Altair® FluxMotor® 2023

Release Notes

Updated: 09/01/2023

Intellectual Property Rights Notice

Copyright © 1986-2023 Altair Engineering Inc. All Rights Reserved.

This Intellectual Property Rights Notice is exemplary, and therefore not exhaustive, of intellectual property rights held by Altair Engineering Inc. or its affiliates. Software, other products, and materials of Altair Engineering Inc. or its affiliates are protected under laws of the United States and laws of other jurisdictions. In addition to intellectual property rights indicated herein, such software, other products, and materials of Altair Engineering Inc. or its affiliates may be further protected by patents, additional copyrights, additional trademarks, trade secrets, and additional other intellectual property rights. For avoidance of doubt, copyright notice does not imply publication. Copyrights in the below are held by Altair Engineering Inc. or its affiliates. Additionally, all non-Altair marks are the property of their respective owners.

This Intellectual Property Rights Notice does not give you any right to any product, such as software, or underlying intellectual property rights of Altair Engineering Inc. or its affiliates. Usage, for example, of software of Altair Engineering Inc. or its affiliates is governed by and dependent on a valid license agreement.

Altair HyperWorks®, a Design & Simulation Platform

Altair® AcuSolve® ©1997-2023

Altair® Activate® ©1989-2023

Altair® Automated Reporting Director™ ©2008-2022

Altair® Battery Designer™ ©2019-2023

Altair® CFD™ ©1990-2023

Altair® Compose® ©2007-2023

Altair® ConnectMe™ ©2014-2023

Altair® DesignAI™ ©2022-2023

Altair® EDEM™ ©2005-2023

Altair® EEvision™ ©2018-2023

Altair® ElectroFlo™ ©1992-2023

Altair® Embed® ©1989-2023

Altair® Embed® SE ©1989-2023

Altair® Embed®/Digital Power Designer ©2012-2023

Altair® Embed® Viewer ©1996-2023

Altair® e-Motor Director™ ©2019-2023

Altair® ESAComp® ©1992-2023

Altair® expertAI™ ©2020-2023

Altair® Feko® ©1999-2023

Altair® Flow Simulator™ ©2016-2023

Altair® Flux® ©1983-2023

Altair® FluxMotor® ©2017-2023

Altair® GateVision PRO™ ©2002-2023

Altair® Geomechanics Director™ ©2011-2022

Altair® HyperCrash® ©2001-2023

Altair® HyperGraph® ©1995-2023

Altair® HyperLife® ©1990-2023

Altair® HyperMesh® ©1990-2023

Altair® HyperMesh® CFD ©1990-2023

Altair® HyperMesh® NVH ©1990-2023

Altair® HyperSpice™ ©2017-2023

Altair® HyperStudy® ©1999-2023

Altair® HyperView® ©1999-2023

Altair® HyperViewPlayer® ©2022-2023

Altair® HyperWorks® ©1990-2023

Altair® HyperWorks® Design Explorer ©1990-2023

Altair® HyperXtrude® ©1999-2023

Altair® Impact Simulation Director™ ©2010-2022

Altair® Inspire™ ©2009-2023

Altair® Inspire™ Cast ©2011-2023

Altair® Inspire™ Extrude Metal ©1996-2023

Altair® Inspire™ Extrude Polymer ©1996-2023

Altair® Inspire™ Form ©1998-2023

Altair® Inspire™ Mold ©2009-2023

Altair® Inspire™ PolyFoam ©2009-2023

Altair® Inspire™ Print3D ©2021-2023

Altair® Inspire™ Render ©1993-2023

Altair® Inspire™ Studio ©1993-2023

Altair® Material Data Center™ ©2019-2023

Altair® Model Mesher Director™ ©2010-2023

Altair® MotionSolve® ©2002-2023

Altair® MotionView® ©1993-2023

Altair® Multi-Disciplinary Optimization Director™ ©2012-2023

Altair® Multiscale Designer® ©2011-2023

Altair® newFASANT™ ©2010-2020

Altair® nanoFluidX® ©2013-2023

Altair® NVH Director™ ©2010-2023

Altair® NVH Full Vehicle™ ©2022-2023

Altair® NVH Standard™ ©2022-2023

Altair® OptiStruct® ©1996-2023

Altair® physicsAI™ ©2021-2023

Altair® PollEx™ ©2003-2023

Altair® PSIM™ ©2022-2023

Altair® Pulse™ ©2020-2023

Altair® Radioss® ©1986-2023

Altair® romAI™ ©2022-2023

Altair® RTLvision PRO™ ©2002-2023

Altair® S-CALC™ ©1995-2023

Altair® S-CONCRETE™ ©1995-2023

Altair® S-FRAME® ©1995-2023

Altair® S-FOUNDATION™ ©1995-2023

Altair® S-LINE™ ©1995-2023

Altair® S-PAD™ ©1995-2023

Altair® S-STEEL™ ©1995-2023

Altair® S-TIMBER™ ©1995-2023

Altair® S-VIEW™ ©1995-2023

Altair® SEAM® ©1985-2023

Altair® shapeAI™ ©2021-2023

Altair® signalAI™ ©2020-2023

Altair® SimLab® ©2004-2023

Altair® SimLab® ST ©2019-2023

Altair® SimSolid® ©2015-2023

Altair® SpiceVision PRO™ ©2002-2023

Altair® Squeak and Rattle Director™ ©2012-2023

Altair® StarVision PRO™ ©2002-2023

Altair® Structural Office™ ©2022-2023

Altair® Sulis™ ©2018-2023

Altair® ultraFluidX® ©2010-2023

Altair® Virtual Gauge Director™ ©2012-2023

Altair® Virtual Wind Tunnel™ ©2012-2023

Altair® Weight Analytics™ ©2013-2023

Altair® Weld Certification Director™ ©2014-2023

Altair® WinProp™ ©2000-2023

Altair® WRAP™ ©1998-2023

Altair HPCWorks®, a HPC & Cloud Platform

Altair® Allocator™ ©1995-2023

Altair® Access™ ©2008-2023

Altair® Accelerator™ ©1995-2023

Altair® Accelerator™ Plus ©1995-2023

