Altair® FluxMotor® 2022.3

Release Notes

Updated: 04/07/2023

Contents

Introduction 1

This document gives the major information about Altair® FluxMotor® 2022.3. All the added new features are briefly described below followed by an update about issues and bugs. For more detailed information, please refer to the user help guides. The list of documents to read is presented below.

This chapter covers the following:

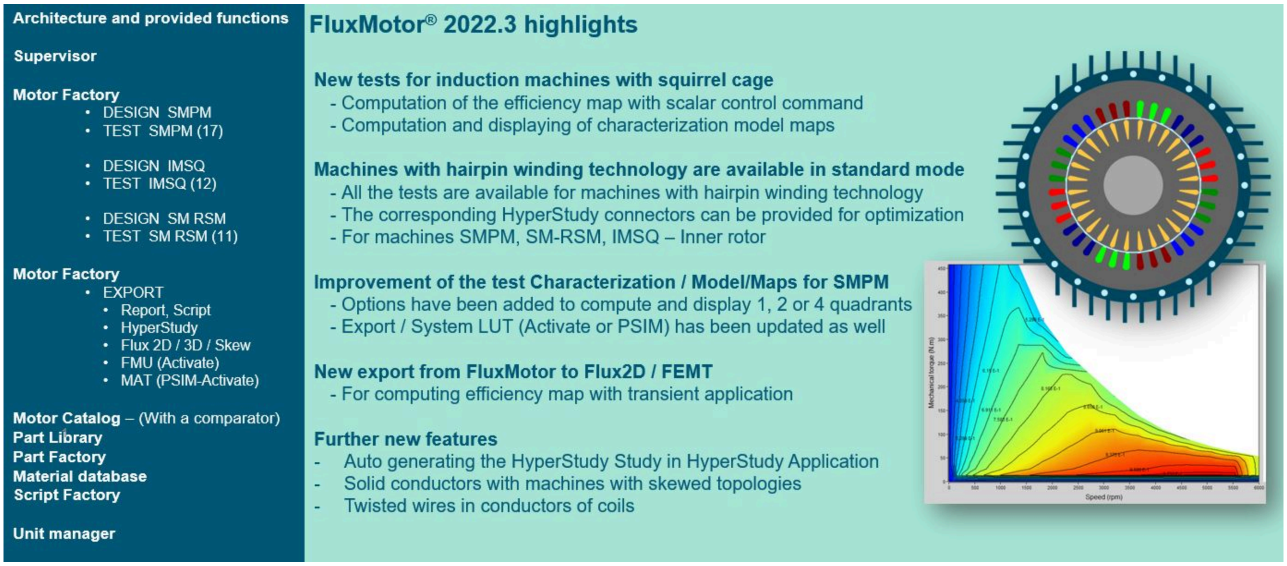
1.1 Overview

Here are the highlights of the new version:

1. New tests for induction machines with squirrel cage
    - Computation and displaying of characterization model maps
    - Computation of the efficiency map with scalar control command
2. Machines with hairpin winding technology are available in standard mode
    - Synchronous machine with permanent magnets
    - Reluctance synchronous machine
    - Induction machine with squirrel cage
3. All the tests are available for machines with hairpin winding technology

    > **Note:** The corresponding HyperStudy connectors can be provided for optimization

4. Improvement of the test Characterization / Model/Maps for SMPM
    - Options have been added to compute and display 1, 2 or 4 quadrants
    - Export / System LUT (Activate or PSIM) has been updated for exporting data based on 1, 2 or 4 quadrants
5. New export from FluxMotor to Flux2D / FEMT for computing efficiency map with transient application
6. Further new functions
    - Auto generating the HyperStudy Study in HyperStudy Application
    - Solid conductors can be used for machines with skewed topologies (Rotor or Stator), for computation with FluxMotor or while exporting project to Flux Skew.
    - The model periodicity (in the back end of Motor Factory) can be considered when the coils, represented with solid conductors are twisted.



FluxMotor 2022.3 – Highlights

1.2 Documents to read

> **Important:** It is highly recommended to read the user guides given below, before using FluxMotor®. Each user help document can be downloaded from the online user help

Below, here is the list of documents which are available.

1. General user guides for any type of machine:

- Installation_guide_en.pdf (Installation for both Altair® Flux® and Altair® FluxMotor®)
- Supervisor_2022.3.pdf
- MotorCatalog_2022.3.pdf
- PartLibrary_2022.3.pdf
- PartFactory_2022.3.pdf
- Materials_2022.3.pdf
- ScriptFactory_2022.3.pdf
- MotorFactory_2022.3_Introduction.pdf
- MotorFactory_2022.3_3Phase_Winding.pdf

2. User guides dedicated to Synchronous Machines with Permanent Magnets – Inner and Outer Rotor

- MotorFactory_2022.3_SMPM_IOR_3PH_Design.pdf
- MotorFactory_2022.3_SMPM_IOR_3PH_Test_Introduction
- MotorFactory_2022.3_SMPM_IOR_3PH_Test_Characterization.pdf
- MotorFactory_2022.3_SMPM_IOR_3PH_Test_WorkingPoint.pdf
- MotorFactory_2022.3_SMPM_IOR_3PH_Test_PerformanceMapping.pdf
- MotorFactory_2022.3_SMPM_IR_3PH_Test_Mechanics.pdf
- MotorFactory_2022.3_SMPM_IOR_3PH_Export.pdf

3. User guides dedicated to Reluctance Synchronous Machines – Inner Rotor

- MotorFactory_2022.3_SMRSM_IR_3PH_Design.pdf
- MotorFactory_2022.3_SMRSM_IR_3PH_Test_Introduction.pdf
- MotorFactory_2022.3_SMRSM_IR_3PH_Test_Characterization.pdf
- MotorFactory_2022.3_SMRSM_IR_3PH_Test_WorkingPoint.pdf
- MotorFactory_2022.3_SMRSM_IR_3PH_Test_PerformanceMapping.pdf
- MotorFactory_2022.3_SMRSM_IR_3PH_Test_Mechanics.pdf
- MotorFactory_2022.3_SMRSM_IR_3PH_Export.pdf

4. User guides dedicated to Induction Machines with Squirrel Cage – Inner and Outer Rotor

- MotorFactory_2022.3_IMSQ_IOR_3PH_Design.pdf
- MotorFactory_2022.3_IMSQ_IOR_3PH_Test_Introduction
- MotorFactory_2022.3_IMSQ_IOR_3PH_Test_Characterization.pdf
- MotorFactory_2022.3_IMSQ_IOR_3PH_Test_WorkingPoint.pdf
- MotorFactory_2022.3_IMSQ_IOR_3PH_Test_PerformanceMapping.pdf
- MotorFactory_2022.3_IMSQ_IR_3PH_Test_Mechanics.pdf
- MotorFactory_2022.3_IMSQ_IOR_3PH_Export.pdf

List of new features

2

This chapter covers the following:

2.1 New tests for induction machines with squirrel cage

2.1.1 Computation and displaying of characterization model maps

Overview

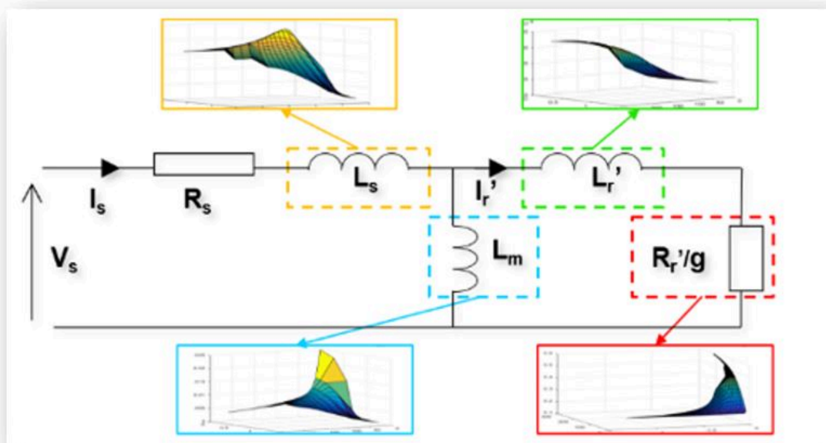
The aim of the test "Characterization – Model – Motor – Scalar" is to characterize the behavior of the machine in function of a set of Line-Line voltage (U) and a set of power supply frequency (f) (only the motor operating mode is available).

Characterization – Model – Motor – Scalar - Illustration

The computations are based on the identification and the solving of a non-linear model which is built with maps. It considers cross saturation and eddy current effects in the squirrel cage.

The identification of the model (1st harmonic) is operated with the steady state AC application of Flux (Finite Elements).

All this allows getting a very good compromise between the accuracy of results and the computation time.



Characterization – Model – Motor – Scalar - Model

All the main electromagnetic quantities are computed and displayed as curves in function of speed for a given power supply frequency and a set of Line-Line voltages.

Note: In the current version, this test is proposed in a beta mode, which implies that all functionalities are not entirely qualified yet, but the users can use it for evaluation.

The results of this test gives an overview of the electromagnetic behavior of the machine considering its topology and physical properties of active components.

For a set of Line-Line voltages (U) and a set of power supply frequencies (f), the general data of the machine, like mechanical torque, currents, power factor and power balance are computed and displayed as curves.

This gives the capability to make comparisons between the results got from the measurements and with FluxMotor®.

With this test, system engineers will find a characterization tool adapted to their needs and able to provide accurate curves ready to be used in system simulation software, like Activate or PSIM. Indeed, from the results obtained in this test, a scalar drive and control can be applied.

User inputs and outputs

The main user input parameters are "the maximum Line-Line voltage, the rated power supply frequency, the maximum line current and the maximum speed". In addition, temperatures of winding, and squirrel cage must be set, and the power electronics data if needed.

The main outputs are displayed as curves versus speed for a set of Line-Line voltage (U) and a set of power supply frequency (f) such as Mechanical torque, Mechanical power, Machine efficiency, System efficiency, Machine electrical power, System electrical power, Machine total losses, System total losses, Stator total losses, Rotor total losses, Mechanical total losses, Power electronics losses, Power factor, Stator current

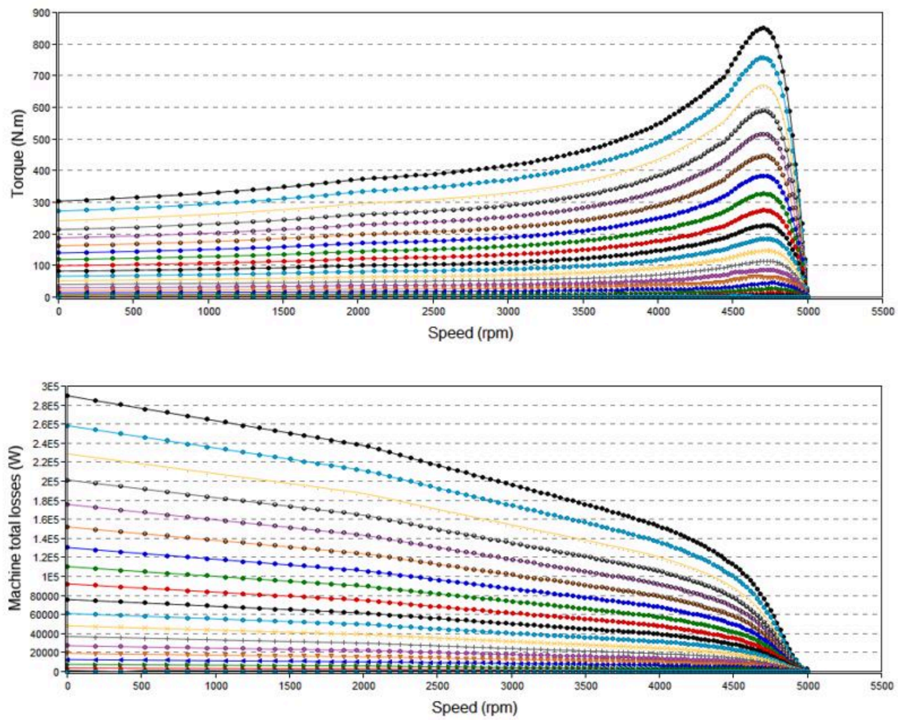
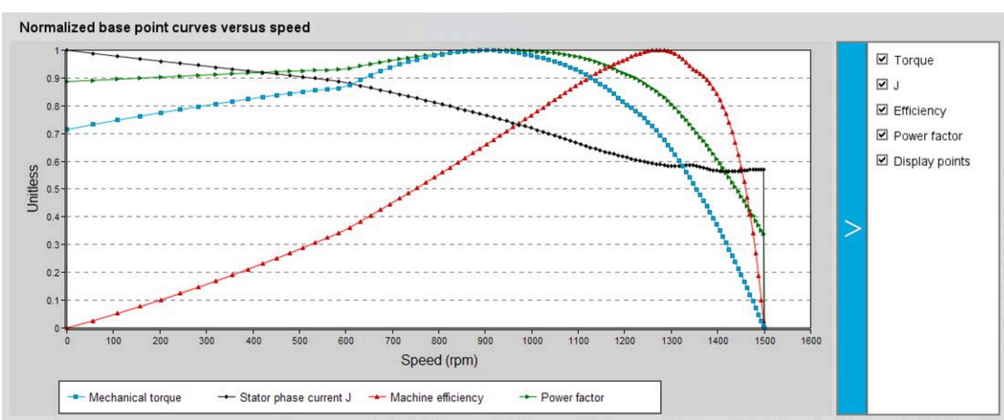


Illustration of results for a set of Line-Line voltage (U) and a set of power supply frequency (f)

Some outputs, like torque, current, efficiency, and power factor are also displayed as the normalized base point curves.



