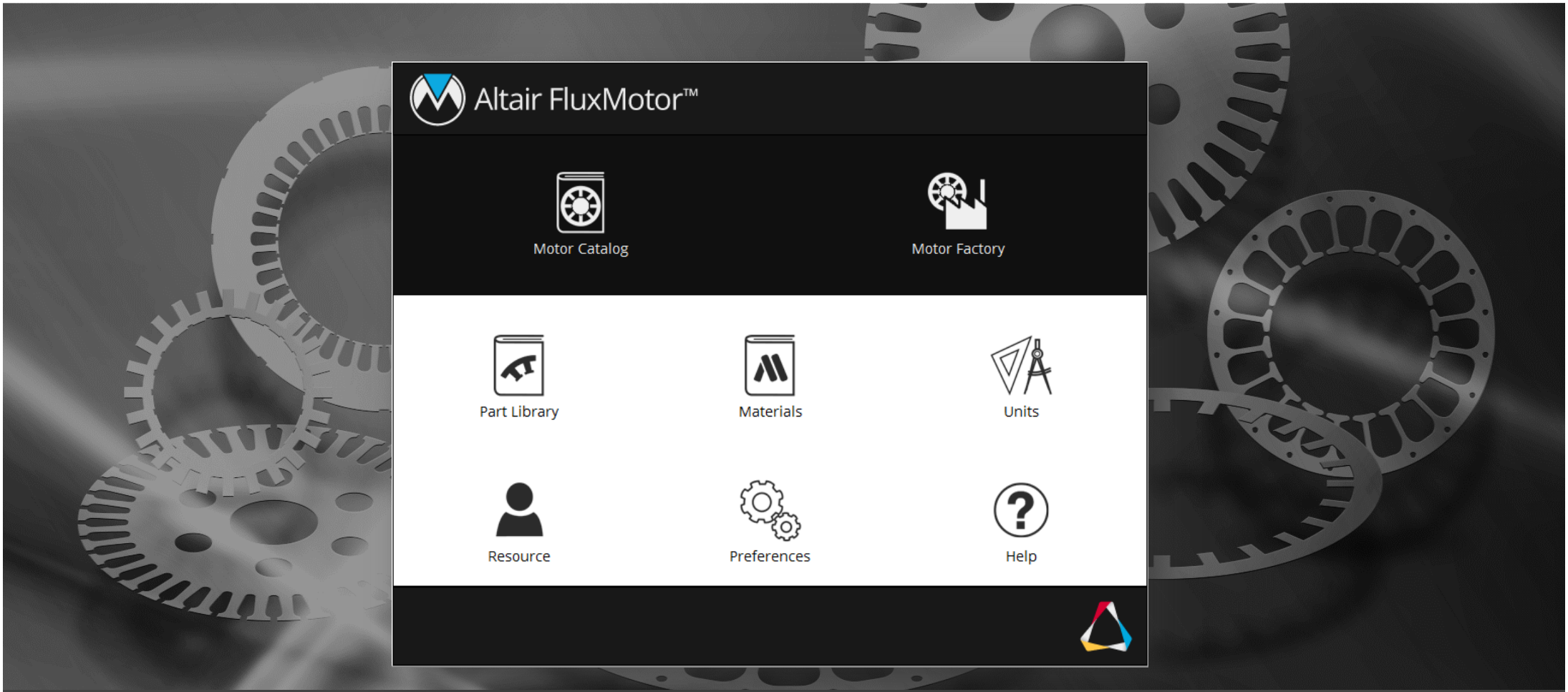

Altair FluxMotor™

e-Motor concept design

Fabrice Marion • FluxMotor Program Manager • October 2019

Altair

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Why Altair FluxMotor™ ?

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NOWADAYS: THE CONSTRAINTS AND OBJECTIVES

Looking to achieve …

- … Sustainable development, Efficiency, Green Energy

In a world with vanishing borders…

- … Globalization: competitive open environment

Designing is sometimes repurposing…

- … Catalog of full motors to adapt

Optimizing designs and operations is the goal …

- … Interchangeable parts, Topology screening

…DESIGN BETTER, FASTER AND CHEAPER

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THE NEED ? FOR WHOM ? FOR WHAT PURPOSE?