Altair® Breeze™ ©2022-2023

Altair® Cassini™ ©2015-2023

Altair® Control™ ©2008-2023

Altair® Desktop Software Usage Analytics™ (DSUA) ©2022-2023

Altair® FlowTracer™ ©1995-2023

Altair® Grid Engine® ©2001, 2011-2023

Altair® Hero™ ©1995-2023

Altair® Mistral™ ©2022-2023

Altair® Monitor™ ©1995-2023

Altair® NavOps® ©2022-2023

Altair® PBS Professional® ©1994-2023

Altair® PBS Works™ ©2022-2023

Altair® Software Asset Optimization (SAO) ©2007-2023

Altair® Unlimited™ ©2022-2023

Altair® Unlimited Data Analytics Appliance™ ©2022-2023

Altair RapidMiner®, a Data Analytics & AI Platform

Altair® Analytics Workbench™ ©2002-2023

Altair® Knowledge Hub™ ©2017-2023

Altair® Knowledge Studio® ©1994-2023

Altair® Knowledge Studio® for Apache Spark ©1994-2023

Altair® Knowledge Seeker™ ©1994-2023

Altair® Monarch® Classic ©1996-2023

Altair® Monarch® Data Prep Studio ©2015-2023

Altair® Monarch Server™ ©1996-2023

Altair® Panopticon™ ©2004-2023

Altair® Panopticon™ BI ©2011-2023

Altair® SLC™ ©2002-2023

Altair® SLC Hub™ ©2002-2023

Altair® SmartWorks™ ©2002-2023

Altair® RapidMiner® ©2001-2023

Altair® RapidMiner® AI Hub ©2001-2023

Altair® RapidMiner® Cloud ©2001-2023

Altair® RapidMiner® Studio ©2001-2023

Altair One® ©1994-2023

Altair® License Utility™ ©2010-2023

2023

July 19, 2023

Technical Support

Altair provides comprehensive software support via web FAQs, tutorials, training classes, telephone, and e-mail.

Altair One

Altair One (https://altairone.com/) is Altair's customer portal giving you access to the Marketplace, the Community, Managed Licenses, Altair Drive, My Apps, and the Learning Center. We recommend that all users create an Altair One account and use it as their primary portal for everything Altair.

Altair Community

Visit the Altair Community (https://community.altair.com/community) where you can participate in forums, share insights, access knowledge base articles, and contact Support. Once you login to the Altair Community, subscribe to the forums and user groups to get up-to-date information about release updates, upcoming events, and questions asked by your fellow members.

These valuable resources help you discover, learn and grow, all while having the opportunity to network with fellow explorers like yourself.

Once your Altair One account is set up, use this link to access the Altair support page: www.altair.com/customer-support/

Altair Learning

Altair's in-person, online, and self-paced trainings provide hands-on introduction to our products, focusing on overall functionality. Trainings are conducted at our corporate and regional offices.

For more information visit: https://learn.altair.com/

If you are interested in training at your facility, contact your account manager or technical specialist for more details.

Telephone and E-mail

If you are unable to contact Altair support via the customer portal, you may reach out to technical support via phone or e-mail. Use the following table as a reference to locate the support office for your region.

Altair support portals are available 24x7 and our global support engineers are available during normal Altair business hours in your region.

When contacting Altair support, specify the product and version number you are using along with a detailed description of the problem. It is beneficial for the support engineer to know what type of workstation, operating system, RAM, and graphics board you have, so include that in your communication.

Location	Telephone	E-mail
Australia	+61 3 9866 5557	anzsupport@altair.com
Brazil	+55 113 884 0414	br_support@altair.com

Location	Telephone	E-mail
Canada	+1 416 447 6463	support@altairengineering.ca
China	+86 400 619 6186	support@altair.com.cn
France	+33 141 33 0992	francesupport@altair.com
Germany	+49 703 162 0822	hwsupport@altair.de
Greece	+30 231 047 3311	eesupport@altair.com
India	+91 806 629 4500	support@india.altair.com
Israel		israelsupport@altair.com
Italy	+39 800 905 595	support@altairengineering.it
Japan	+81 3 6225 5830	jp-support@altair.com
Malaysia	+60 32 742 7890	aseansupport@altair.com
Mexico	+52 55 5658 6808	mx-support@altair.com
New Zealand	+64 9 413 7981	anzsupport@altair.com
South Africa	+27 21 831 1500	support@altair.co.za
South Korea	+82 704 050 9200	support@altair.co.kr
Spain	+34 910 810 080	support-spain@altair.com
Sweden	+46 46 460 2828	support@altair.se
United Kingdom	+44 192 646 8600	support@uk.altair.com
United Kingdom/Data Analytics	+44 (0) 8081 892481 +44 203 868 0230	dasupport@altair.com
United States	+1 248 614 2425	hwsupport@altair.com
United States/Data Analytics	+1-800-988-4739 +1 978.275.8350	dasupport@altair.com

If your company is being serviced by an Altair partner, you can find that information on our web site at https://www.altair.com/PartnerSearch/.