Normalized base point curves

For more details, please refer to the following documents:

MotorFactory_2022.3_IMSQ_IOR_3PH_Test_Introduction and
MotorFactory_2022.3_IMSQ_IOR_3PH_Test_Characterization.

2.1.2 Computation of the efficiency map with scalar control command

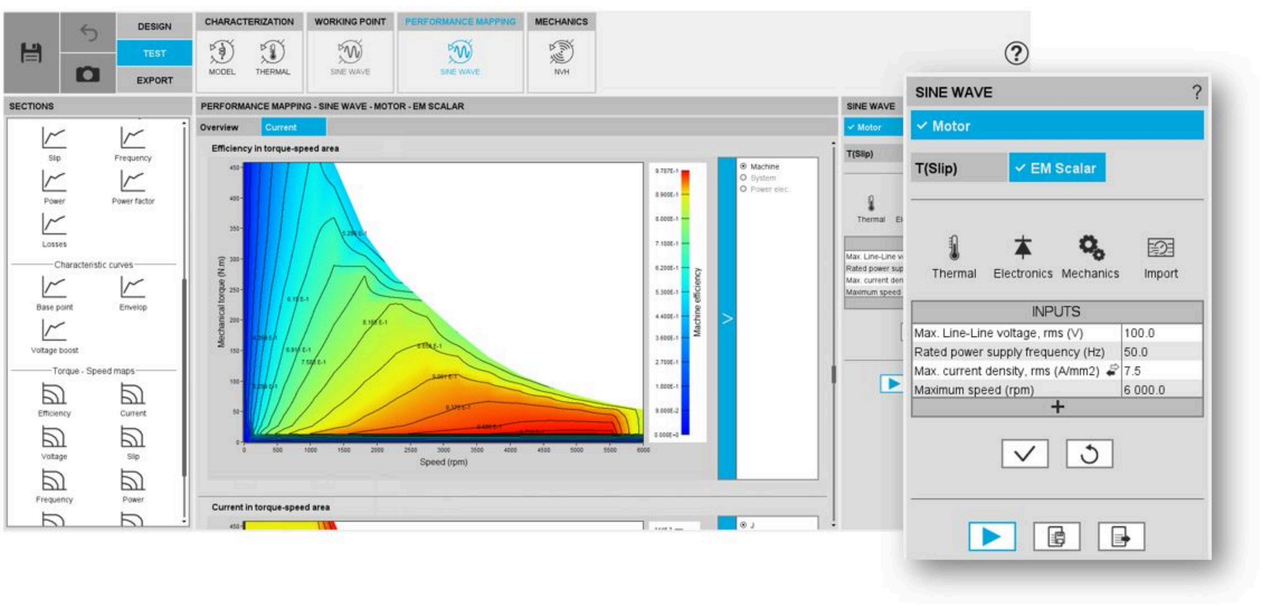
Overview

The aim of the test “Performance mapping – Sine wave – Motor – Efficiency map scalar” is to characterize the behavior of the machine in the "Torque-Speed" area.

Input parameters like “the maximum Line-Line voltage, the rated power supply frequency, the maximum line current and the maximum speed” of the machine are considered here.

One type of command mode is available: scalar command.

Input parameters define the torque-speed area in which the evaluation of the machine behavior is performed.

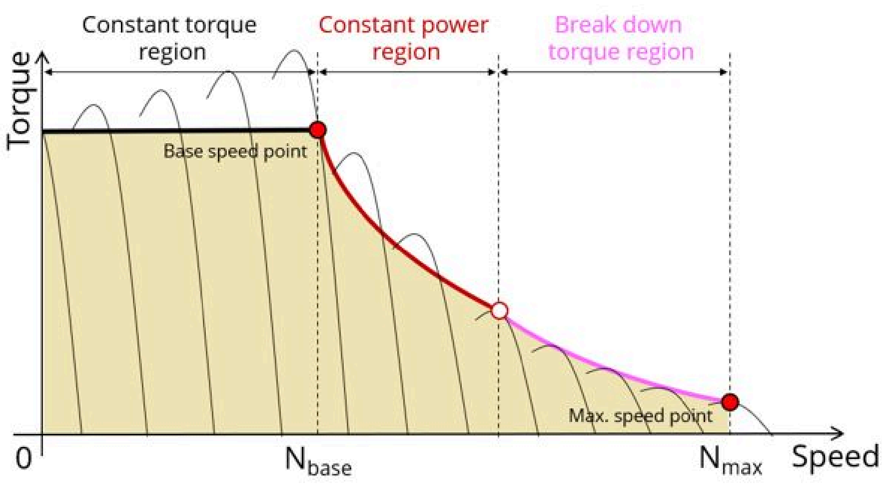


Performance mapping – Sine wave – Motor - Efficiency map - Motor - Illustration

The computations are based on the identification and the solving of a non-linear model which is built with maps. It considers the cross saturation and the eddy current effects in the squirrel cage.

The identification of the model (1st harmonic) is operated with the steady state AC application of Flux (Finite Elements).

All this allows getting a good compromise between accuracy of results and computation time.



Characterization – Model – Motor – Scalar - Model

In the results, the performance of the machine at the base point (base speed point) and at the maximum speed (maximum speed point) set by the user are presented.

User inputs and outputs

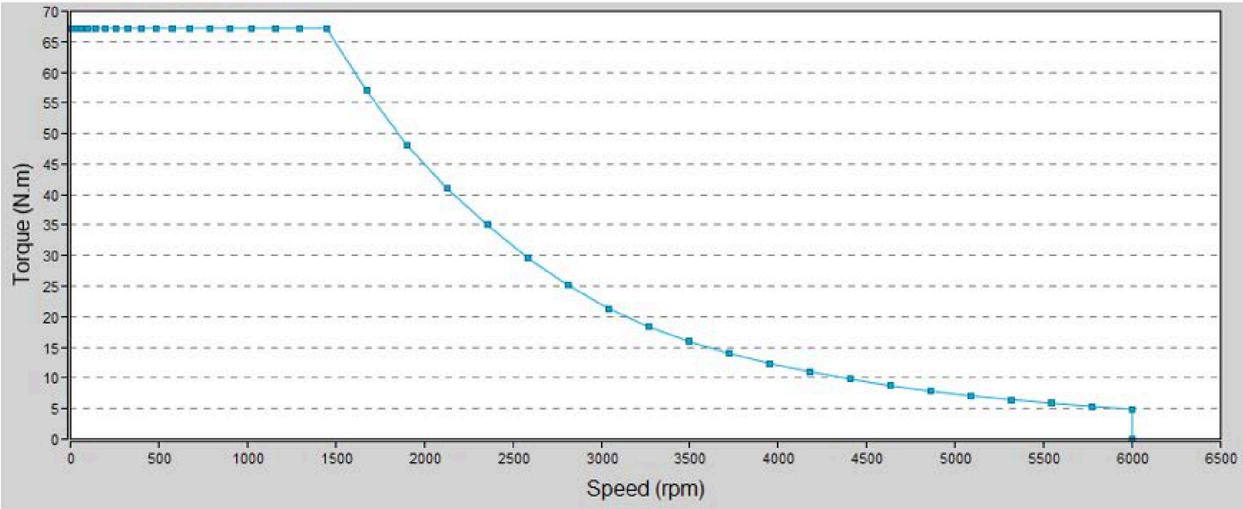
The main user input parameters are the maximum Line-Line voltage, the rated power supply frequency, the maximum line current and the maximum speed". In addition, temperatures of winding, and squirrel cage must be set, and the power electronics data if needed.

The main outputs are displayed with data, curves, maps, and tables.

Among the main test results, there are data about the machine performance for both base speed point and maximum speed point (torque, speed, electrical power, power factor, power balance, efficiency etc.)

Curves that present machine quantities versus speed are computed and displayed (torque, efficiency, current, voltage, slip, frequency, powers, power factor, losses).

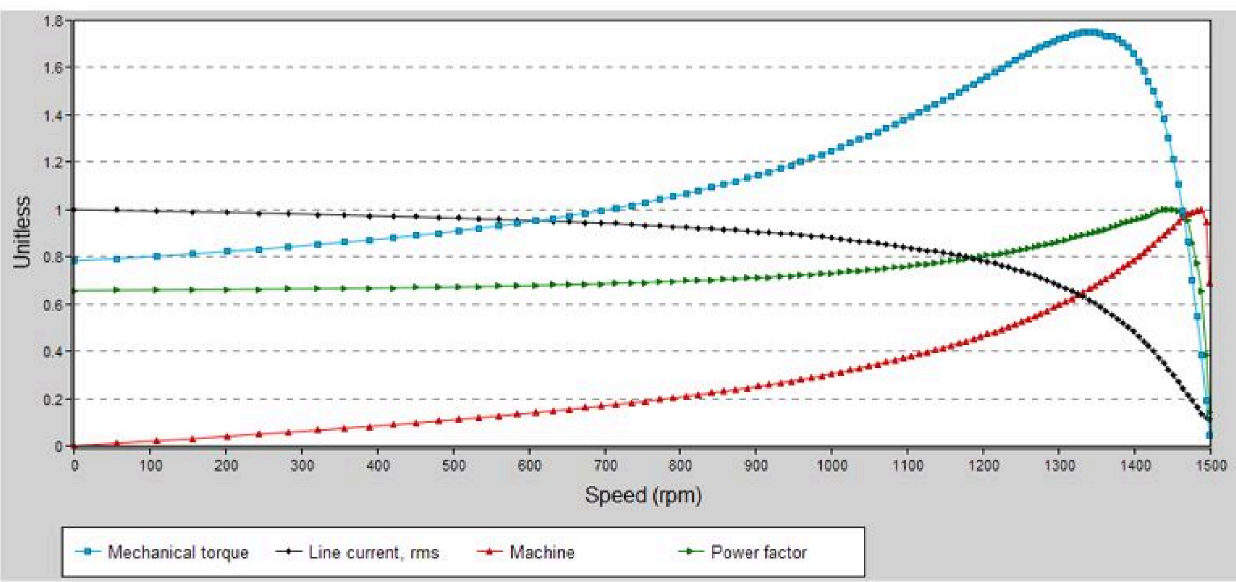
Note: The iron losses are neglected in the current version.