Design & manufacture

- Electric motor designer, manufacturers…

Evaluate & integrate

- Integrators, OEM…

Demonstrate & sell

- Sales staff, supplier, training staff…

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PRODUCT TARGETS

A global dedicated platform to **e-Motor concept design**

Fast evaluation of techno-economic performance

Support users to **make documented decision quickly**

Accessible to a **broad range of users**

- Whatever the level of use, whatever the task

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OUR PRIORITIES

High productivity gain

Fast analysis with good accuracy

Possible customizations… parts

Connection for advanced study

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HIGH PRODUCTIVITY GAIN

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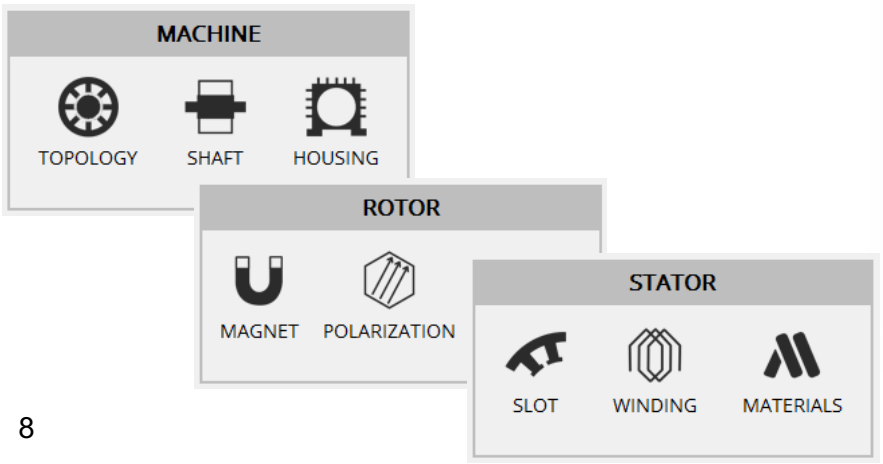
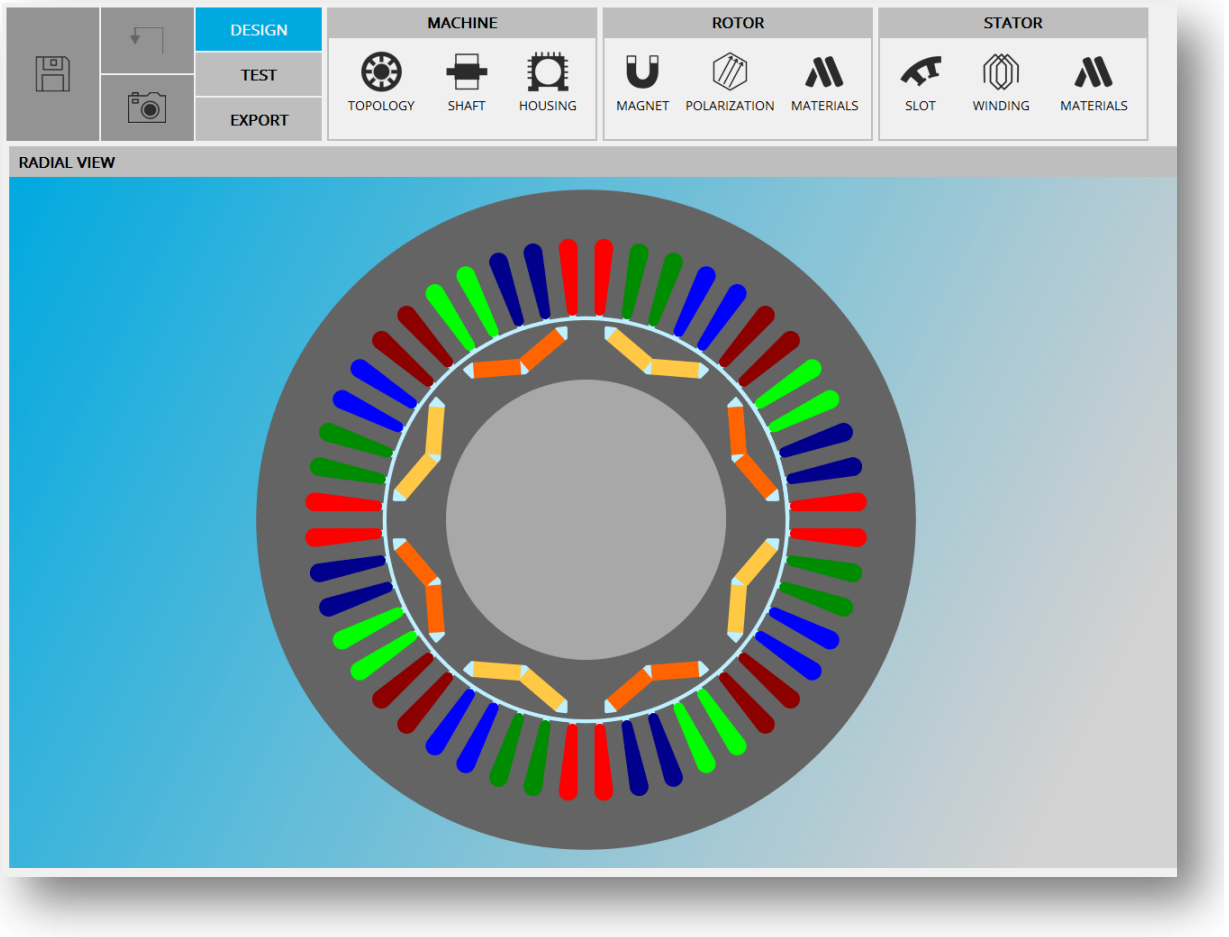
DESIGNING ELECTRIC MOTORS