See www.altair.com for complete information on Altair, our team, and our products.

Contents

Overview

1

Highlights of the new version

This document gives the major information about Altair® FluxMotor® 2023. The main highlights of this new version are described below.

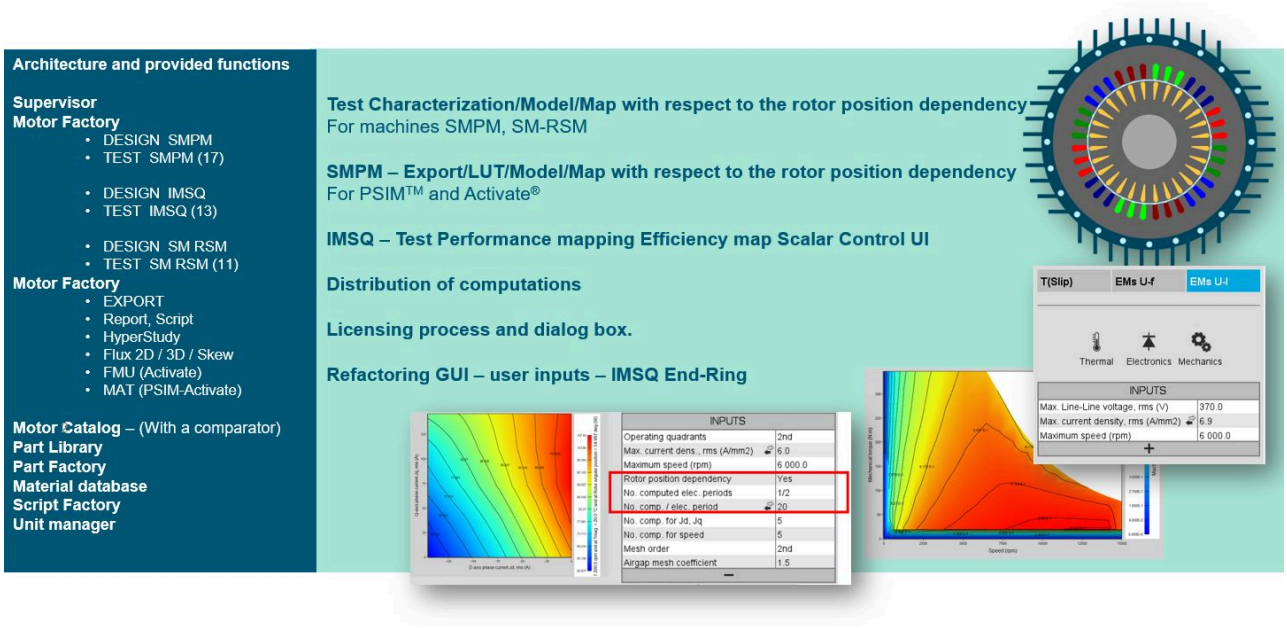
For more detailed information, please refer to the user help guides. The list of documents to read is presented below.

Here are the highlights of the new version:

1. **Improvement of the test Characterization / Model / Maps**
    - Options have been added to compute and display maps with respect to the rotor position dependency
    - This improvement concerns Synchronous Machines with Permanent Magnets (SMPM) and Reluctance Synchronous Machine (RSM) as well.
2. **Export / System LUT (Activate or PSIM) has been updated for exporting data with respect to the rotor position dependency.**
    - This improvement is available for Synchronous Machines with Permanent Magnets (SMPM)
3. **New test for induction machines with squirrel cage**
    - Computation of the efficiency map with scalar control command. In this new test the control is based on the three main user input parameters: "The maximum Line-Line voltage, the maximum line current and the maximum speed.
4. **The distribution of computations is available**

    The parametric distribution of the FluxMotor solver, "Flux", is now possible on a single machine. Distributed computing allows the user to save computation time.
5. **The licensing process and dialog box have been modified to be the same as in Flux®**
6. **The end-ring workspace, a GUI dedicated to user inputs - has been refactored for the induction machine design.**

All the added new features are briefly described below followed by an update on issues and bugs.



FluxMotor 2023 – Highlights

List of new features

2

This chapter covers the following:

2.1 Improvement of the test Characterization / Model / Maps for SMPM & RSM

Options have been added to compute and display maps with respect to the rotor position dependency.

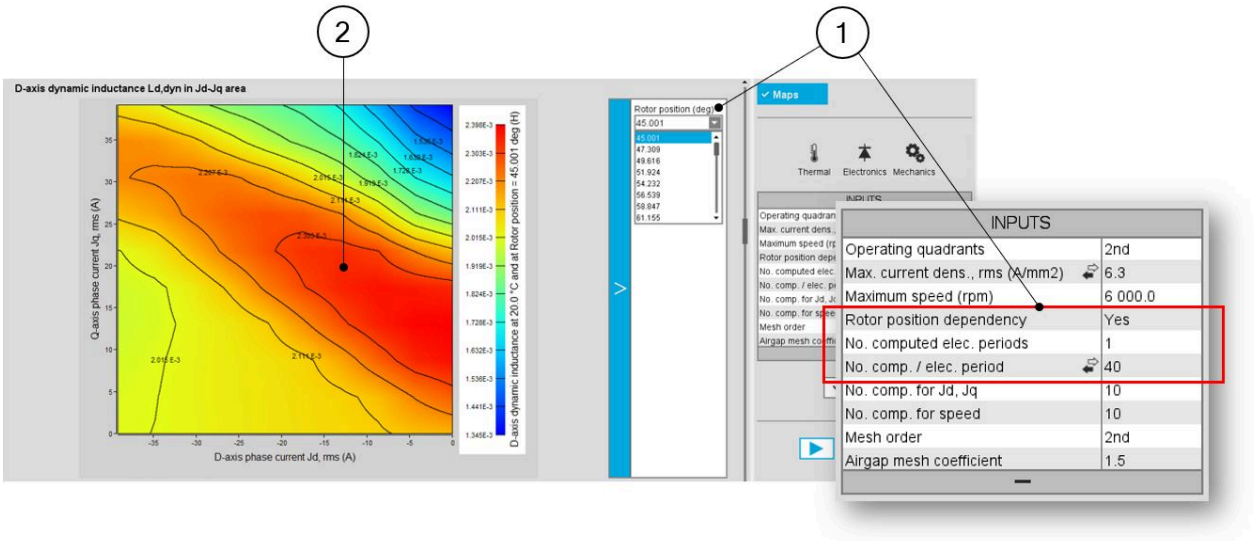
This allows obtaining an equivalent accuracy level as transient computations for most of the Emag. quantities.