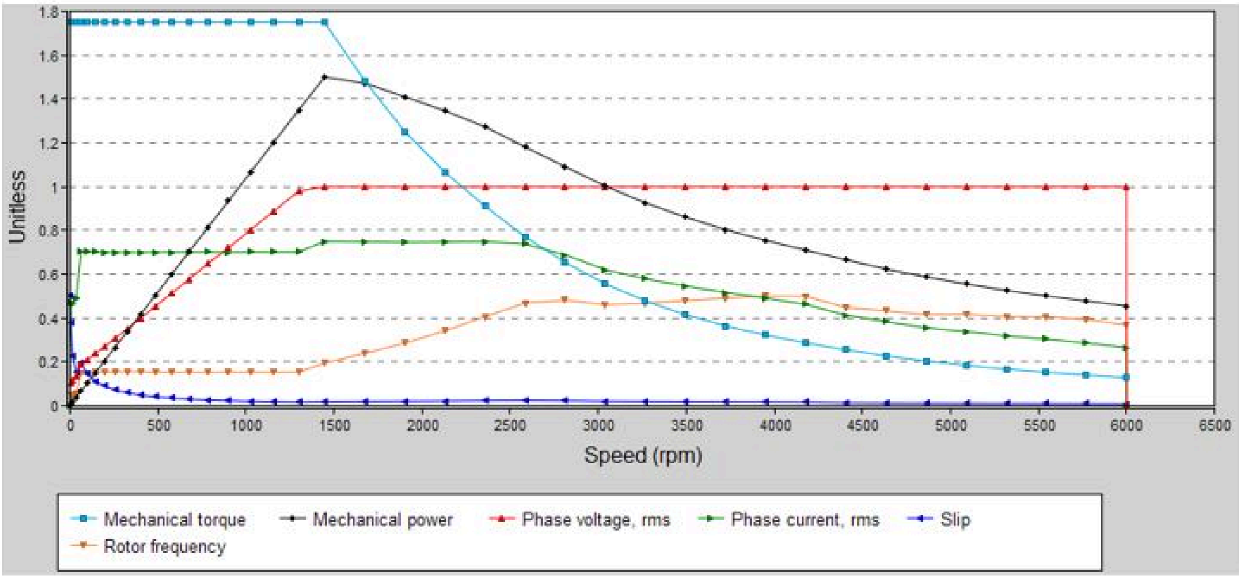
Mechanical torque versus speed - Example

There are also characteristic curves like, the normalized base point curves, the normalized torque-speed curves, and the voltage boost. versus speed (low speed between zero speed and base speed).

Such results help the user to understand the possible performance of the machine in its electric environment.



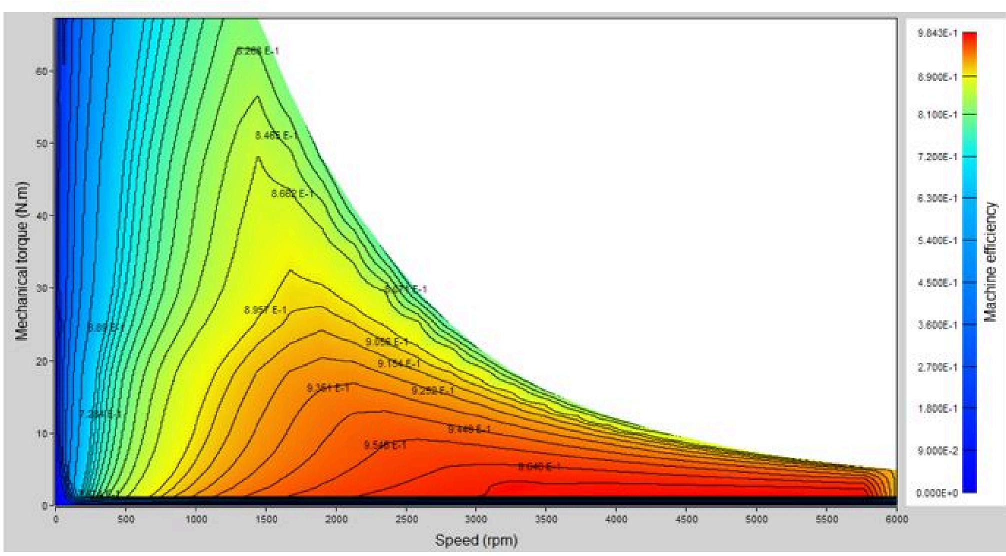
Characteristics curves - Normalized base point curves - Example



Characteristics curves - Normalized torque speed curves - Example

Maps that present machine quantities in the torque-speed area are computed and displayed (efficiency, current, voltage, slip, frequency, power, power factor, losses).

Note: The iron losses are neglected in the current version.



Efficiency in torque-speed area - Example

2.2 Machines with hairpin winding technology in standard mode

Overview

Two types of winding can be designed in Motor Factory: Classical winding or Hairpin winding.

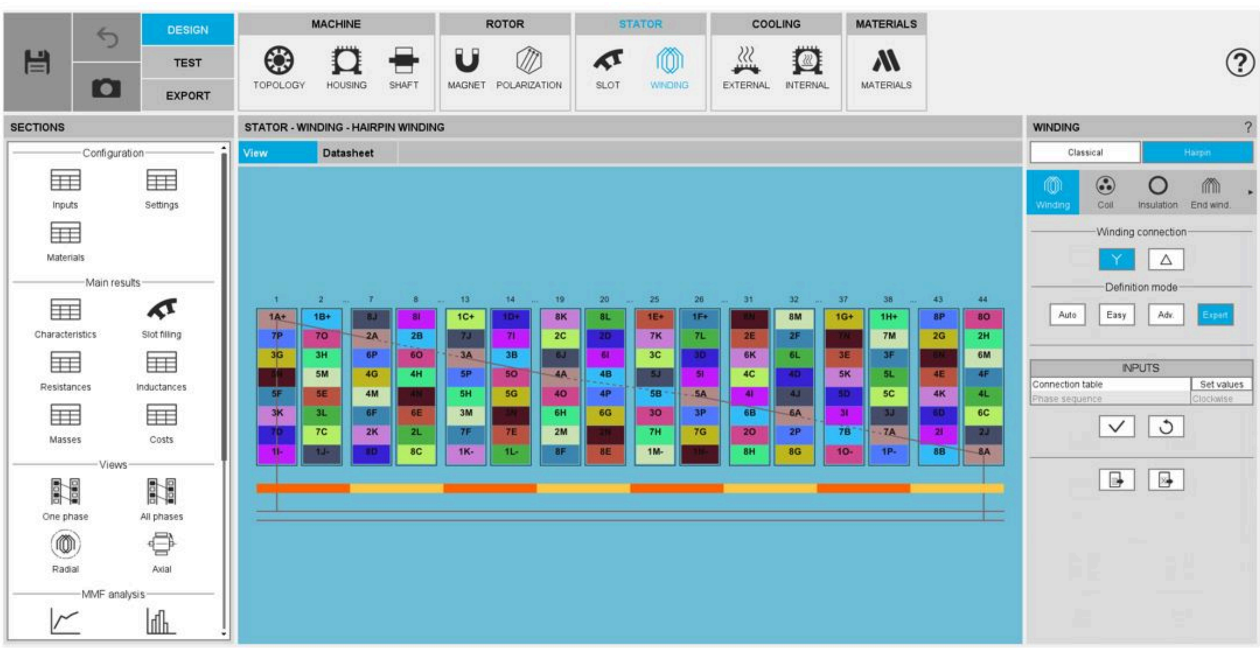
The design of machines built with the hairpin technology and their export from FluxMotor to Flux2D are now available in standard mode.

Moreover, all the tests are also available with the corresponding HyperStudy connectors which can be provided for optimization.

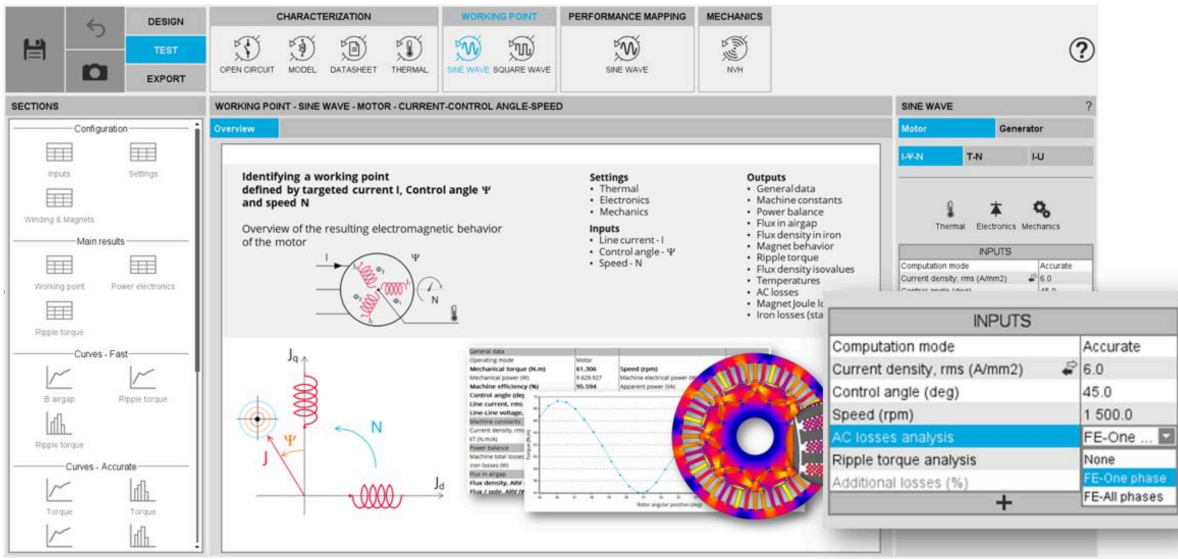
Here is the home page below, for designing both classical and hairpin winding.

The main principles of GUI are similar in both kind of windings, classical and hairpin.

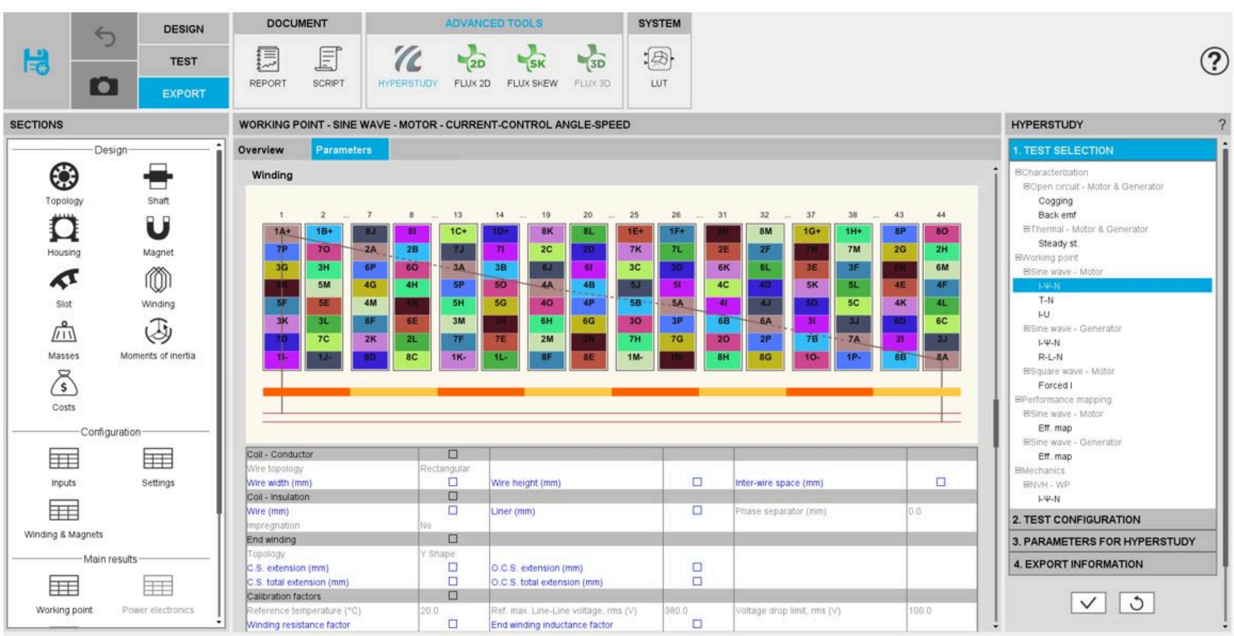
As for a classical winding, dedicated section help users to define the winding architecture, the coil, the electrical insulations, the end-winding, and the potting.



WINDING design area – Area dedicated to Hairpin winding topology – In standard mode



Tests are available for computing performance of machines
with hairpin winding topology Motor Factory – TEST area



Optimisation of machines with hairpin winding topology is possible – Motor Factory – EXPORT area

This new functionality is available for Synchronous Machine with Permanent Magnets (SMPM) – inner rotor, Reluctance Synchronous Machine (RSM) – inner rotor and Induction Machine with Squirrel cage – Inner rotor.

2.3 Improvement of the test Characterization / Model/Maps for SMPM

The aim of the test "Characterization - Model - Motor - Maps" is to give 2D maps in Jd-Jq plane for characterizing the 3-Phase synchronous machines with permanent magnets.

These maps allow predicting the behavior of the electrical rotating machine at a system level.

