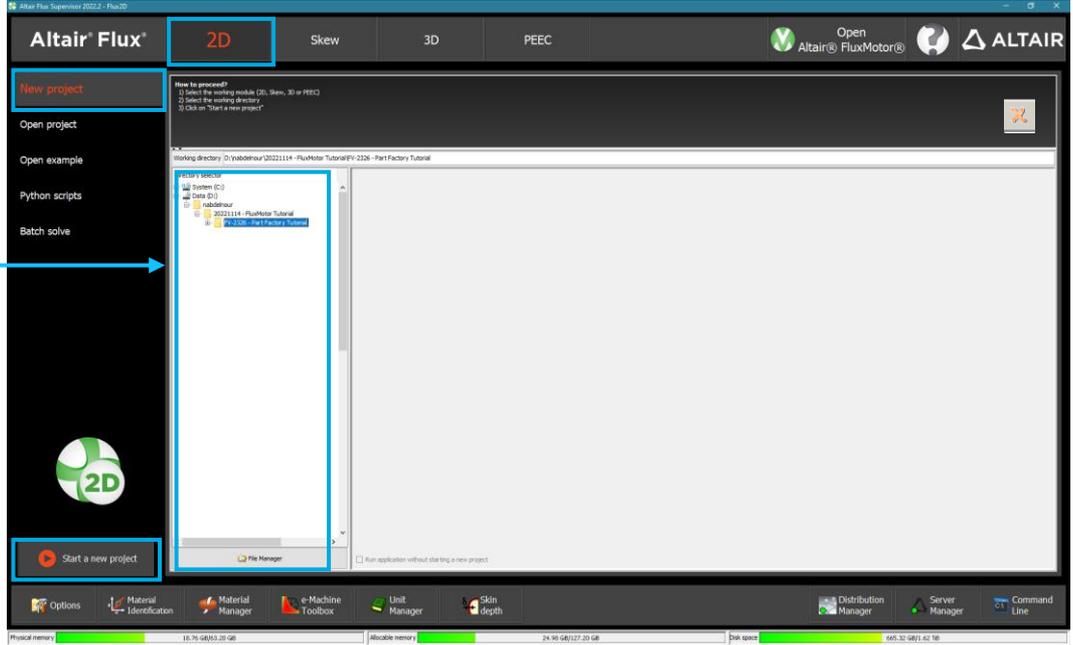
1

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Step	Action
1	Choose Flux 2D Application and New Project
2	Define your workspace in the Directory Tree
3	Start a new project
4	A Flux Project is opened. Leave the Sketcher context with the button

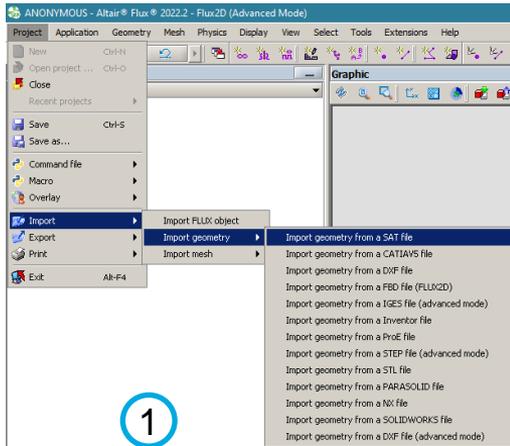




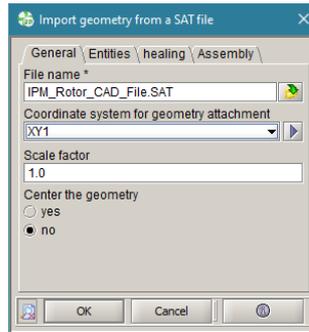
Import the CAD File to Flux 2D

You can find in the below image the supported CAS file types (SAT, CATIAVS, DXF, ...)

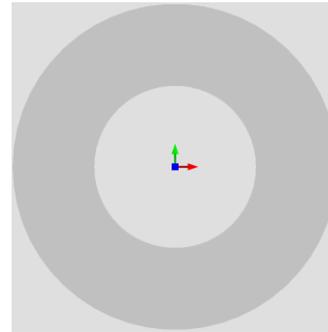
Step	Action
1	Project > Import > Import geometry > Import geometry from a SAT file
2	Choose the SAT file and fill in the text box of the import No modification needed on the other tabs
3	The geometry is imported in your model context
4	Modify face region colors



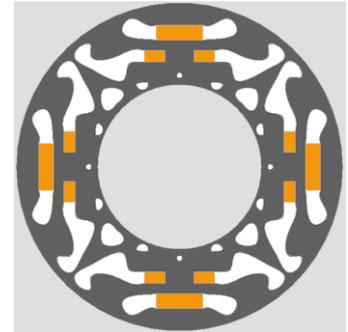
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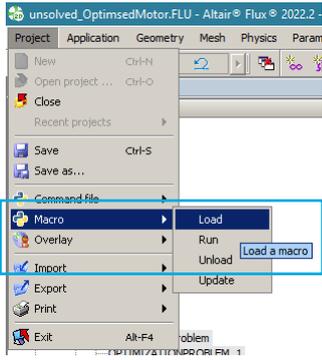


Isolate a Motor Part

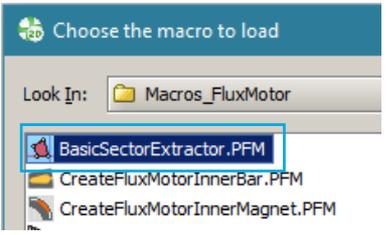
Load BasicSectorExtractor Macro

The *BasicSectorExtractor* Macro isolates the part you want to export to FluxMotor.