Note: This is the first development step to obtain an accurate model for the calculation of efficiency maps.

Note: This improvement concerns Synchronous Machines with Permanent Magnets (SMPM) and Reluctance Synchronous Machine (RSM) as well.

In case the Rotor position dependency is set to “Yes”, computations are done in the Jd - Jq plane with an additional third axis corresponding to the rotor position θr.

Illustrations of results depending on the user’s inputs dealing with the Rotor position dependency (“Yes“, or “No”).

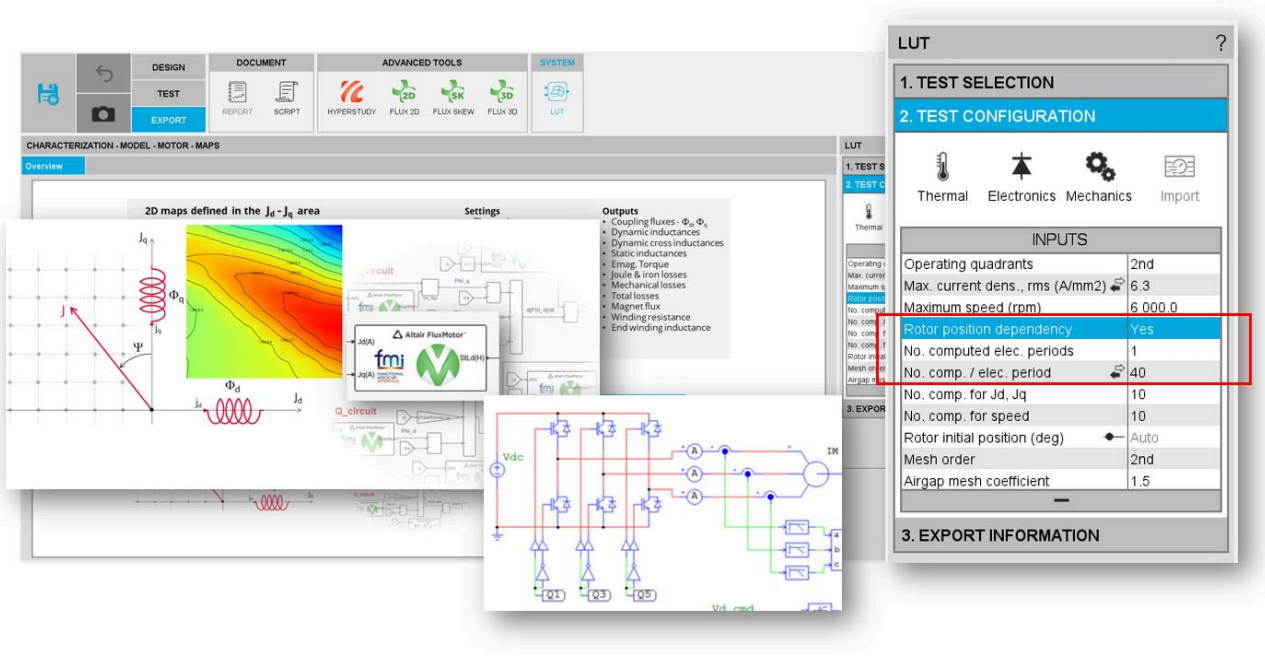


D-axis dynamic inductance in Jd - Jq area

Selection of rotor angular position (1) in the drop-down menu, the map is instantaneously updated (2)

2.2 Improvement of Export / System LUT (Activate or PSIM)

Export / System LUT (Activate or PSIM) has been updated for exporting data with respect to the rotor position dependency



Export / System LUT (Activate or PSIM)

New options to compute and display maps with respect to the rotor position dependency.