In this test, engineers will find a system integrator and / or control-command tool adapted to their needs and able to provide accurate maps ready to be used in system simulation software like Activate or PSIM.

Performance of the machine in steady state can be deduced from the results obtained in this test in association with the drive and control mode to be considered.

Options have been added to compute and display 1, 2 or 4 quadrants

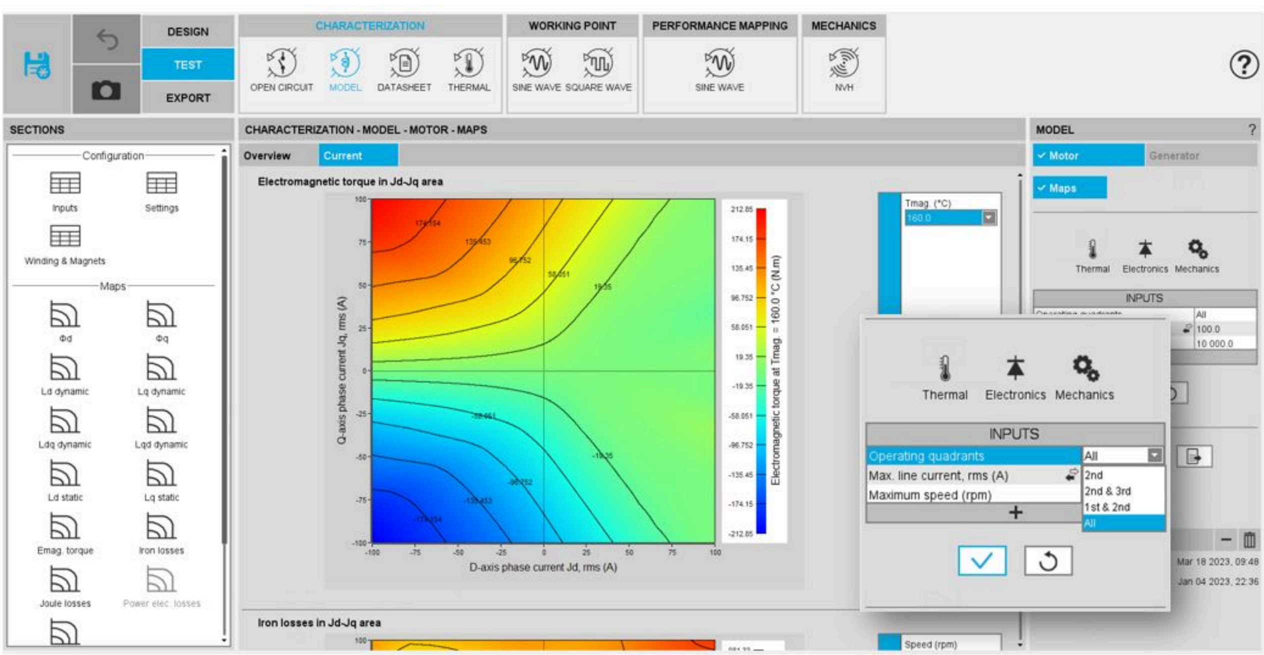
Export / System LUT (Activate or PSIM) has been updated for exporting data based on 1, 2 or 4 quadrants

Among the standard inputs, the operating quadrants can be selected.

This allows defining the quadrants in the Jd-Jq plane, where the test will be carried out.

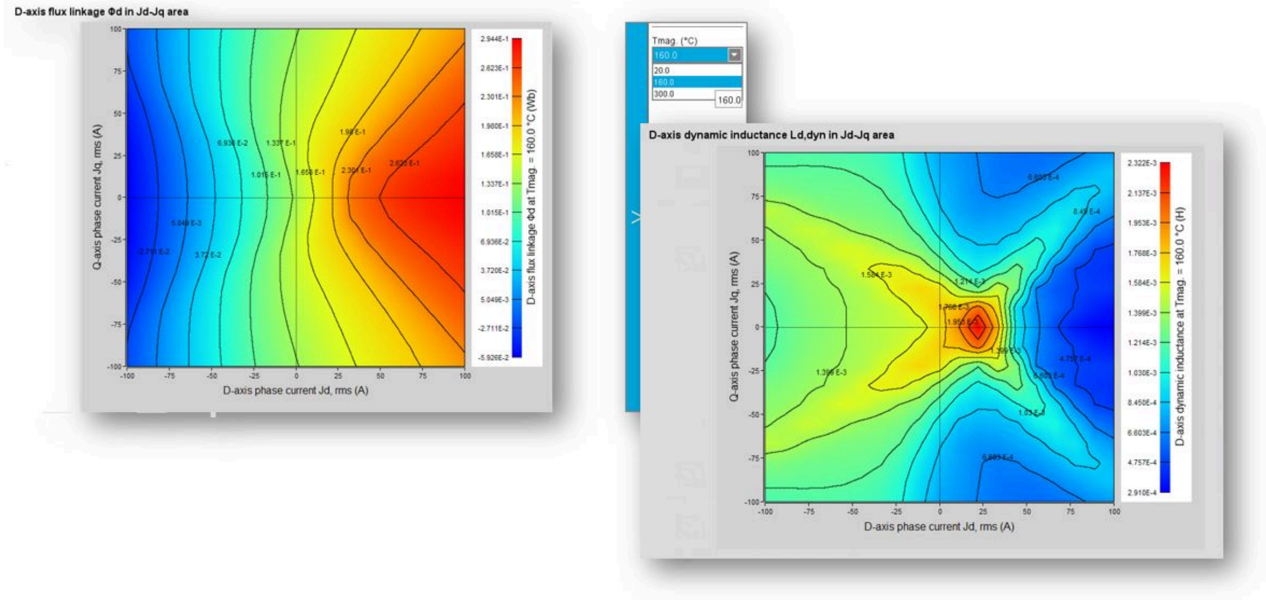
By default, the only considered quadrant is the 2nd one (i.e., the grid is only defined for negative values of the current in the d axis and positive one in the q axis). This corresponds to the motor mode.

The other possible values for this input are: "2nd and 3rd ", "1st and 2nd "and "all".

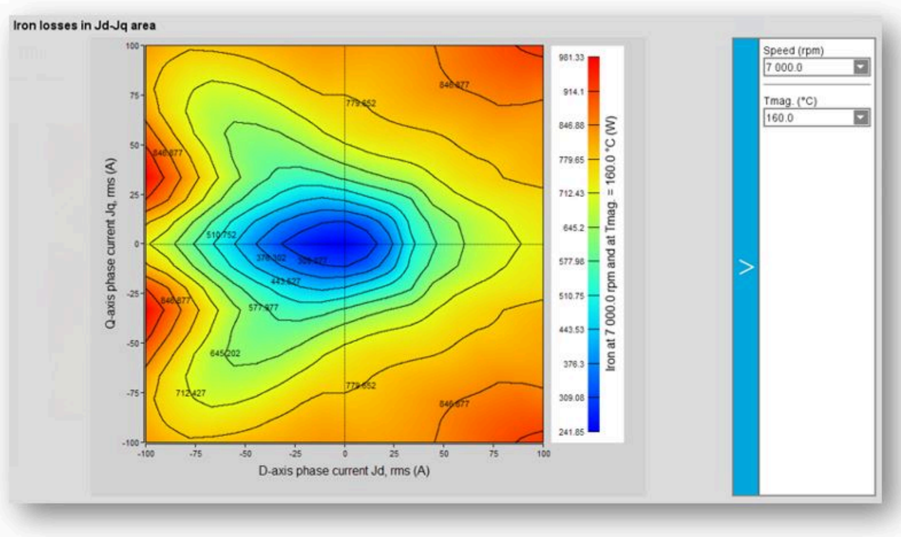


Characterization / Model / Maps for SMPM - New user's inputs to select the operating quadrants.

Illustrations with few examples of map displaying:



D-Axis flux linkage, D-Axis dynamic inductance in the Id-Iq area



Iron losses in the Id-Iq area

Note: Maps can be displayed depending on the magnet temperature, and the rotor speed when relevant.

2.4 New export from FluxMotor to Flux2D / FEMT

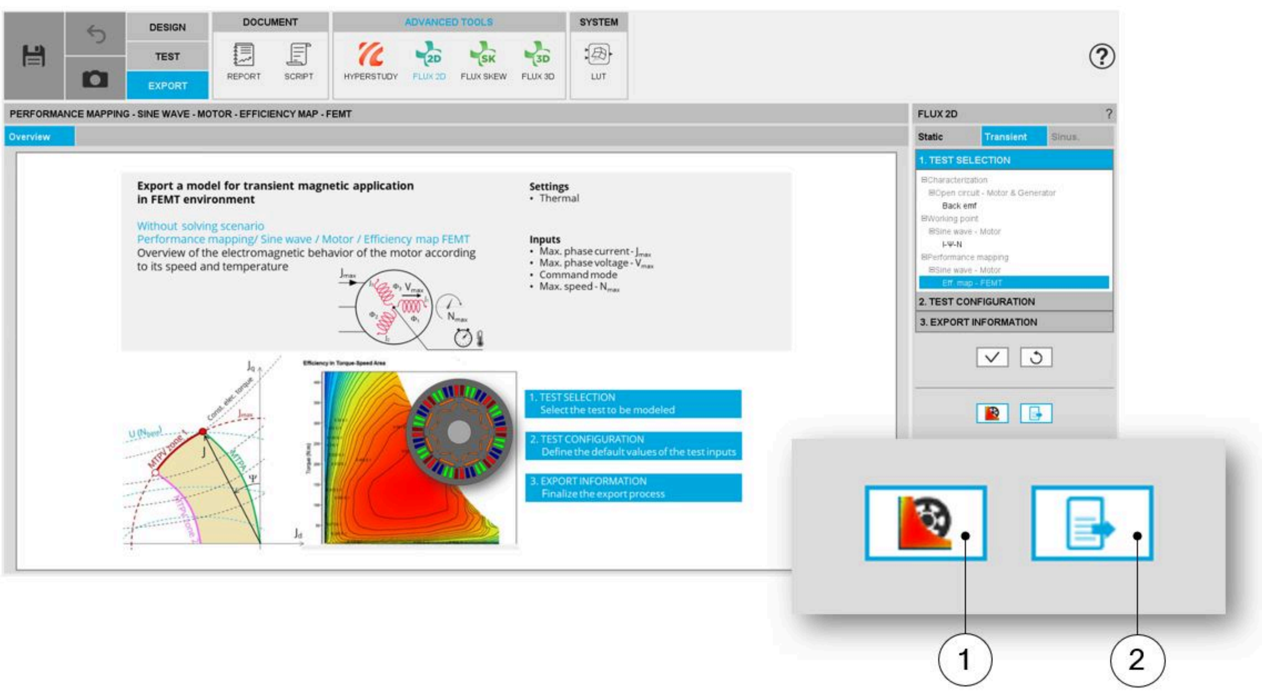
The aim of the test "Performance mapping – Sine wave – Motor – Efficiency map - FEMT" is to characterize the machine efficiency map, launching a set of transient simulations which allows very high accuracy.

The resulting model is fully parameterized, and it is built in Flux® 2D environment, transient application.

To run this test, Flux® 2D offers a dedicated toolbox called Flux e-Machine Toolbox (FeMT) which automatically manages the set of simulations and their postprocessing to build complete and accurate maps.