Step	Action
1	Go to [Project] -> [Macro] -> [Load]
2	Choose the BasicSectorExtractor macro in the Macros_FluxMotor directory
3	Macro appears in your command section



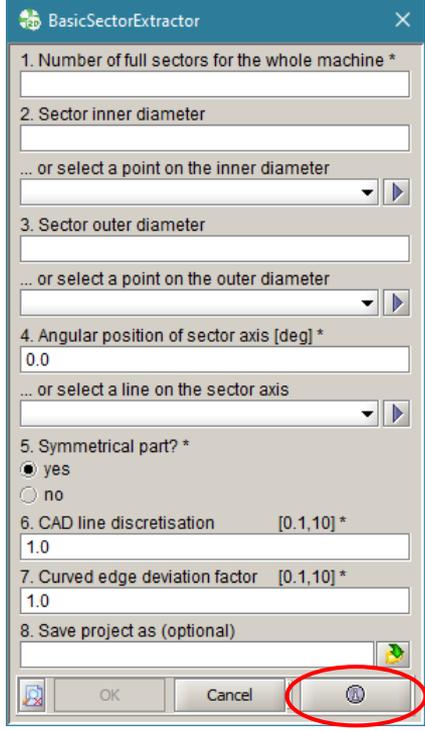
1



2



3



Open macro documentation





Isolate a Motor Part

Run BasicSectorExtractor Macro to Isolate a Part

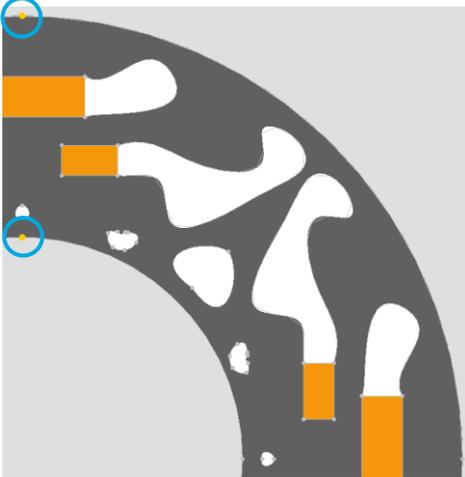
1.

2.

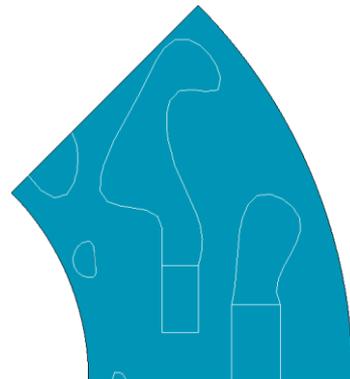
3.

4.

Step	Action
1	Run the Macro
2	Fill in the geometric parameters. In 2. and 3., you can either fill a diameter or give a point to compute it
3	Fill in the curve lines discretisation precision options. (Details in the next slide)
4	Give a name to the Flux project



Result of the macro is found in a new project called Fxm_Rotor_Part.FLU

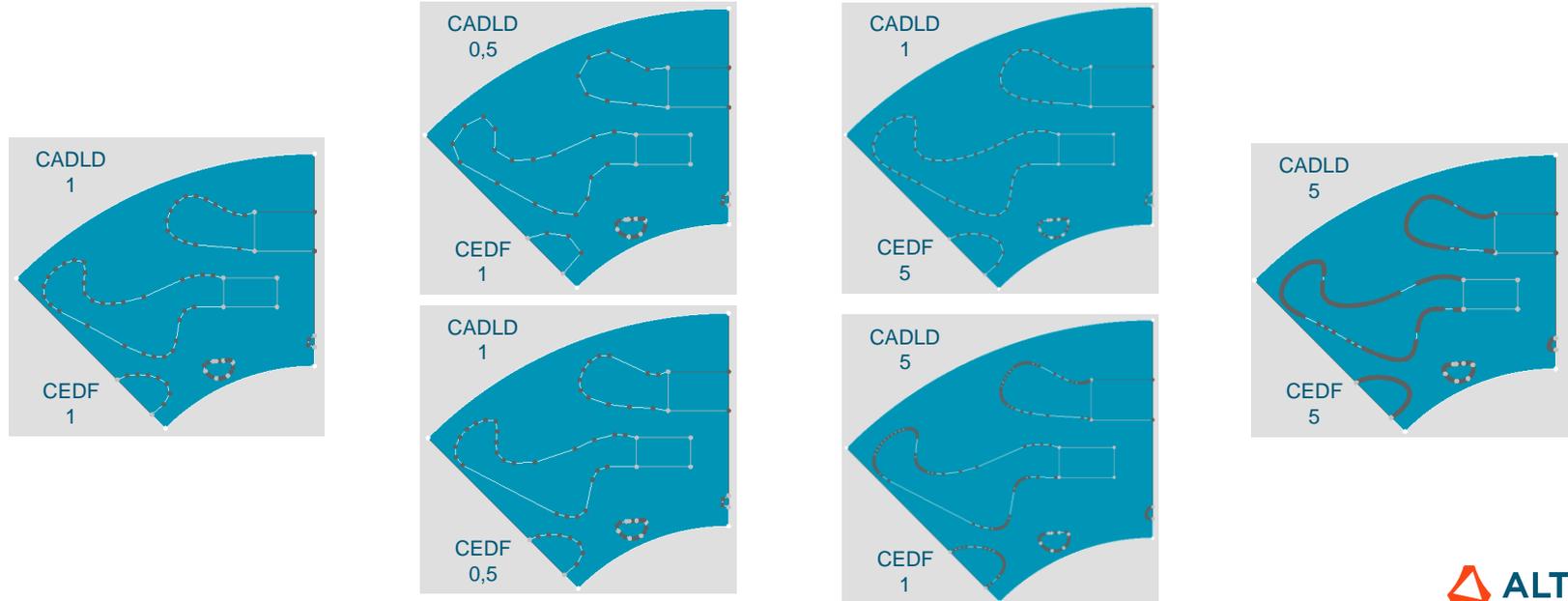




Isolate a Motor Part

Line discretization options to make spline curves compatible with FluxMotor

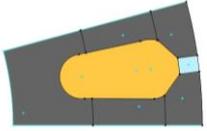
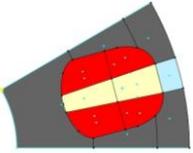
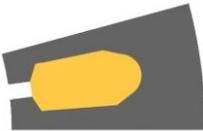
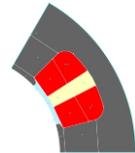
- CAD line discretization (CADLD) defines discretization level along the curve being considered.
- Curve edge deviation factor (CEDF) allows to smooth the curve.