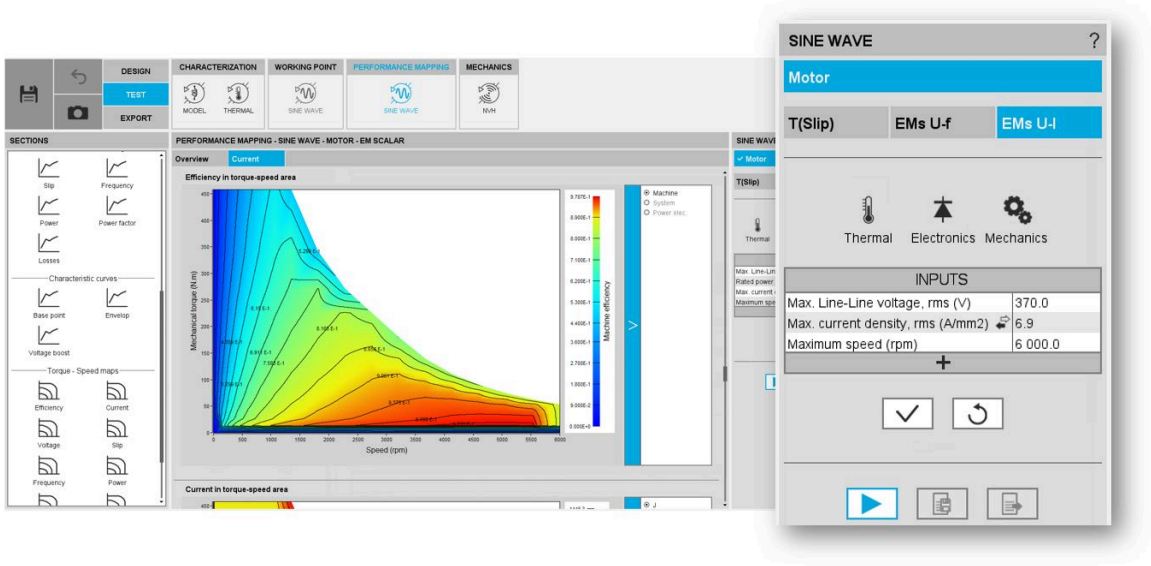
2.3 New tests for induction machines with squirrel cage

Computation of the efficiency map with scalar control command (U-I)

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

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

The main difference with the test “Performance mapping – Sine wave – Motor – Efficiency map scalar U - f” (available in the previous version) is that the speed of the base speed point is not defined by a user input (Rated power supply frequency) but deduced by the internal process of computation to maximize mechanical power.



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

One type of command mode is available: scalar command.

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

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, is presented.

A set of curves (like Torque-Speed curve) and maps (like Efficiency map) are computed and displayed.

Note: Curves are calculated and displayed identically to those presented in the test “Performance mapping – Sine wave – Motor – Efficiency map scalar U-f”.

2.4 The distribution of computations is available in FluxMotor.

Overview

The parametric distribution of the FluxMotor solver, "Flux", is now possible on a single machine. Distributed computing allows the user to save computation time.

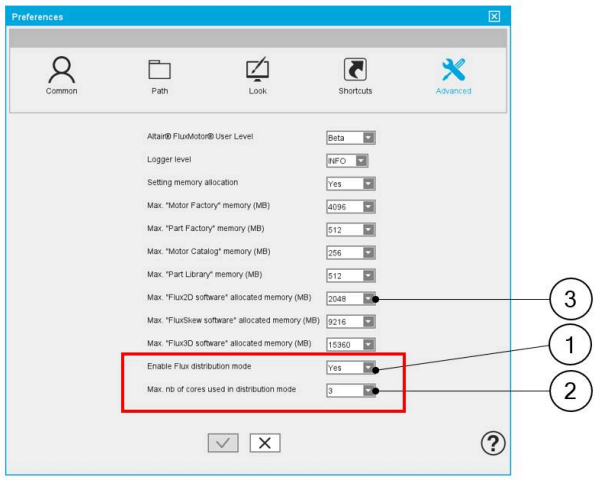
For example, a test "Scalar Maps" may be automatically distributed if the Flux distribution mode is enabled. In this case, several Flux projects will run at the same time to solve all the required test configurations.

The main parameter of a distributed computation is the "Maximum number of cores used in distribution mode" (i.e., the number of running Flux in parallel).

How to set up a parametric distribution on a single machine?

In FluxMotor, the Flux distribution mode (number of secondary Flux in parallel) must be set in "Preferences" in the section "Advanced". It's just needed to set "Flux distribution mode" to "Yes" and to select the "Maximum number of cores" you want to use.

> **Important:** We strongly recommend using static memory with the distribution mode to make the most of the reduction in computation times, which is less important with dynamic memory.



Flux distribution mode

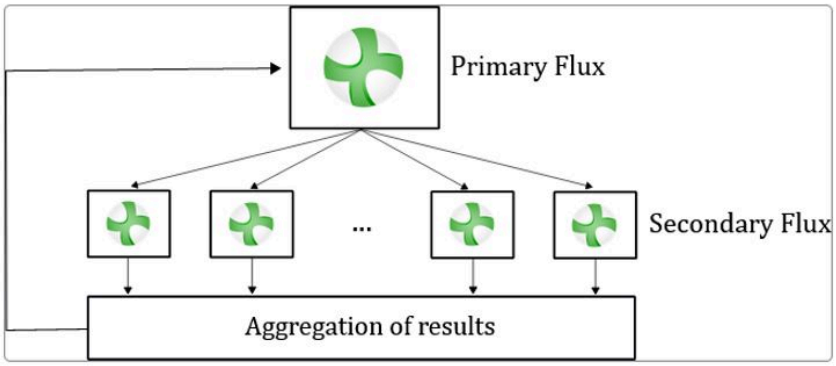
1	Button to enable the Flux solver distribution mode
2	Button to select the maximum number of cores used by the distribution
3	Button to set the allocated memory (The static allocated memory is recommended)

Principles

The "Flux distribution mode" allows the user to save computation time by parallelizing the Finite Element (FE) solving of a test.

Indeed, FE solving is done by parallelizing several independent configurations of a FE problem (such as the value of the stator current) instead of running them sequentially.

A primary Flux project launches and controls all the other secondary projects (distribution). The primary project oversees the gathering of all the results obtained during the solving process by all the sub-projects Flux as shown in the figure below:



Flux distribution mode - Flux process operating principle

When the Flux distribution mode is activated, FluxMotor automatically uses it and manages the number of cores used to reduce, as far as possible, the computation time.