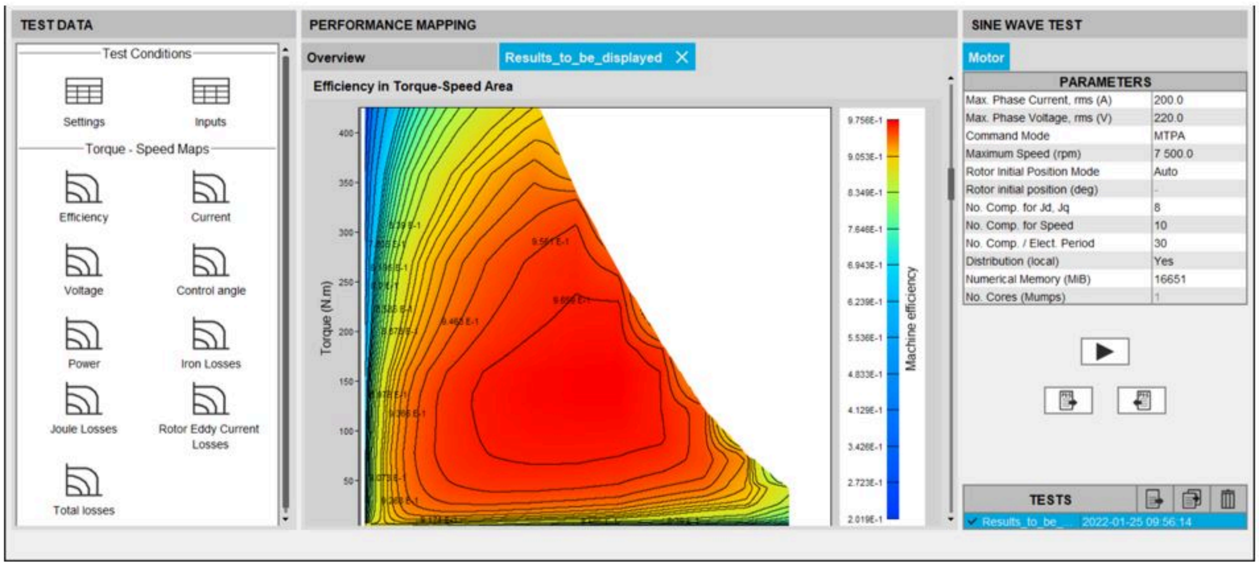
Through this export, the users will obtain a FeMT project ready to be solved. Additionally, the Flux 2D project used by FEMT is also available.

> **Note:** Even if the export process is quite fast, the simulation in FeMT is based on a big set of transient simulations, that usually requires a high computation time. For more information, refer to FeMT user help guide.



Export a project from FluxMotor to Flux e-Machine Toolbox (FeMT) – Motor Factory – EXPORT area

> **Note:**
>
> There are two buttons to finalize the export of the model:
>
> One button (1) allows to directly and automatically launch Flux® 2D (Flux e-Machine Toolbox (FeMT)) and builds the model.
>
> The second button (2) allows to build the python file which can be launched manually in Flux e-Machine Toolbox (FeMT)



Flux e-Machine Toolbox (FeMT)

> **Warning:** The Export to FeMT cannot be applied for machines where the number of parallel paths is not equal to 1. This issue will be fixed in the next version.

2.5 Further new functions

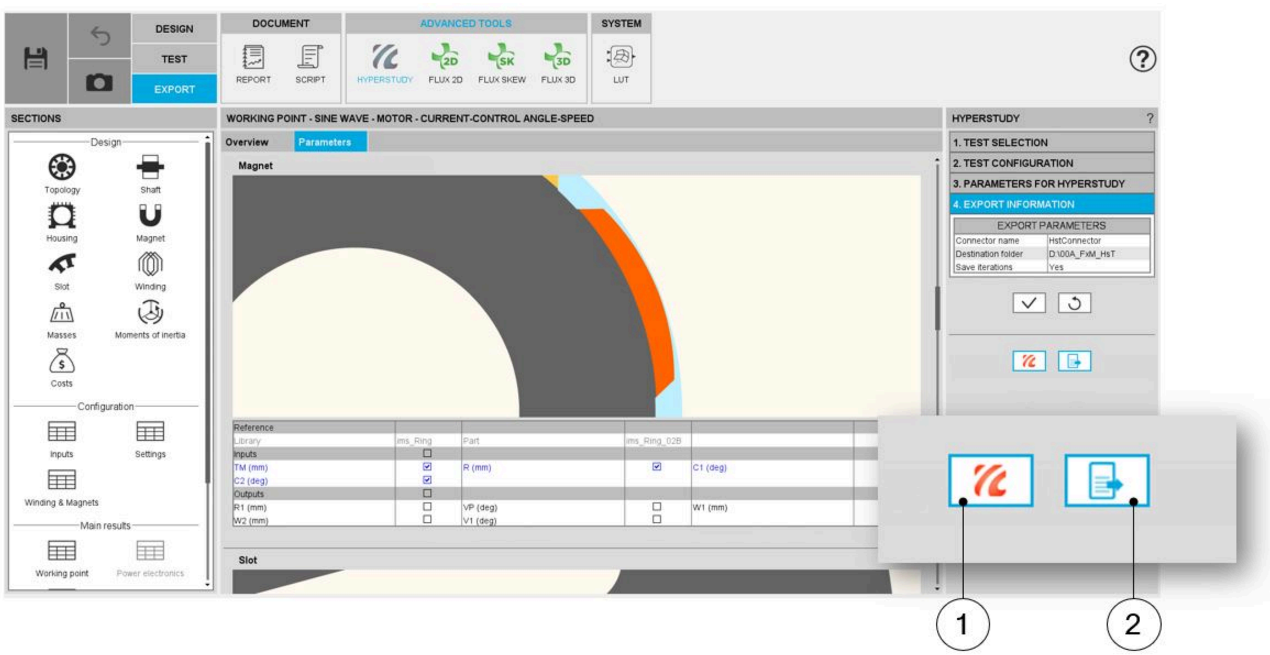
2.5.1 Auto generating the HyperStudy Study in HyperStudy Application

The aim of this export from FluxMotor to HyperStudy is to build a connector, allowing Altair® HyperStudy® to drive Altair® FluxMotor® for performing motor optimizations based on the computation processes embedded into FluxMotor®.

To finalize this operation from FluxMotor, two buttons are now available:

The first button (1) allows to directly and automatically launch HyperStudy, builds and load the connector to perform the optimization.

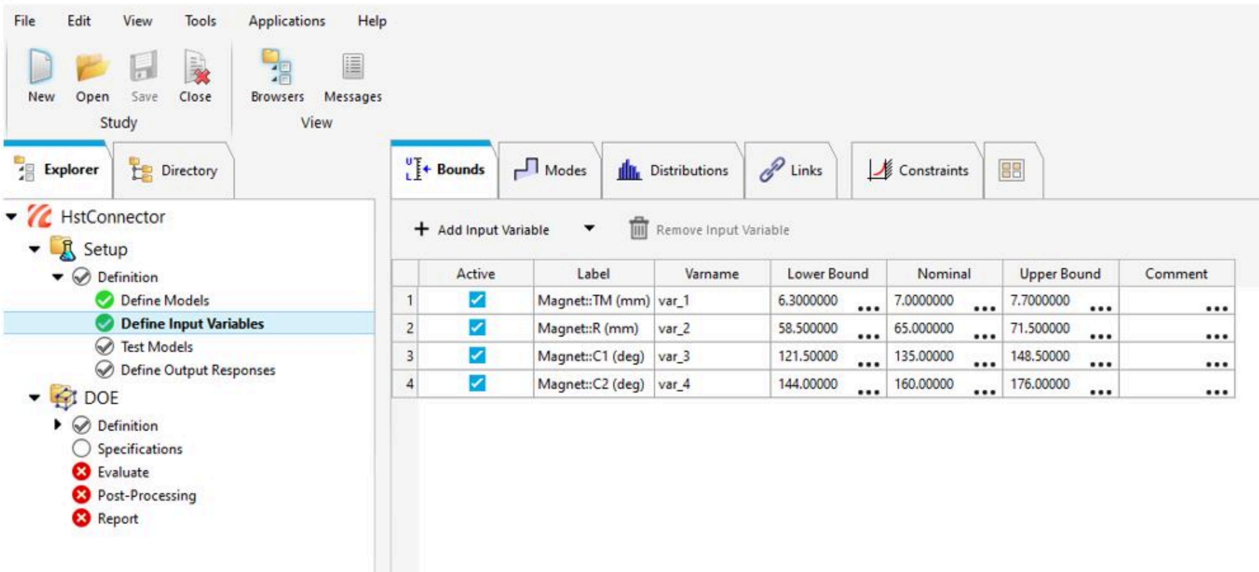
The second button (2) allows to build the connector.



A new button (1) allows to directly and automatically launch HyperStudy with the connector ready to be used for optimization

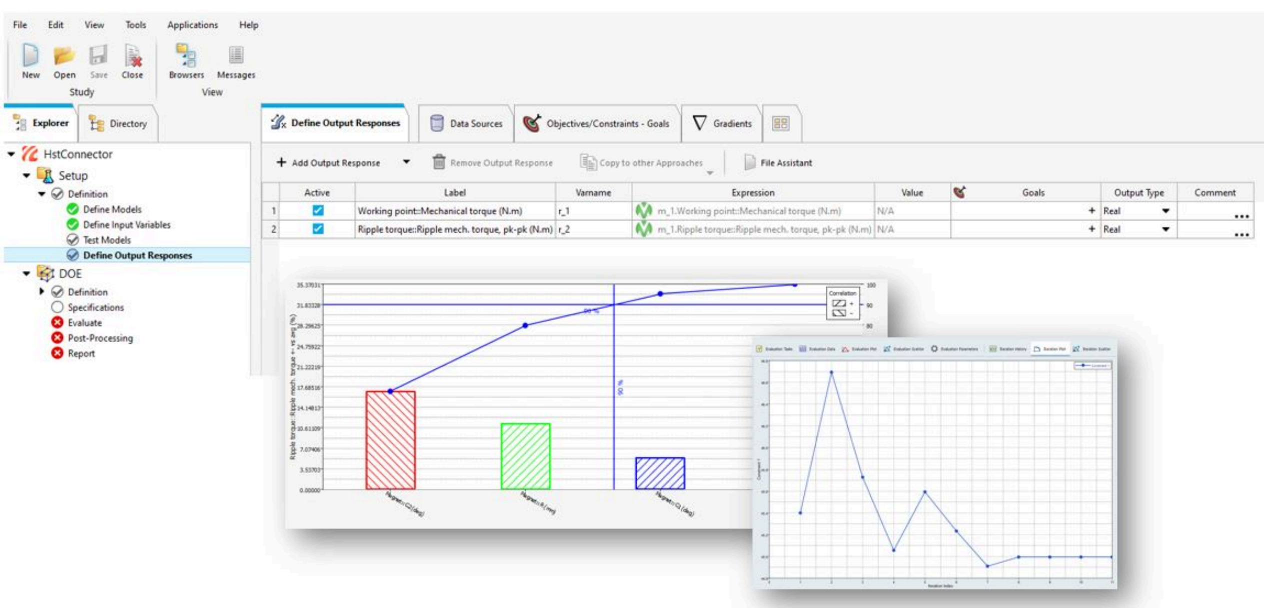
When one clicks on this button (1), HyperStudy is automatically opened, with the connector built by FluxMotor uploaded.

The studies can be initialized and run immediately in HyperStudy. The input variables as well as the output responses that have been selected in FluxMotor are automatically identified and uploaded.



HyperStudy is opened with the input variables and the output responses ready to be defined

Performing an optimization with HyperStudy is just a click away from FluxMotor.



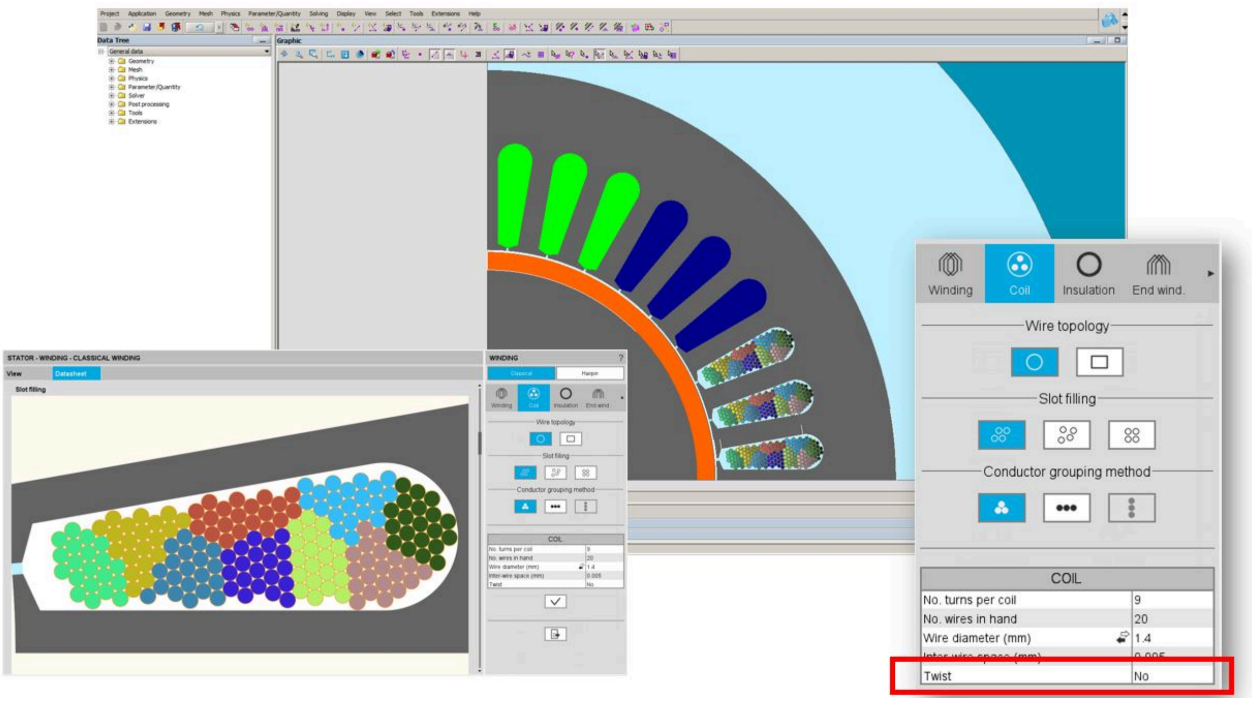
Once the definition of the HyperStudy project done, the studies can be performed

2.5.2 Model periodicity and coils with solid conductors

This new feature deals with the capability to use the twist option inside the conductors of coils.