Create the FluxMotor Rotor Part

- You should choose the correct macro to create the Excel file containing your part dimensions.
- The Excel file can be read by FluxMotor in the Part Library to import the part.
- You can find technical notes of macros in *Macros_FluxMotor* directory of Flux 2D.

<p>Look In: Macros_FluxMotor</p> <ul style="list-style-type: none">BasicSectorExtractor.PFMCreateFluxMotorInnerBar.PFMCreateFluxMotorInnerMagnet.PFMCreateFluxMotorInnerSaliency.PFMCreateFluxMotorInnerSlot.PFMCreateFluxMotorOuterBar.PFMCreateFluxMotorOuterMagnet.PFMCreateFluxMotorOuterSlot.PFMSketchMotorSector.PFMTransformCADLinesToMultiSegments.PFM	<h3>Inner Bars</h3>  <p>CreateFluxMotorInnerBar.PFM</p>	<h3>Inner Magnets</h3>  <p>CreateFluxMotorInnerMagnet.PFM</p>	<h3>Inner Slots</h3>  <p>CreateFluxMotorInnerSlot.PFM</p>
<h3>Inner Saliency</h3>  <p>CreateFluxMotorInnerSaliency.PFM</p>	<h3>Outer Bars</h3>  <p>CreateFluxMotorOuterBar.PFM</p>	<h3>Outer Magnets</h3>  <p>CreateFluxMotorOuterMagnet.PFM</p>	<h3>Outer Slots</h3>  <p>CreateFluxMotorOuterSlot.PFM</p>

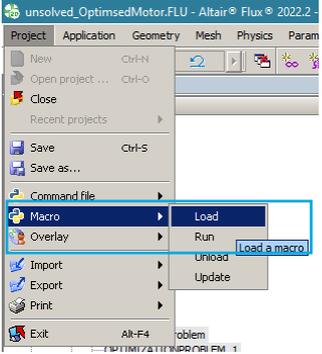


Create the FluxMotor Rotor Part

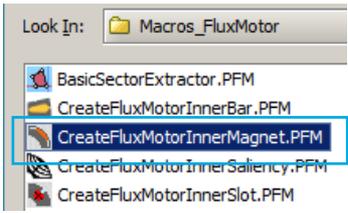
Load CreateFluxMotorInnerMagnet Macro

The *CreateFluxMotorInnerMagnet Macro* is used for this SMPM internal rotor part

Step	Action
1	Go to [Project] -> [Macro] -> [Load]
2	Choose the CreateFluxMotorInnerMagnet macro in the Macros_FluxMotor directory
3	Macro appears in your command section



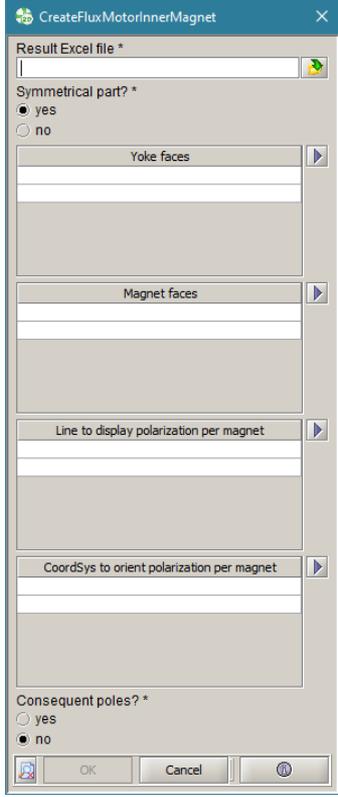
1



2



3



Run CreateFluxMotorInnerSaliency Macro to Create the FluxMotor Part

Step	Action
1	Run the Macro
2	Fill the part file name
3	Choose the rotor iron parts face
4	Chose the magnet faces
5	Chose the line where the magnetization arrows start from
6	Chose the coordinate system which magnet magnetization lines are along its x axis
7	A parametrized FluxMotor Excel file is created in your Working Directory

The screenshot shows the 'CreateFluxMotorInnerMagnet' dialog box with the following fields and callouts:

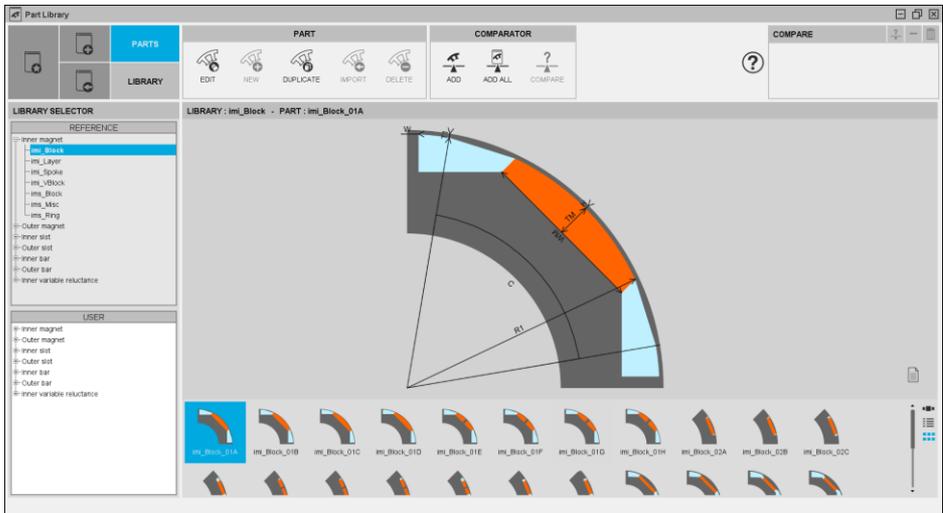
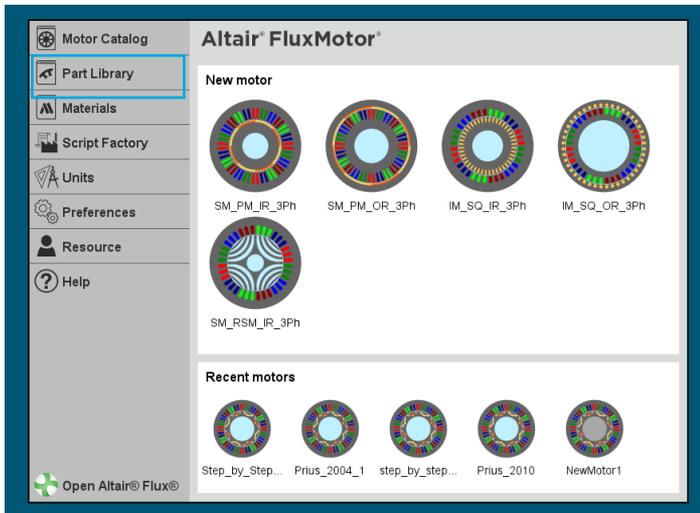
- 1:** Points to the software toolbar.
- 2:** Points to the 'Result Excel file *' field containing 'Fxm_Rotor_Part'.
- 3:** Points to the 'Yoke faces' list containing '1'.
- 4:** Points to the 'Magnet faces' list containing '3' and '8'. A text box says 'Press Ctrl to select multiple faces'.
- 5:** Points to the 'Line to display polarization per magnet' list containing '16' and '78'.
- 6:** Points to the 'CoordSys to orient polarization per magnet' list containing 'XY1' and 'XY1'.
- 7:** Points to a file icon labeled 'Fxm_Rotor_Part.xls'.