Tests that use "Flux distribution mode" are listed in the following table:

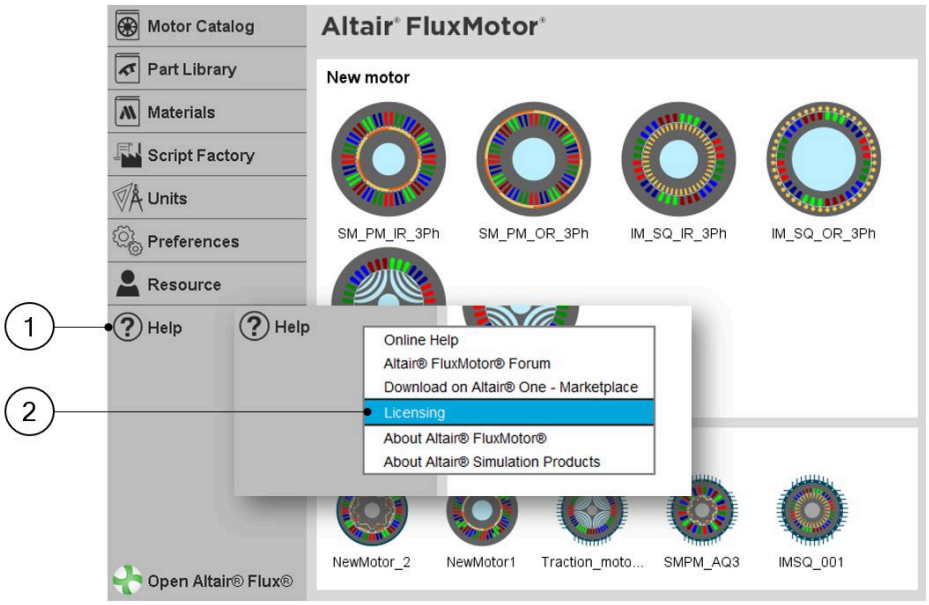
Machine type	Available with Skew	Tests addressed by the Flux distribution
SM PM IR (OR) 3PH	Yes	Test "Characterization - Model - Maps" Test "Working point - Sine wave - T, N" Test "Performance mapping - Sine wave - Efficiency Map"
SM RSM IR 3PH	Yes	Test "Characterization - Model - Maps" Test "Performance mapping - Sine wave - Efficiency Map"
IM SQ IR (OR)	No	Test "Characterization - Model - Scalar Maps" Test "Performance mapping - Sine wave - Efficiency Map scalar U, f" Test "Performance mapping - Sine wave - Efficiency Map scalar U, I"

2.5 Licensing process and dialog box has been modified

Overview

The licensing process and dialog box have been modified and are the same as in Flux®.

From the FluxMotor Supervisor, one can access the license manager by clicking on the “Help” icon and then on the sub-menu Licensing that displays the “License setup” window.



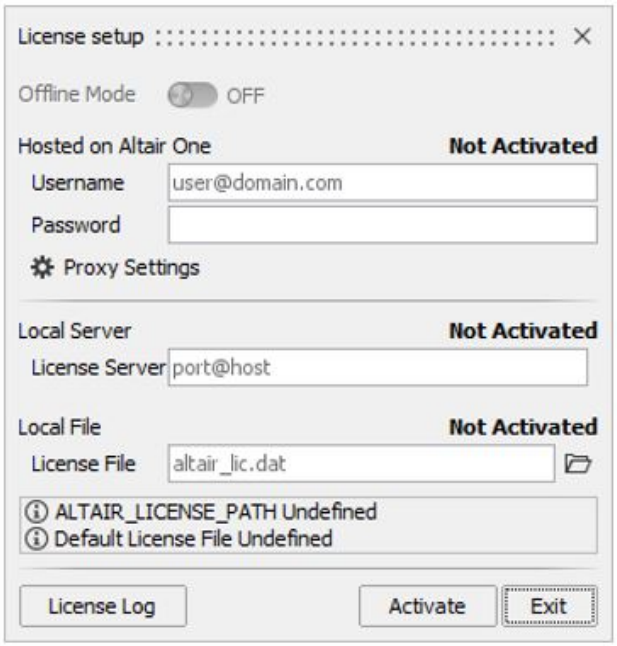
Selection of the “License setup” window

1	Access to the “Help” functions
2	Access to the “License setup” window

This feature allows checking whether a license for FluxMotor is defined or not when the FluxMotor supervisor is launched.

« License setup » window

The “License setup” window has five areas:



The “License setup” window

- Hosted on Altair OneTM. Altair OneTM account license can be used offline (Offline Mode)
- Local server
- Local file
- Information area where messages related to the license are displayed
- License Log, where it is possible to obtain information about the license validity.