In the previous versions, this option was available but not reliable, while the machine modelling was represented with an anticyclic periodicity.

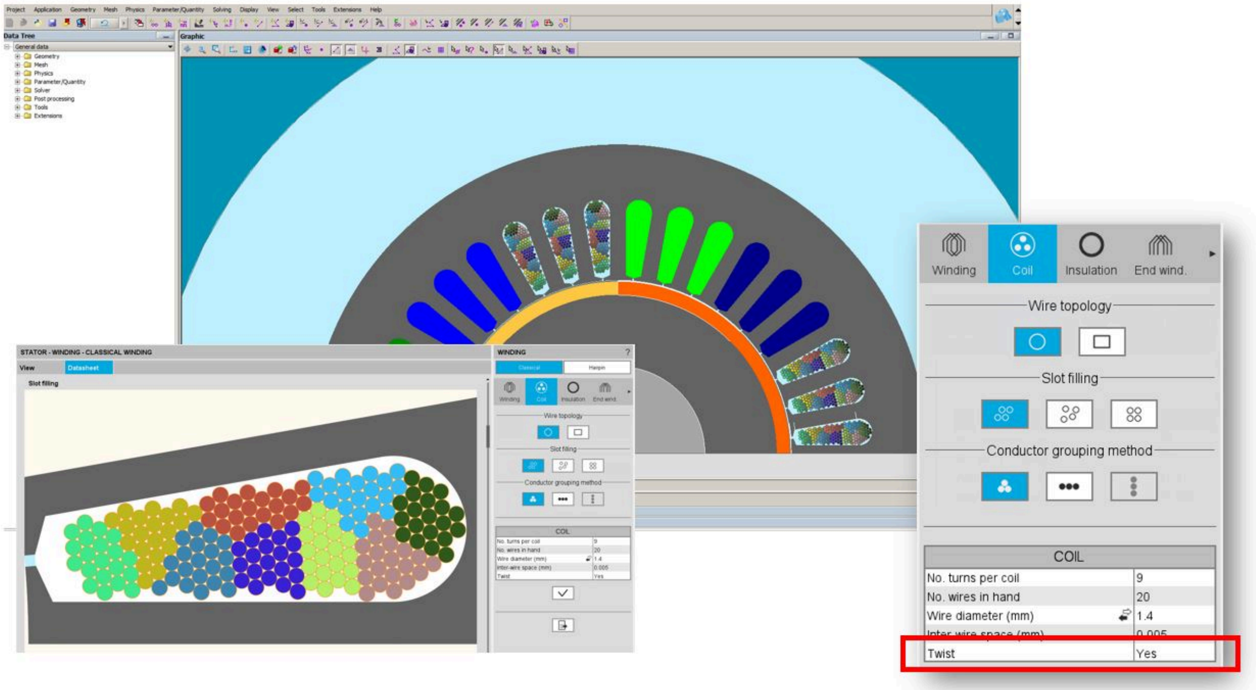
A major periodicity modelling and computation refactoring has been done to fix this problem. Hence, this allows well managing such configuration in Motor Factory.



Case 1: No twisted wires inside the conductor of coils

The periodicity is based on a quarter of the geometry with anticyclic conditions

Twisting the wires inside the conductors of coils modify the periodicity. The machine must be represented for half of the geometry instead of a quarter.



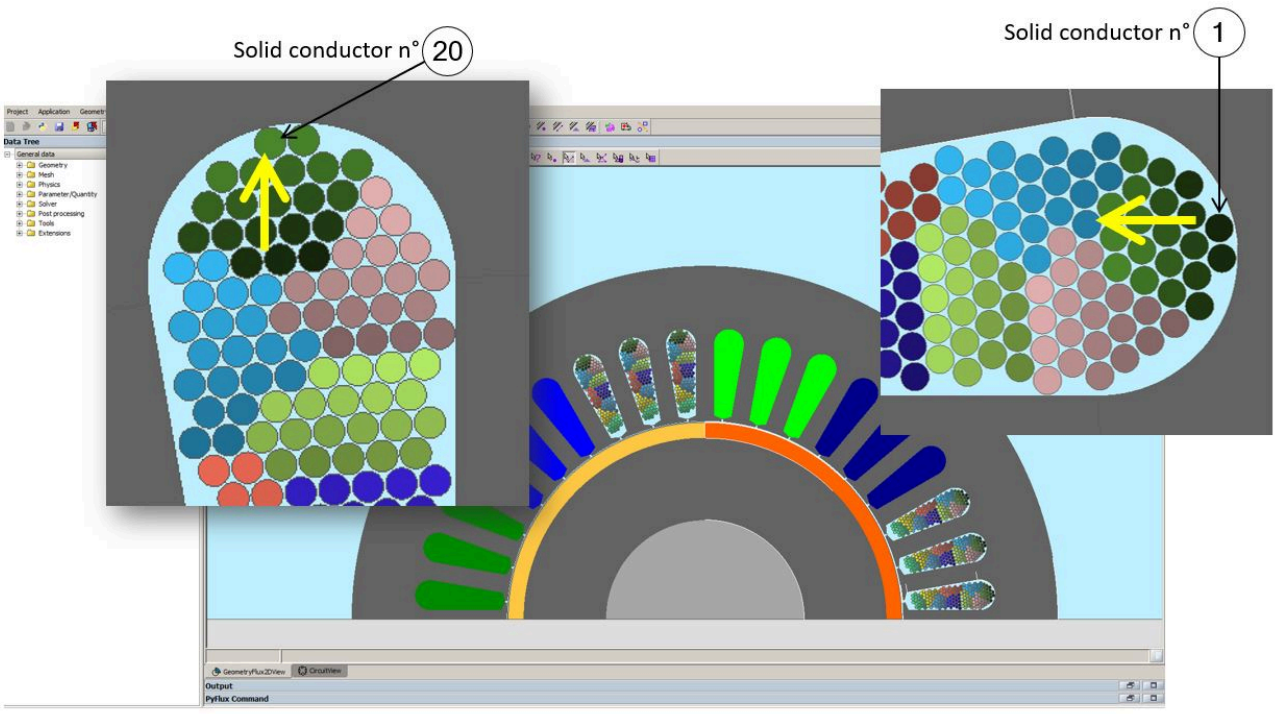
Case 2: Twisted wires inside the conductor of coils

The periodicity is based on a half of the geometry with cyclic conditions

The modelling of the twisted wires is considered in FluxMotor as well as in Flux 2D (or Skew) while exporting the project.

In case of twisted wires, the wires change position between the forward (IN) and return side (OUT) of the coil.

That leads to the modification in the model periodicity which is based on a half of the geometry with cyclic conditions in the considered case below.



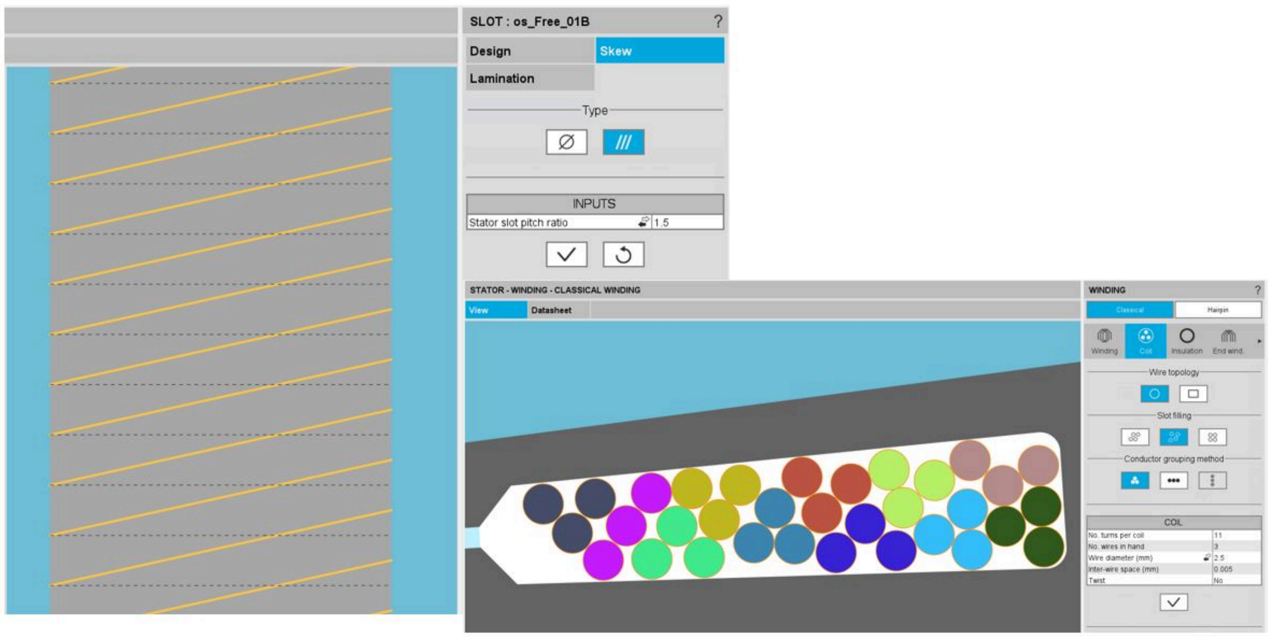
Case 2: Twisted wires inside the conductor of coils

In each conductor, the color gradient illustrates the change in position

The periodicity is based on a half of the geometry with cyclic conditions

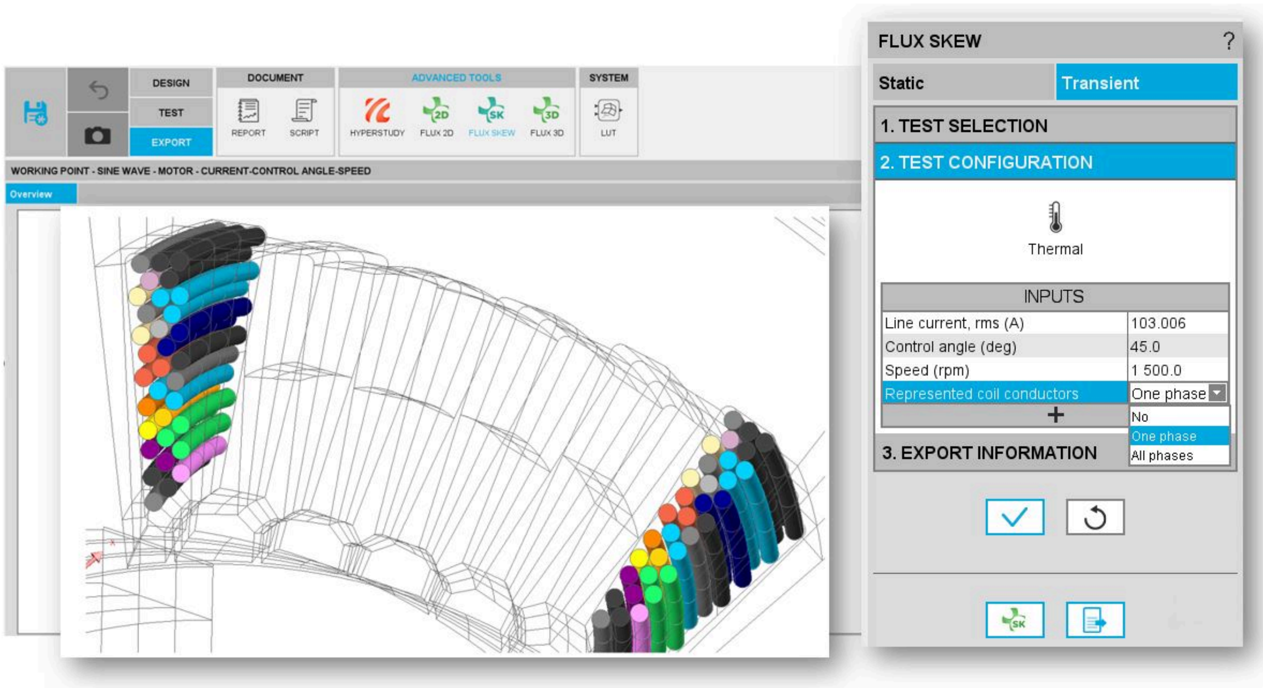
2.5.3 Solid conductors can be used for machines with skewed topologies

The wires can be considered as solid conductors when the stator or the rotor are skewed.