At the bottom of the dialog, the 'Consequent poles?' section has 'no' selected. The 'OK' button is circled in red, with a red arrow pointing to the text 'Open macro documentation'.



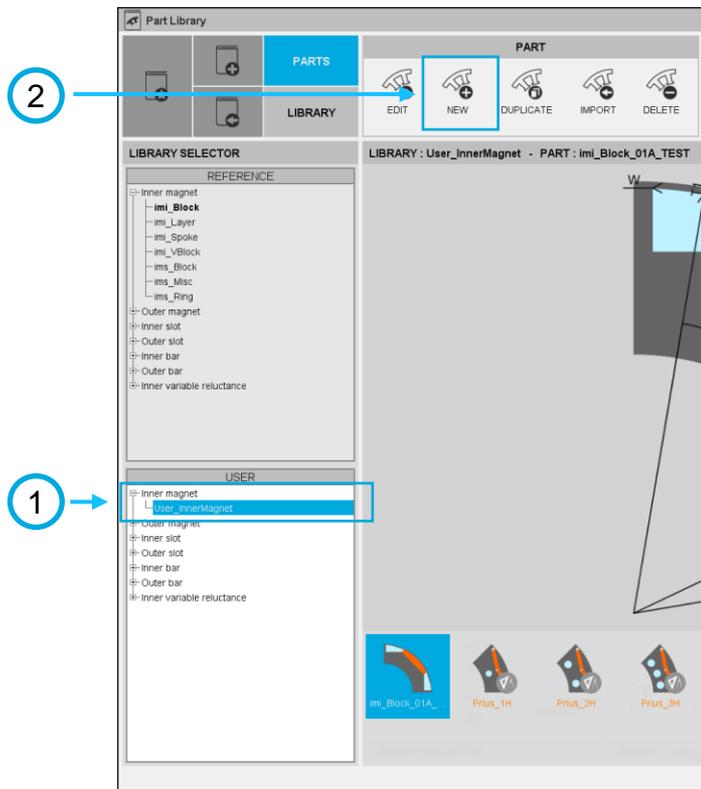
Open Part Library in FluxMotor

You can enter Part Library environment where the Excel File can be imported to use your model in FluxMotor.

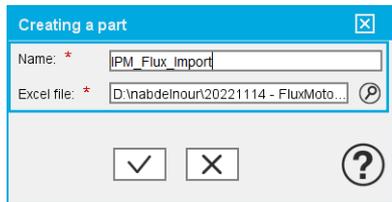


1. Import CAD in Flux2D
2. Extract the basic sector
3. Create the Excel file of the part
4. Create the part in Part Library

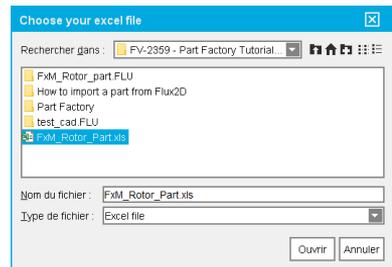
Part Import in FluxMotor



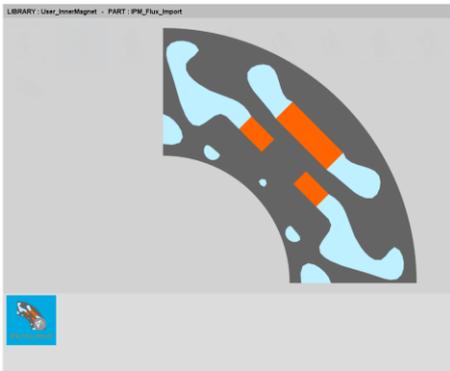
3



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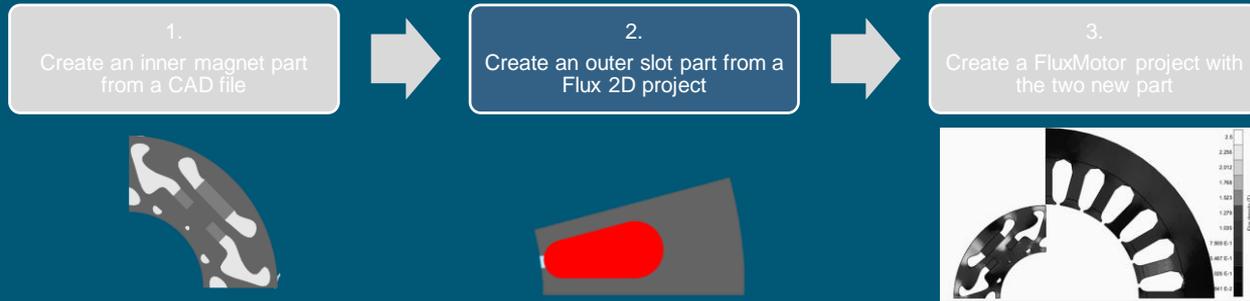


Step	Action
1	Place yourself in the Inner Magnet User Part Catalogue
2	Click on New to import your part
3	Name the Part and browse to choose the Excel part file
4	Import the part