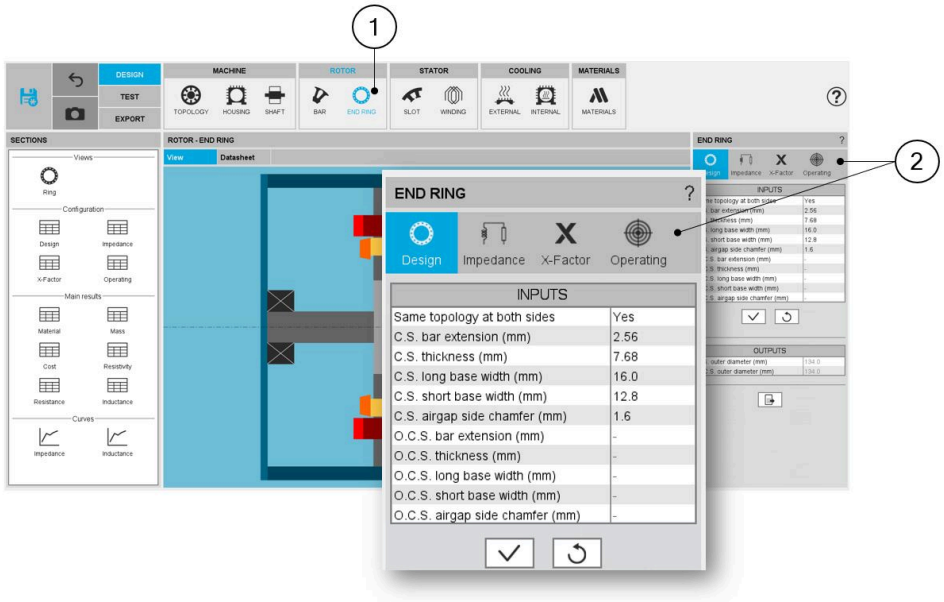
2.6 Further new functions

- Refactoring of end-ring workspace – Section selection mode
- Winding direction for coils

2.6.1 Refactoring of end-ring workspace – Section selection mode

The end-ring workspace, a GUI dedicated to user inputs - has been refactored for the induction machine design.

The process for choosing the section in which user inputs are defined is implemented in the end-ring workspace as illustrated below.

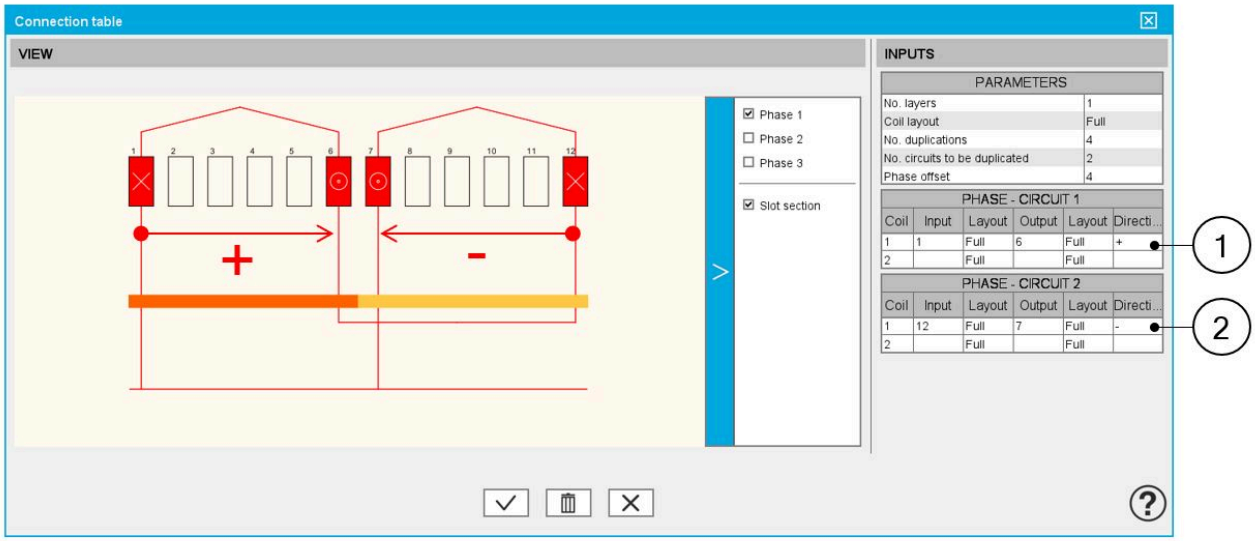


Scrolling selection bar – The end-ring workspace of induction machines

1	End ring workspace
2	Scrolling selection bar where Design, Impedance, X-factor, and Operating conditions sections can be selected.

2.6.2 Winding direction for coils

In the “Expert mode” for defining the winding architecture, it is now possible to orient the coils when defining the phase circuits.



Orient the coils when defining the phase circuits

1	Definition of a positive orientation of the coil i.e., in the clockwise direction from the connection size (=ascending order of slot numbers)
2	Definition of a negative orientation of the coil i.e., in the counterclockwise direction from the connection size (=descending order of slot numbers)

List of fixed issues and major improvements

3

This chapter covers the following:

3.1 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).

These issues have been corrected.

No option to save the work after loss of license

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

These issues have been corrected.

Error with automatic connection between FluxMotor and HyperStudy

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

This issue has been corrected.

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 the system crash (ref.: FXM-13949).

This issue has been corrected.

3.2 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 the Steady State AC application. This occurs regardless of 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)

This issue has been corrected.

List of warnings

4

This chapter covers the following:

4.1 All machines

Network server license activation (FXM-15895)

To use a network server license (port@host information), one must specify this license with the windows environment variable: ALTAIR_LICENSE_PATH.

Setting the network server license into the FluxMotor license setup window doesn't allow running Flux2D or Flux Skew in the backend of FluxMotor, nor opening HyperStudy solution from the export area of Motor Factory.

Distribution of computations cannot be used for computing NVH spectrogram (FXM-15772).

Winding – Expert mode – defining of several circuit per sector

In Expert mode, several parallel circuits can be defined in a sector, and moreover several coils can be built in one circuit.

Such circuits can be connected in parallel according to the user's input No. parallel paths.