Example of a machine with a skewed stator defined in Motor Factory

The solid conductors can be considered while exporting projects from FluxMotor to Flux Skew as well as in the back end of Motor Factory for computing the machine performance.



Exporting a machine with a skewed stator in Flux Skew is possible with represented coil conductors (One phase or All phases) and the resulting model in Flux Skew

List of fixed issues and major improvements

3

This chapter covers the following:

3.1 All machines

Export script doesn't work for machines with outer rotor

(ref.: FXM-15161).

This issue has been corrected.

Running tests fails with GUI is in Japanese

(ref.: FXM-15099).

This issue has been corrected.

Stator Joule losses are not displayed

In the tests dedicated to the computation of a working point (for synchronous machines or induction machines), if the mode of computation is fast the stator Joule losses are computed, but not displayed in the table of results. However, these can be deduced from the power balance information (ref.: FXM-15142).

This issue has been corrected.

Computation of forces on teeth is not available

The computation of forces on teeth is not available since the workflow to compute forces on the teeth in NVH must be updated (ref.: FXM-15086).

This issue has been corrected.

Unable to export machine with squared lamination

Exporting a machine with squared lamination for specific winding architecture. Indeed, the parallel path manager cannot manage odd number of half coils in incomplete parallel path and flux cannot either (ref.: FXM-14956).

This issue has been corrected.

The slot filling with wires inside fails for inner slot

Sometimes, the slot filling with wires (solid conductors) fails for the inner slots (ref.: FXM-15150).

This issue has been corrected.

Twist of conductors cannot be considered with antiperiodic conditions

When the twist of conductors is selected in the winding area, if the motor presents an anticyclic periodicity, the twist of conductors won't be considered in the flux project (ref.: FXM-14935).

This issue has been corrected.

Removal of the housing is not well managed

Removal of the housing is not well managed with hairpin winding and potting are selected all together (ref.: FXM-14731).

This issue has been corrected.

Transient thermal computation

Sometimes, there is an issue with nonlinear thermal resolution. The convergence criteria don't reach from a certain time iteration leading to non-physical results making the physical properties interpolations impossible. This can occur for duty cycle inside which there are a huge number of working points for instance (ref.: FXM-14570).

This issue has been corrected.

Management of multi-parametric settings with HyperStudy® coupling

Some configurations of parameterized topologies can be obtained manually in Motor Factory, but cannot be created from HyperStudy® for some connectors

One must be able to manage the case of sequential input update in HyperStudy® connector, especially for topology definitions (ref.: FXM-13612).

This issue has been corrected.

3.2 Induction machines – Motor Factory – Test environment

Defining the end ring reference temperature fails (Manual mode)

The reference temperature which is set to define the end ring - impedance in manual modes is not considered for the tests execution (ref.: FXM-15147)

This issue has been corrected.

3.3 Induction machines – Motor Factory – Export environment

Defining the end ring reference temperature fails (Manual mode)

The reference temperature which is set to define the end ring impedance in manual modes is not considered while exporting a project to Flux 2D or Flux Skew (ref.: FXM-15145).

This issue has been corrected.

End-ring impedance – Reference temperature is not well applied

While exporting a model from FluxMotor® to Flux® 2D or Flux® Skew environment, if the end-ring impedance has been defined with the "constant computation mode" (= user mode) instead of the automatic one, the reference temperatures set by the user are not used in the resulting Flux® project. Instead, the default values are automatically considered (ref.: FXM-13713).

This issue has been corrected.

3.4 Script Factory

The find/replace dialog box has an issue

In Script Factory, the find/replace dialog box must be closed when the end of the file is reached. When the search reaches the end of the file, the only way to restart from the beginning is to close the dialog window, reopen and enter once again the data (ref.: FXM-15138).

This issue has been corrected.

3.5 Supervisor – Preferences

Preferences and reboot

The preferences that require a reboot are not updated after the reboot (ref.: FXM-13121).

This issue has been corrected.

List of warnings

4

This chapter covers the following:

4.1 All machines

Natural convection for end winding

While choosing a model, where the end spaces are cooled with natural convection, FluxMotor® model uses quite a low rotor tip speed ratio (a value of 5) to describe the fluid velocity far from the rotating components. This may lead to overestimation of the cooling of the end winding on high-speed machines.

When a tip speed ratio of 5 seems to overestimate the end winding cooling, it is advised to switch to the forced convection mode.

This mode allows forcing some higher tip speed ratios for areas far from the rotor, but reduces the efficiency of the cooling on the end winding.

This model will be improved for future versions.

Transient thermal computations - Displaying of iso-temperatures

In the test "Performance mapping – Sine wave – Motor – Efficiency map", when a cycle is considered with a transient thermal solving, the representation of the temperature iso-values inside the machine can be visualized all along the cycle with an animation.

The animation can run for the axial and radial views. However, both the animations are not well synchronized. Therefore, there can be troubles while using both at the same time.

Modification of units

To take the change of units into account in a test, the user must reopen Motor Factory. The modification is not considered instantaneously in the applications of Altair FluxMotor® like Motor Factory.

Preferences – Beta level mode

In the tab "Advanced settings / Preferences", Altair® FluxMotor® "User Level" can be: Standard or Beta. By default, the user level is Standard. In Beta level, the entire qualified features are not available for evaluation.

The FluxMotor® Beta level mode allows performing NVH computations for induction machines – Inner rotor. It gives access to the application "Scripting Factory".

Export a model into Flux® environment with represented elementary wires

- **Building time of the model in Flux®**

  When slots are filled out with a lot of elementary wires, and all the phases need to be represented with solid conductors inside Flux® 2D model, the resulting python file can be very long. Therefore, the process for building the corresponding model into Flux® environment can take a longer time.

Browse function

Sometimes, opening a folder from FluxMotor® applications via browser function requires a longer time (several seconds).

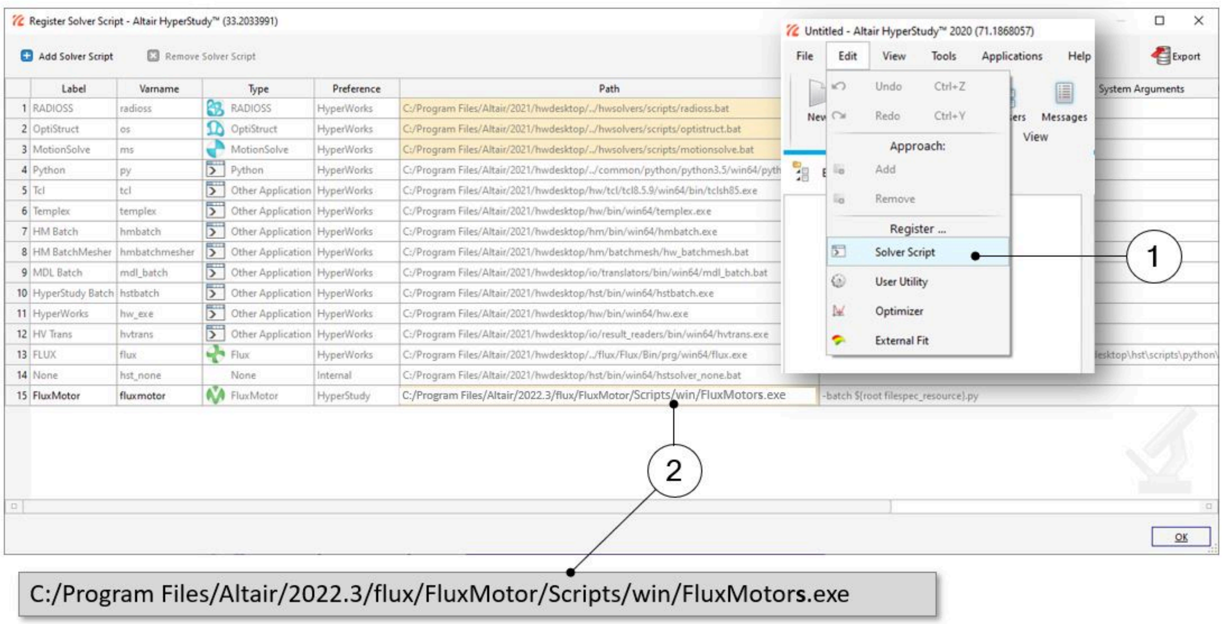
Hairpin architecture

Solving tests or exporting projects to Flux is not allowed when the Hairpin winding is built with two layers. This will be fixed for the next version (FXM-15516).

Export environment – HyperStudy®

1. **New solver script to be registered**

   Before starting new studies in Altair® HyperStudy® by using connectors exported from Altair® FluxMotor®, FluxMotor® must be registered as a new solver script in HyperStudy®. This must be defined only while using the coupling for the first time.



Connection between Altair® FluxMotor® and Altair® HyperStudy®

1	Open the area in HyperStudy® to register FluxMotor® 2022.3 script
2	Path where FluxMotors.exe must be selected to be registered as a new solver in HyperStudy®. **Note:** FluxMotors.exe with an "s" at the end of FluxMotors. This must be defined only when using the coupling for the first time.

Note: In the version 2022.1 of HyperStudy, the FluxMotor solver script is automatically registered, when the default path installation is selected while installing Flux and FluxMotor.

> **Note:** The new auto generation of the HyperStudy study in HyperStudy Application (described above) allows to automatically register FluxMotor® as a new solver script in HyperStudy®. If HyperStudy is not installed in the same folder (by default : C:\Program Files\Altair\2022.3\hwdesktop\hst), the path must be defined in the user preferences via the supervisor of FluxMotor (Path to HyperStudy – Needed for HyperStudy export).

2. **New test and connectors for HyperStudy®**

   Connectors for coupling FluxMotor® and HyperStudy® are not yet available for the new added tests, like those with transient thermal computations, or the tests for induction machine like the "Characterization – Model – Motor – Scalar" and the "Performance mapping – Sine wave – Motor – Efficiency map scalar".

3. **Mandatory synchronization between connector and FluxMotor versions**

   The connectors used in HyperStudy must be synchronized with the FluxMotor solver version.

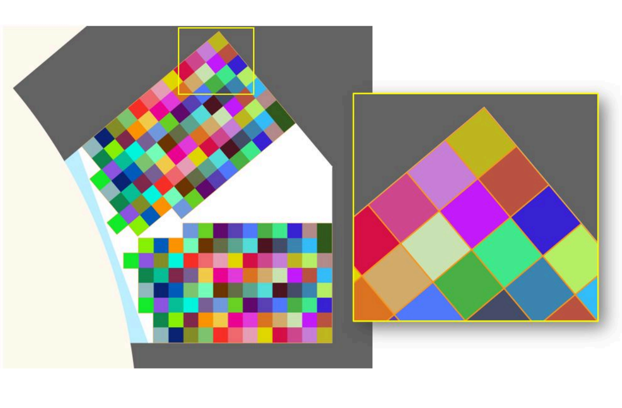
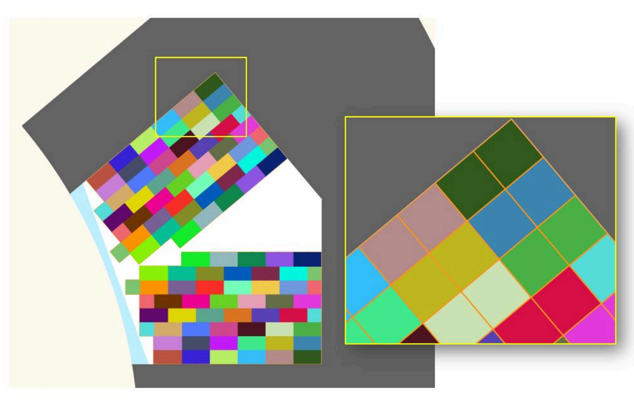
   An error message (inside the log files) is generated while performing HyperStudy studies with a connector provided with a former version of FluxMotor solver.