This part is not parametrized but can be used in FluxMotor for tests

CREATE AN OUTER SLOT PART FROM A FLUX 2D PROJECT

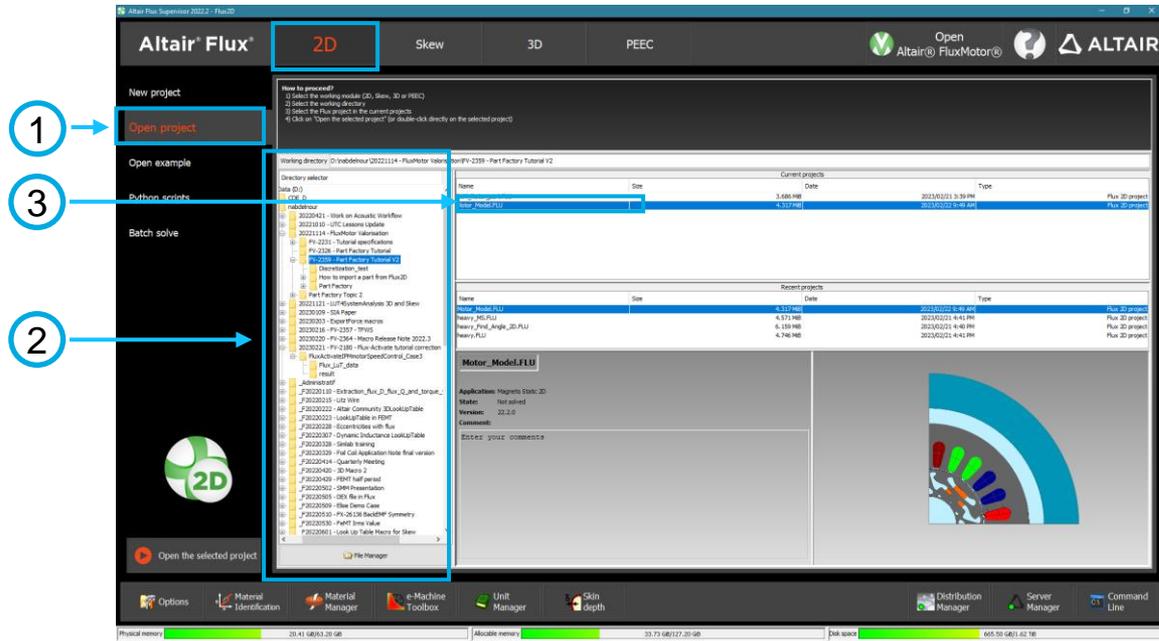




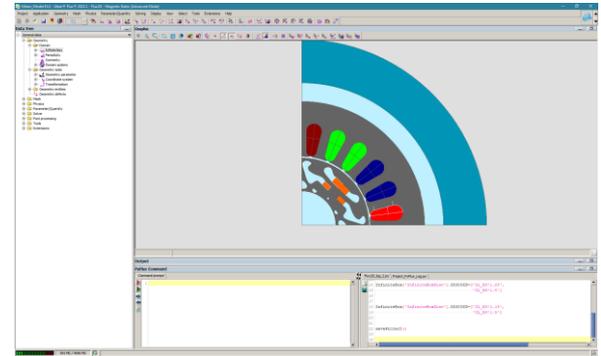
Open a Ready Flux 2D Project

In this case you have already your Flux project, just open it!

The project “Motor_Model.FLU” is given with the tutorial but this workflow can be run on another Flux Model.



Step	Action
1	Choose Flux 2D Application and Open Project
2	Find the project in your Directory Tree
3	Double click on the project to open it





Isolate a Motor Part

Run BasicSectorExtractor Macro to Isolate a Part

Macro will be run to isolate a slot

Step	Action
1	Load the macro (slide 9) and run it
2	Fill in the geometric parameters. In 2. and 3., you can either fill a diameter or give a point to compute it
3	Fill in the curve lines discretisation precision options. (Details on slide 9)
4	Give a name to the Flux project

1. Number of full sectors for the whole machine *
24

2. Sector inner diameter
... or select a point on the inner diameter
193

3. Sector outer diameter
... or select a point on the outer diameter
101

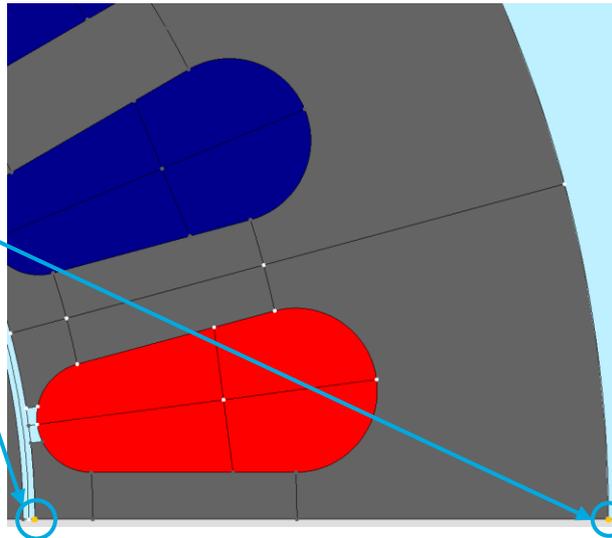
4. Angular position of sector axis [deg] *
7.5
... or select a line on the sector axis