Straightforward workflow

A new machine project within minutes





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DESIGN

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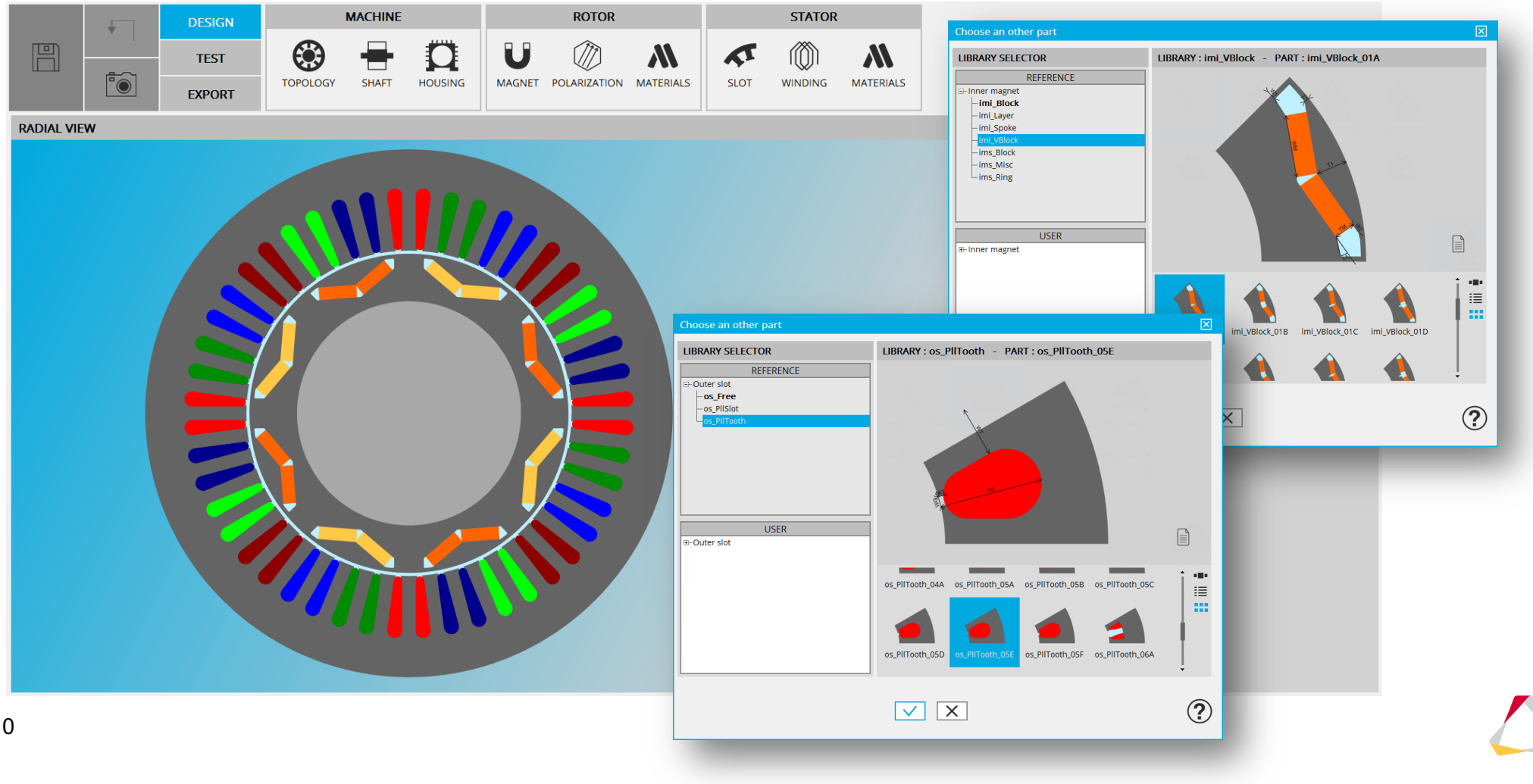
SYNC. MACH. PERMANENT MAGNETS – INNER ROTOR