Problems with slot filling

1. The slot filling is not yet possible with a non-symmetric parallel slot.
2. When a toothed winding design is considered with rectangular shape wires, the conductor grouping method "horizontal" doesn't work properly leading to wrong visualization of conductors. In that case, it is recommended to select the conductor grouping method "vertical".

   All works well with circular shape wires

   Example with a toothed winding design (i.e. the coil pitch = 1) and with 2 wires in hand.

	
Horizontal filling – wrong visualization, but the total number of wires is right	Vertical filling – good visualization

NVH computations - Advice for use

The modal analysis and the radiation efficiency are based on analytical computation, where the stator of the machine is considered as a vibrating cylinder.

The considered cylinder behavior is weighted by the additional masses, like the fins or the winding and the subtractive masses, like the slots and the cooling circuit holes.

This assumption allows getting faster evaluation of the behavior of machine in connection to NVH. But, in no way this can replace a mechanical finite element modeling and simulation.

Possible reasons for deviations of results can be the following ones:

- The limits of the analytical model are reached or overpassed
- Unusual topology and/or dimensions of the teeth/slots
- Complexity of the stator-frame structure when it is composed with several components for instance
- The ratio between the total length of the frame Lframe and the stack length of the machine Lstk. In any case, this ratio must be lower than 1.5:

$$\frac{L_{Frame}}{L_{stk}} \leq 1.5$$

4.2 Synchronous machines – Motor Factory – Test environment

Working point – Square wave – Forced I – and delta connection

When running the test "Working point – Square wave – Motor – Forced I" with a delta winding connection, two electrical periods are considered for reaching a steady state behavior of the motor. However, sometimes two periods are not enough to get a good convergence of the process, and therefore, the displayed results may not correctly represent the steady state.

Motors built and tested with previous versions can be loaded with the current version. The existing "current tests" are removed and transformed as "saved tests" with reference to the original version (All the previous versions).

Sometimes, results of the current tests are removed. The test must be executed again to get the corresponding results.

Delta winding connection

When a delta winding connection is considered, the computation doesn't consider the circulating currents. This can lead to a different result than what expected in transient computation for the test "Characterization - Open-circuit - back-emf".

In such case, it is recommended to perform a transient computation in Altair® Flux® environment. The application "Export to Flux®" thereby, allows exporting this kind of model to the corresponding scenario ready to be solved.

Evaluation of the maximum achievable speed

The aim of this result is to give a rough estimation of the maximum reachable speed, which can be achieved by the machine. This computation is performed by considering a MTPV command mode. However, when the resulting control angle is low (no saliency in the airgap of the machine), the evaluation of the maximum achievable speed may be far away from the maximum speed given by the "Performance mapping – Sine wave – Motor - Efficiency map" test.

Export to FeMT

The export of projects to FEMT is limited to SMPM inner Rotor machines.

Furthermore, when there is more than one parallel path, export to FeMT is blocked because the two electric circuit models are not yet compatible, in the electric circuit built by FluxMotor, here, parallel paths are built to represent the corresponding parallel circuits.

4.3 Induction machines – Motor Factory – Design environment

Computation of inter bar impedance

For induction machines, inter bar impedance (resistance and inductance) is computed by considering characteristics defined in Motor Factory.

However, while exporting the model into Flux® 2D or into Flux® Skew, inter bar impedance will remain constant, even if a parametric study is performed in Flux® environment. The topology parameter as well as the temperature variations won't impact the inter bar impedance.

4.4 Induction machines – Motor Factory – Test environment

Computation of tests for induction machines with skewing

When the squirrel cage or the slots are skewed for induction machines, the tests are computed with Altair® Flux® Skew at the back end of the FluxMotor®.

This leads to an increase in the computation time.

For the test “Performance Mapping – Sine wave – Motor – T(Slip)” and the test “Characterization – Model – Motor – Linear”, the computation time can be greater than 45 minutes depending on the concerned machine, and is generally lower than 5 minutes when it is without skewing of squirrel cage or slot.

The computation time for computing a working point is generally close to 8 minutes with the skewing of squirrel cage or slots and lower than 1 minute when it is without skewing.

The required allocated memory is higher when Flux® Skew computations are performed at the back-end of the FluxMotor®.

By default, the maximum allocated memory for Flux® Skew software and Flux® 2D software is set to DYNAMIC (user’s preferences - Advanced tab).

Computation of power density for induction machines

There was an issue in the process for computing or displaying the power density for induction machines.

The result was given in W/m^3 while it is in W/kg for other machines SMPM, RSM.

This issue has been corrected.

However, it won’t be possible to use a connector for HyperStudy®, generated with an older version, for driving the FluxMotor® 2022.2.

List of main issues 5

This chapter covers the following:

5.1 All machines

The computation time has increased a lot for transient thermal computations

The computation time needed for the test Characterization/Thermal/Transient is much higher than in the previous version (14 minutes instead of 2 minutes for instance). There is the same problem with the test Performance mapping - Efficiency map while computing user working point(s) analysis with thermal solving.

This issue will be fixed in the next version (ref.: FXM-15653 and FXM-15654).

Full geometry is provided although periodicity would be possible

While exporting a project to Flux 2d or Skew, the periodicity is multiplied by 2 when the number of represented poles is odd and different from 1 (ref.: FXM-15566)

No option to save the work after loss of license

Motor Factory 2022.3 does not give option to save the work after loss of license. (FXM-15557, FXM-15556).

Hairpin architecture

Solving tests or exporting projects to Flux is not allowed when the Hairpin winding is built with two layers. This will be fixed for the next version (ref.: FXM-15516)

Error with automatic connection between FluxMotor and HyperStudy

Sometimes, an error occurs when exporting/opening a connector several times in succession (ref.: FXM-15510).

Unable to execute test with Skew enabled in certain machine models (SMPM-OR)

Sometimes, for certain kind of machine, it is not possible to execute test with a skewed topology. In such cases, the error message contains the following message: “Please decrease the "Relative epsilon for distance between Points” (ref.: FXM-15475).

Export to FeMT with too long output path

The Flux script crashes when the output path for FeMT export is too long (ref.: FXM-15471).

Excel export does not work for the test Model - Maps

For the Synchronous machines with Permanent Magnets – SMPM (ref.: FXM-15465).

Fault in the coupling FluxMotor-HyperStudy

An error in the FluxMotor process doesn't stop the HyperStudy execution (ref.: FXM-15402).

ScriptFactory does not stop correctly

This occurs if the FluxMotor process has been killed externally. Then, ScriptFactory is not able to get back to a valid state, neither automatically, neither after a kill of the process (ref.: FXM-15140)

Bad meshing while representing wires inside the slots

When exporting a project from FluxMotor to Flux 2D, the mesh in the slot can be sometime very bad in the region surrounding the represented wires inside the coil conductors (ref.: FXM-15151).

Issue with exported Flux Skew projects

After exporting a Flux Skew project, if the user solves the project and delete the results and then solve again, the running of the project fails (ref.: FXM-15075).

Null values are not well managed while designing the Frame and shaft

Null values are allowed for designing the housing, bearing or shaft dimensions, but this leads to a wrong thermal analysis. It is highly recommended not to use null values for the considered inputs (ref.: FXM-14705).

Error while opening a motor (2020.1) with null shaft extension

Opening a motor built with the version 2020.1 (or older) with a null shaft extension leads to an error. With new versions, a null shaft extension is forbidden (ref.: FXM-14684).

The interwire space is not well defined

The resulting value of the interwire space applied in the finite element model is twice the value set in the user inputs (ref.: FXM-14672).

Air material properties are wrong for high temperature

This issue impacts our internal computation processes during transient thermal solving. Indeed, some iterations involve very high temperature (more than 3000 °K) according to Newton Raphson non-linear solving method. During the resolution, this can lead to negative conductivity and viscosity which may make the computation fail (ref.: FXM-14465).

> **Note:** in case of problem, An "Air material" with the right parameters can be provided

Internal optimization processes can crash

Sometimes, when FluxMotor® launches an optimization in the back end with HyperStudy®, due to an error in the internal process (evaluation of the objective functions), FluxMotor® crashes.

Moreover, without any log file to explain the issue, one cannot understand the cause of system crash (ref.: FXM-13949).

When an IO cannot be loaded, the test results are not accessible

When an IO cannot be loaded, the whole process that loads all the test results is stopped. As a result, no test is visible although the issue may concern one result in a particular test (ref.: FXM-13941).

A wedge and/or inter-coil insulation region leads to a wrong slot equivalent thermal conductivity

The slot radial thermal conductivity, which is automatically provided by the FluxMotor® in "Cooling-Internal" context, and used in all thermal tests, is wrong if the slot contains faces "wedge" or "inter-coil insulator" (ref.: FXM-13896).

Power electronics and coupling with HyperStudy®

For tests where settings "Electronics" is available, data like power electronics stage, maximum efficiency and its rated power can be selected for generating a connector for HyperStudy®, but it should not be.

In the Export-HyperStudy® area, when the selected test is “Working Point, T-N”, the settings of “Electronics” - "Max efficiency", and "Rated Power" - are exported even if the associated option is not selected (ref.: FXM-13726).

Winding environment – MMF computation

The Counter-Clockwise sequence (MMF computation) is not considered in the Altair® Flux® model which one can export. Only the clockwise phase sequence is considered (ref.: FXM-10280).

Using "phase sequence" - set to "Counterclockwise" leads to wrong results in tests (ref.: FXM-13358).

Flux density isovalues

When a skewed topology is considered (Synchronous machines or induction machines), the flux density isovalues, the vector potential isolines and the rotor bars current density isovalues are not displayed (ref.: FXM-12564).

5.2 Synchronous machines – Motor Factory – Test environment

Working point – Square wave – Forced I – Average computation of quantities

The computation of average quantities like the iron losses, the Joule losses in magnets, torque is not executed over a full electrical period. That can lead to wrong results (ref.: FXM-14091).

Maximum speed computation

The estimation of the maximum speed is wrong for the tests "Working point - Sine wave – Motor - U-I" and "Working point - Sine wave – Motor - T-N", when the control mode MTPA is selected (ref.: FXM-10916). The computation is always performed by considering a MTPV command mode.

5.3 Induction machines – Motor Factory – Test environment

Error while testing and / or Exporting to Flux Skew

Sometimes, solving tests or exporting projects to Flux Skew is not allowed when solid conductors (wires) are represented in all phases and the test or export requires an initialization performed in Steady State AC application. This occurs whatever is the winding type (Classic or hairpin). This mainly concerns IMSQ machines for Working Point - U,f,N.

This will be fixed for the next version (ref.: FXM-15499).

Power balance of No-load working point

Sometimes, computation of No-load working point (slip=0.1%) leads to a NaN (Not a Number) result. The computed amount of iron losses is not consistent with the power balance (ref.: FXM-12600).

Torque slip curve

Test results are not continuously consistent over a torque slip curve. This occurs with the test Performance mapping T(Slip) - induction machines with skewed squirrel cage. When the user targets a working point as an added value to be computed with the whole Torque-slip curve, sometimes this additional working point doesn't belong to the curve (ref.: FXM-12599).

5.4 Part Factory

Wrong management of part borders

An inner part with air region on the bottom border is not allowed (ref.: FXM-13445).

5.5 Script Factory

Script Factory does not stop correctly

Script Factory does not stop correctly, if FluxMotors has been killed (ref.: FXM-15140).

Sometimes the store button status is bad

The store button is not enabled when a file is opened without modification (ref.: FXM-15136).

Script Factory freeze temporarily when running a script

When running a script, script factory gives the impression of freezing (while still running in the background). The editing window of the script becomes unresponsive, until the script is done executing (ref.: FXM-13138).

5.6 Supervisor – Preferences

Reboot after changing language fails

While changing the language in Chinese, then in Japanese the automatic reboot of FluxMotor fails (ref.: FXM-15088).