5. Symmetrical part? *
 yes
 no

6. CAD line discretisation [0.1,10] *
5

7. Curved edge deviation factor [0.1,10] *
5

8. Save project as (optional)
FxM_Stator_Part



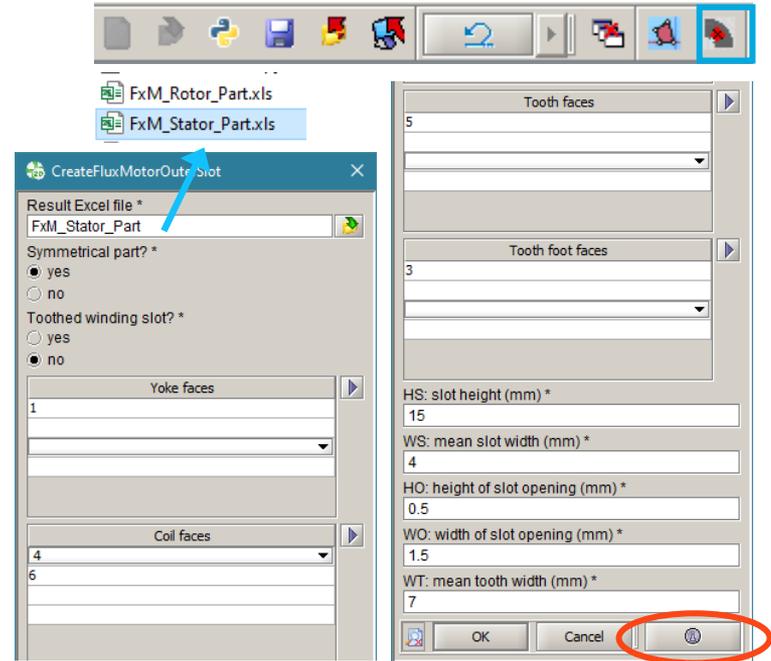
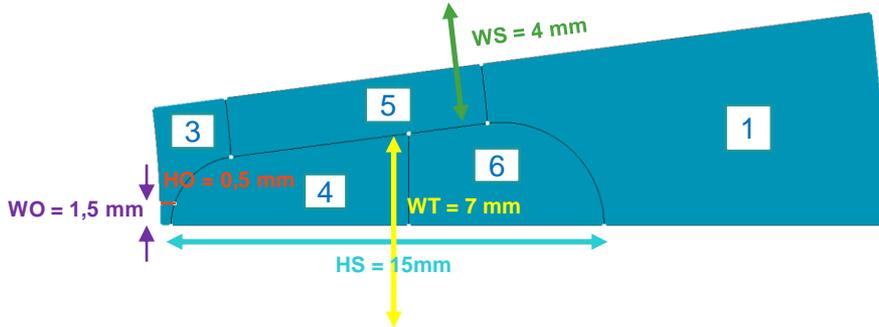
Result of the macro : (in a new project called FxM_Stator_Part.FLU)





Run CreateFluxMotorOuterSlot Macro to Create the FluxMotor Part

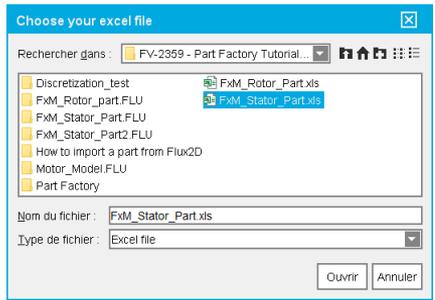
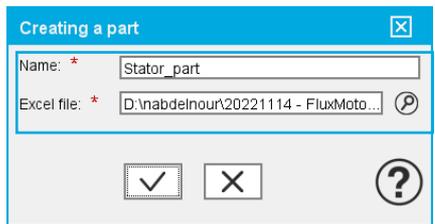
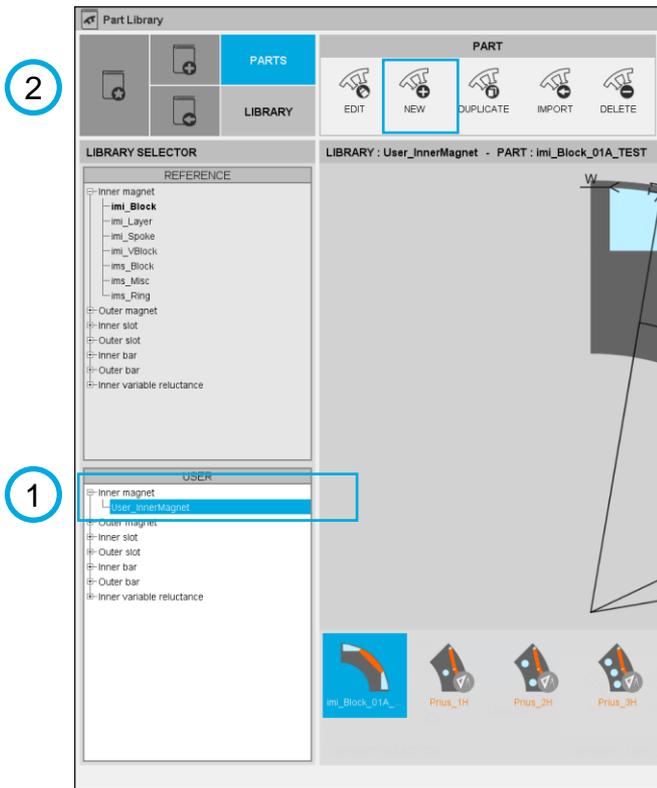
- In the case where there is not a correct distinction of the 4 face types (yoke, coil, tooth and tooth foot), an additional adjustment of the geometry is required.
- The dimensional parameter values, as required in the macro, are used for the iron loss computation in FluxMotor.
- See the macro technical note for more detail.



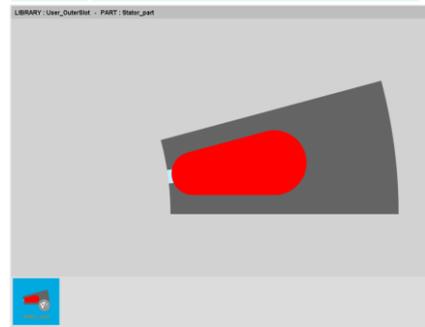
Open macro documentation



Stator Part Import in FluxMotor

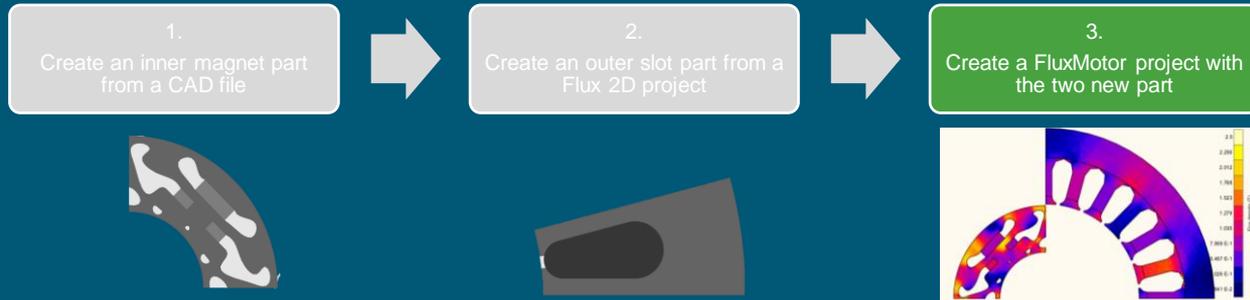


Step	Action
1	Place yourself in the outer slot User Part Catalogue
2	Click on New to import your part
3	Name the Part and browse to choose the Excel part file
4	Import the part



This part is not parametrized but can be used in FluxMotor

CREATE A FLUXMOTOR PROJECT WITH THE TWO NEW PARTS





Import Part in Motor Factory

The created parts are not parametrized. Stator and rotor dimension must first be set according to the part ones.