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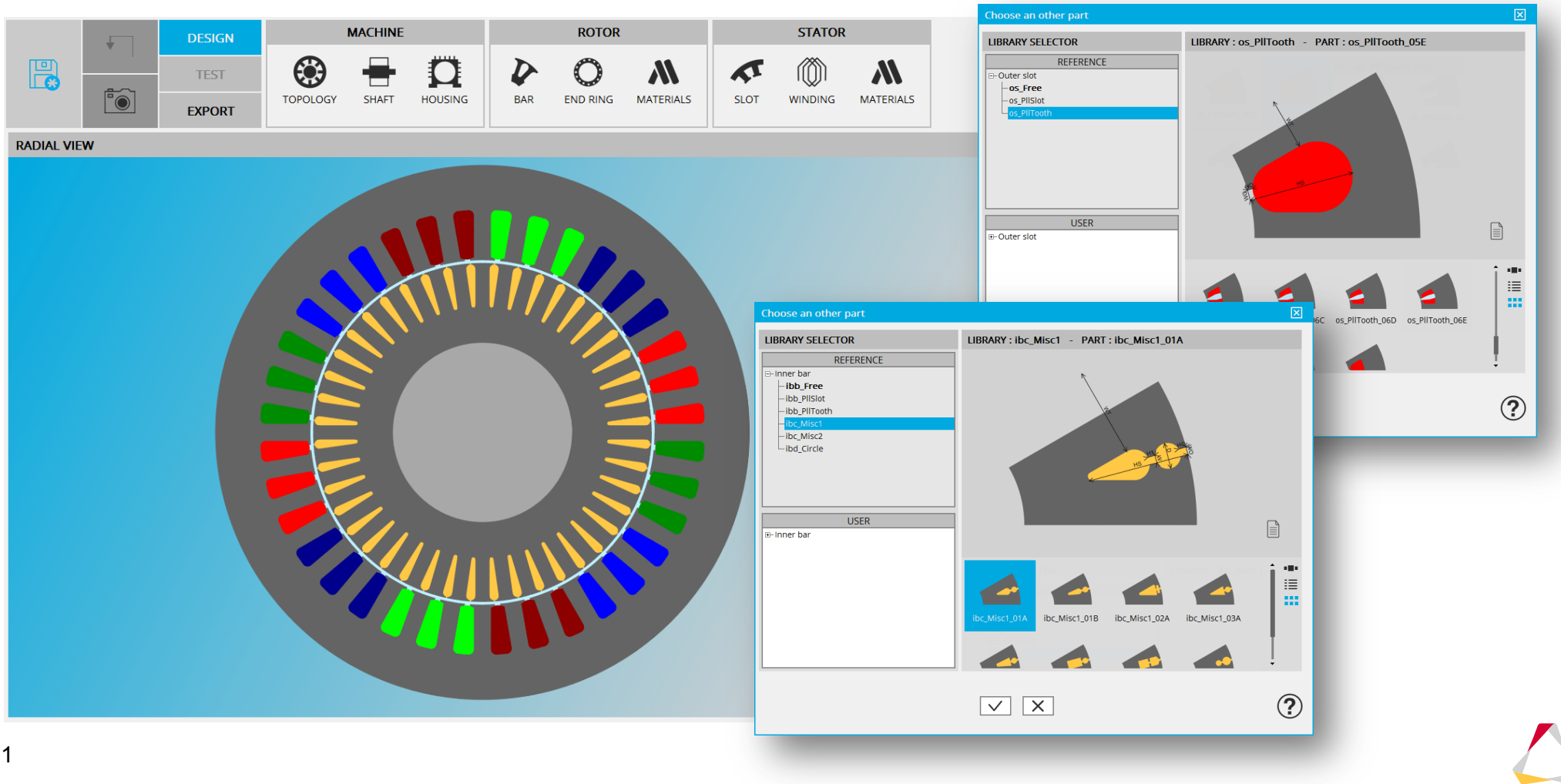
IND. MACH. SQUIRREL CAGE – INNER ROTOR