In that case, it is mandatory to well balance all the parallel paths while building and connecting the coils inside all the circuits.

Indeed, our internal process of computation doesn’t manage the unbalance between parallel paths i.e. in case of unbalance parallel paths the results of computations are wrong.

> **Note:** For example, unbalance between parallel paths can be due to the number of coils per circuit, which can be different from one circuit to another. It can also be induced by the building of coils (differences in conductor lengths...)

Natural convection for end winding

While choosing a model, where the end spaces are cooled with natural convection, the 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 an 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 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 both the axial and radial views. However, both 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 instantaneous 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 the Flux® 2D model, the resulting python file can be very long. Therefore, the process of building the corresponding model into the Flux® environment can take a longer time.

Browse function

Sometimes, opening a folder from FluxMotor® applications via the 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. Compatibility of HyperStudy connectors with respect of FluxMotor solver versions

   The process that describes how to update the HyperStudy connector has been added to the user help guide "MotorFactory_2023_Introduction.pdf"

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.

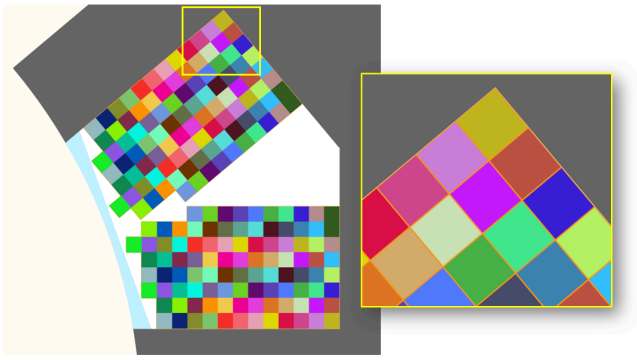
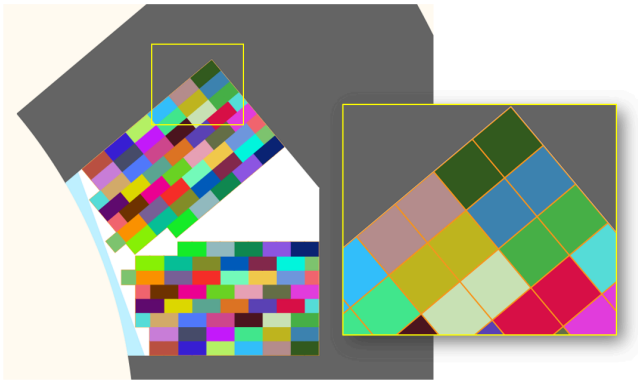
   An error message (inside the log files) is generated while performing HyperStudy studies with a connector provided with a former version of the FluxMotor solver.

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 for a 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 in results can be the following:

- 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 of 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 the 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 into "saved tests" with reference to the original version (All the previous versions).

Sometimes, the 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 expected in transient computation for the test "Characterization - Open-circuit - back-emf".

In such a case, it is recommended to perform a transient computation in the 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, that 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, the inter bar impedance will remain constant, even if a parametric study is performed in the 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 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 the 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 of 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® 2023.

List of main issues

5

This chapter covers the following:

5.1 All machines

When creating a Flux skewed project, issue with project

=> if you save and close your project, it is impossible to open and solve it

=> if you solve the project, it is impossible to delete results and rerun the project (ref.: FXM-15638).

A motor created with the Japanese language cannot be opened

When we create a catalog and a motor with the Japanese language enabled, the catalog of the motor cannot be opened if the user switch back to the English language (ref.: FXM-15827).

The memory preferences are not kept consistent with the execution of a long test

When several instances of batch are run in parallel, we regularly observed that the memory preferences are not kept consistent between two consequent executions of Flux Jobs (ref.: FXM-15777).

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).

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).

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).

Script Factory 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 nor 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, deletes the results, and then solves 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 the 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 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 the 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 a problem, an “Air material” with the right parameters can be provided.

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, and 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 Synchronous machines – Motor Factory – Export environment

Export LUT MAT - Error in FLUX_ID0 variable in thermal solving.

This issue occurs in the EXPORT / SYSTEM / LUT while exporting a MAT-PSIM-Activate format file with thermal solving (with several magnet temperatures).

One of the variables contained in the .mat file (FLUX_ID0) is only generated for the maximum magnet temperature.

In other words, if Tmag=[20, 100, 200], the values stored in FLUX_ID0 correspond to Tmag=200 but the user is not informed about this fact (ref.: FXM-15886).

5.4 Induction machines – Motor Factory – Test environment

Error when exporting and solving a project in Flux Skew – Transient application

This issue occurs when the user input “Represented coil conductors” is set to All phases (ref.: FXM-15877).

Current Max is not respected in IMSQ Scalar control

In the scalar control for induction machines with squirrel cage, the imposed maximum current is not respected (ref.: FXM-15701).

Working Point - UfN – Error while saving the test

For induction machines with an outer rotor, when performing the computation of a working point by using the Accurate with 1

phase Mode, then if you save the test and then perform the computation of the working point by using the Fast test: the computation fails

If we use the inverse sequence: Fast > Save > Accurate, there is no error (ref.: FXM-15868).

IMSQ - Scalar Maps or Efficiency map (U,f) tests fails with hairpin winding technology

Sometimes, the tests Scalar Maps and Efficiency map (U,f) are not correctly solved with a hairpin winding configuration, like for the Motor M1 of the reference catalogue (ref.: FXM-15843).

Power balance of No-load working point

Sometimes, computation of the 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 a 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).

5.5 Part Factory

Wrong management of part borders

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

5.6 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).

5.7 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).