Step	Action
1	Enter topology menu where motor dimension are set up
2	Choose the stator inner diameter as the resulting dimension
3	Fill up motor dimensions
4	Validate motor dimension to obtain the model of the picture

The screenshot shows the Motor Factory software interface. The 'TOPOLOGY' menu is selected in the 'MACHINE' section. The 'STATOR' inner diameter is selected as the dimension input mode. The parameter table is as follows:

STATOR	
Outer diameter (mm)	110.0
Inner diameter (mm)	61.0
Length (mm)	80.0
No. slots	24
AIRGAP	
Length (mm)	5.0 E-1
ROTOR	
Outer diameter (mm)	60.0
Inner diameter (mm)	30.0
Length (mm)	80.0
No. poles	4

Numbered callouts in the image indicate: 1. The TOPOLOGY menu icon; 2. The selected dimension input mode (inner diameter); 3. The parameter table; 4. The validation checkmark button.



Change slot topology

Choose newly created slot topology

Step	Action
1	Enter slot menu where slot topology is chosen
2	Change slot Shape
3	Enter User_OuterSlot catalog
4	Choose Stator_Part
5	Validate slot choice

SLOT : os_Free_01B

Design Skew

Lamination

Slot shape

INPUTS	
HS (mm)	17.582
WS2 (mm)	5.952
H1 (mm)	1.488
WS1 (mm)	4.251
HO (mm)	1.675
WO (mm)	8.503 E-1
R (mm)	8.503 E-1

✓ ↺

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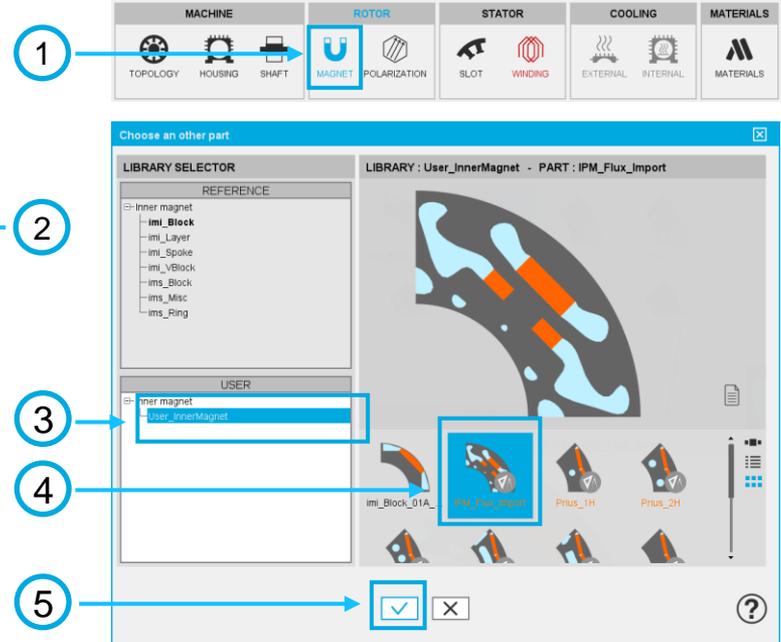
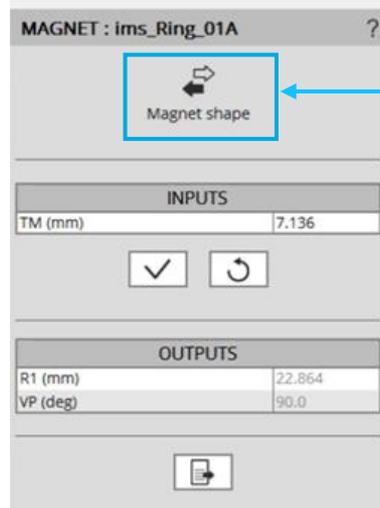
5



Change magnet topology

Choose newly created magnet topology

Step	Action
1	Enter magnet menu where magnet topology is chosen
2	Change Magnet Shape
3	Enter User_InnerMagnet catalog
4	Choose IPM_Flux_Import part
5	Validate magnet choice

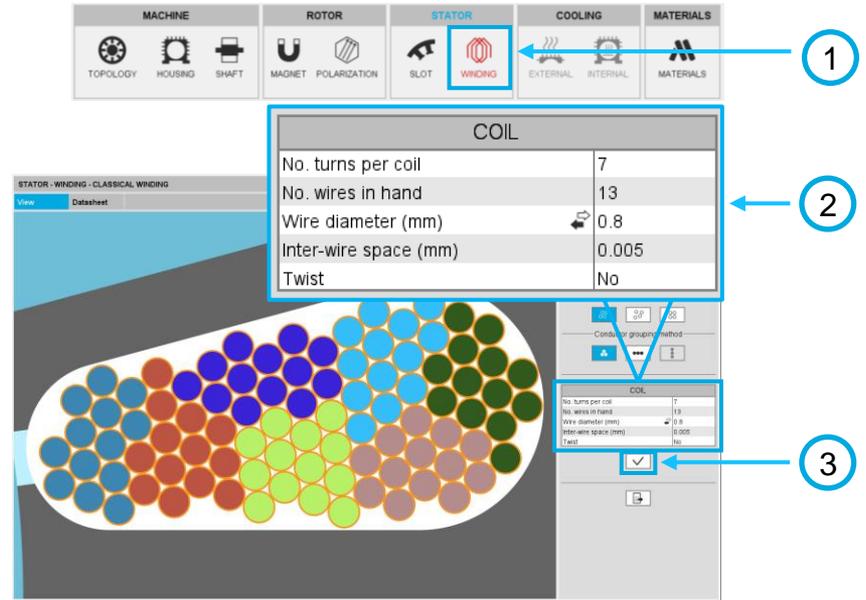
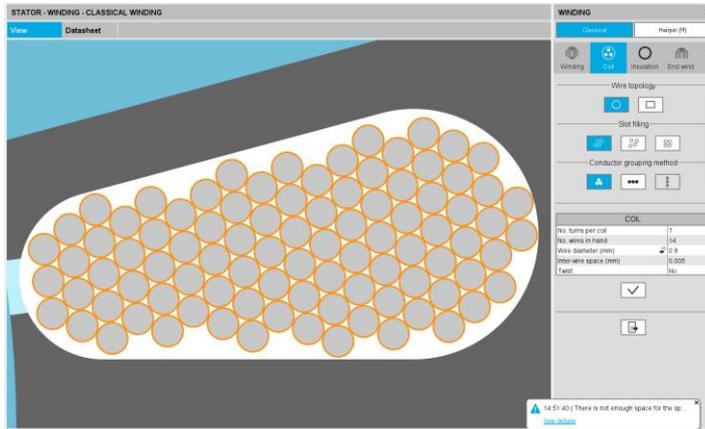




Red alert!

- Winding menu is red if there is not enough space for the specified number of wires in the coils.
- This can be modified in the Winding > Coil menu.

Step	Action
1	Enter winding menu
2	Change coil parameters
3	Validate changes

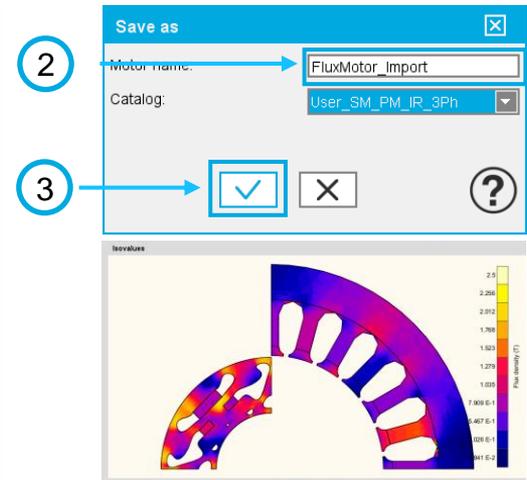
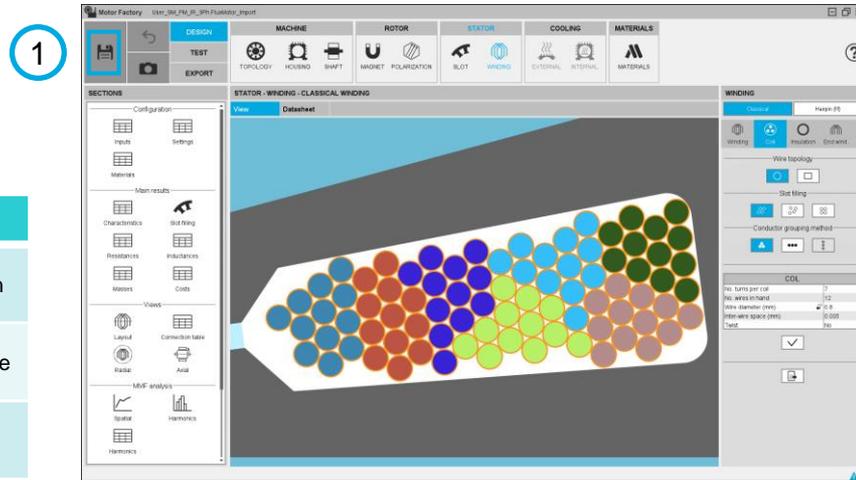




Save Motor Model

- Project is now ready.
- Characterisation and performance test can be run on it.
- But first, the model should be saved in a motor catalog.

Step	Action
1	Click on save button
2	Change Motor Name
3	Confirm saving

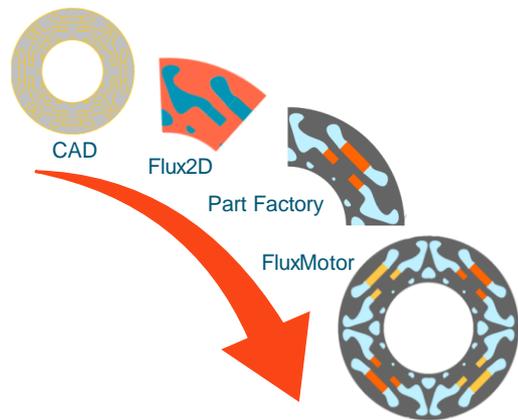


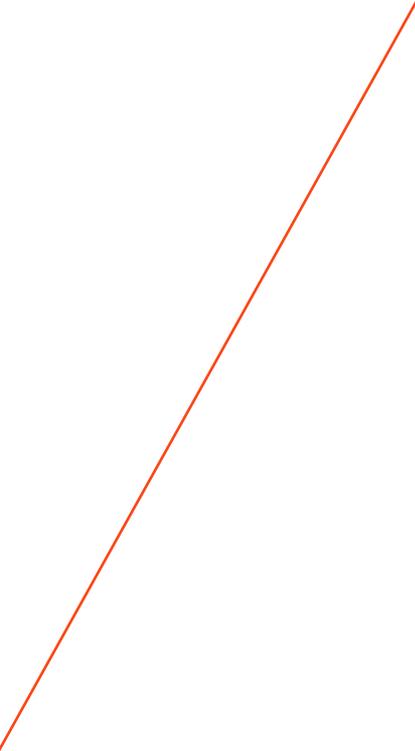
Conclusion

Via macros built in Flux 2D, user can create a non-parameterized part in FluxMotor considering 2 options:

- a CAD file
- a Flux model, that can be:
 - a standard model, or
 - a model issued from the shape optimization

These parts aren't parametrized, so their dimensions must be defined previously in Flux or in your sketcher/modeler, otherwise the structural parameters of the motor in FluxMotor must match the parts' dimension.





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