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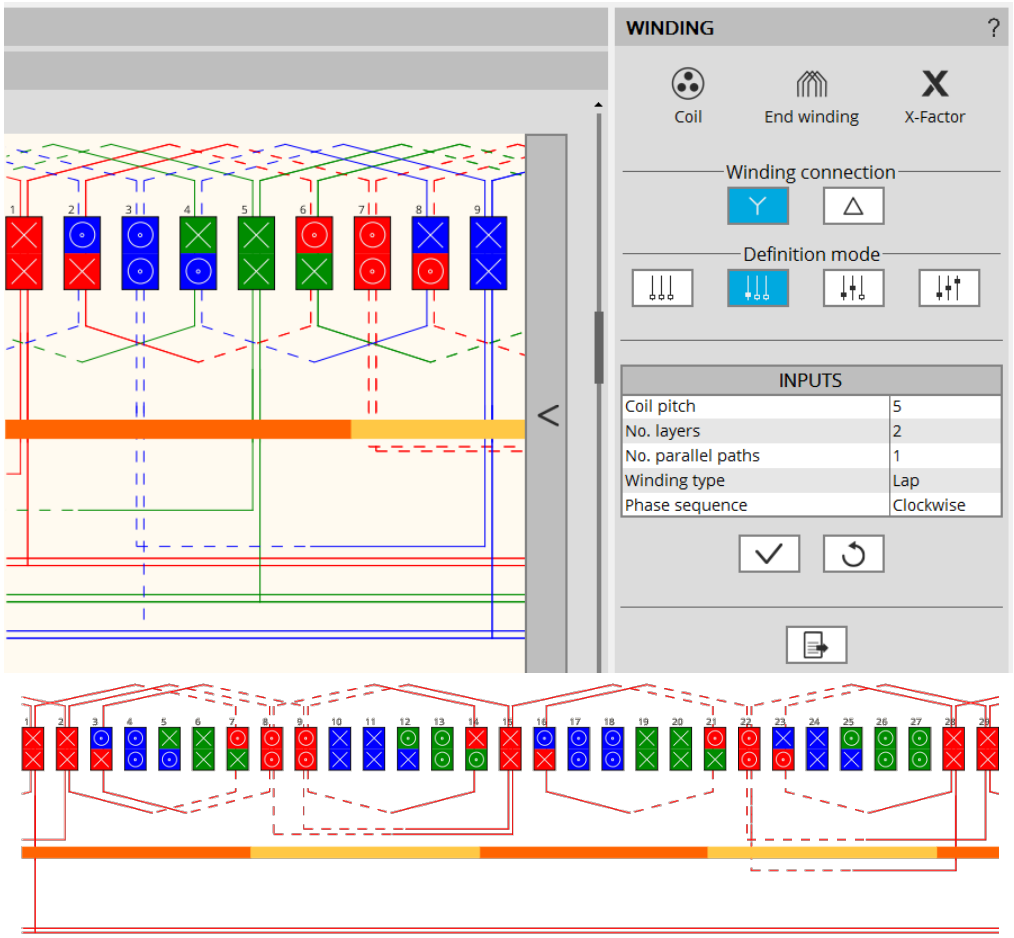
USER-ORIENTED WINDING TOOL

4 winding modes
- Automatic, Easy, Advanced and Expert
- Settings adapted to the task

An automatic diagnostic is issued
- With quality criteria of the winding
- To adjust the winding parameters

An automatic winding report
- Main information to build the winding



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TEST

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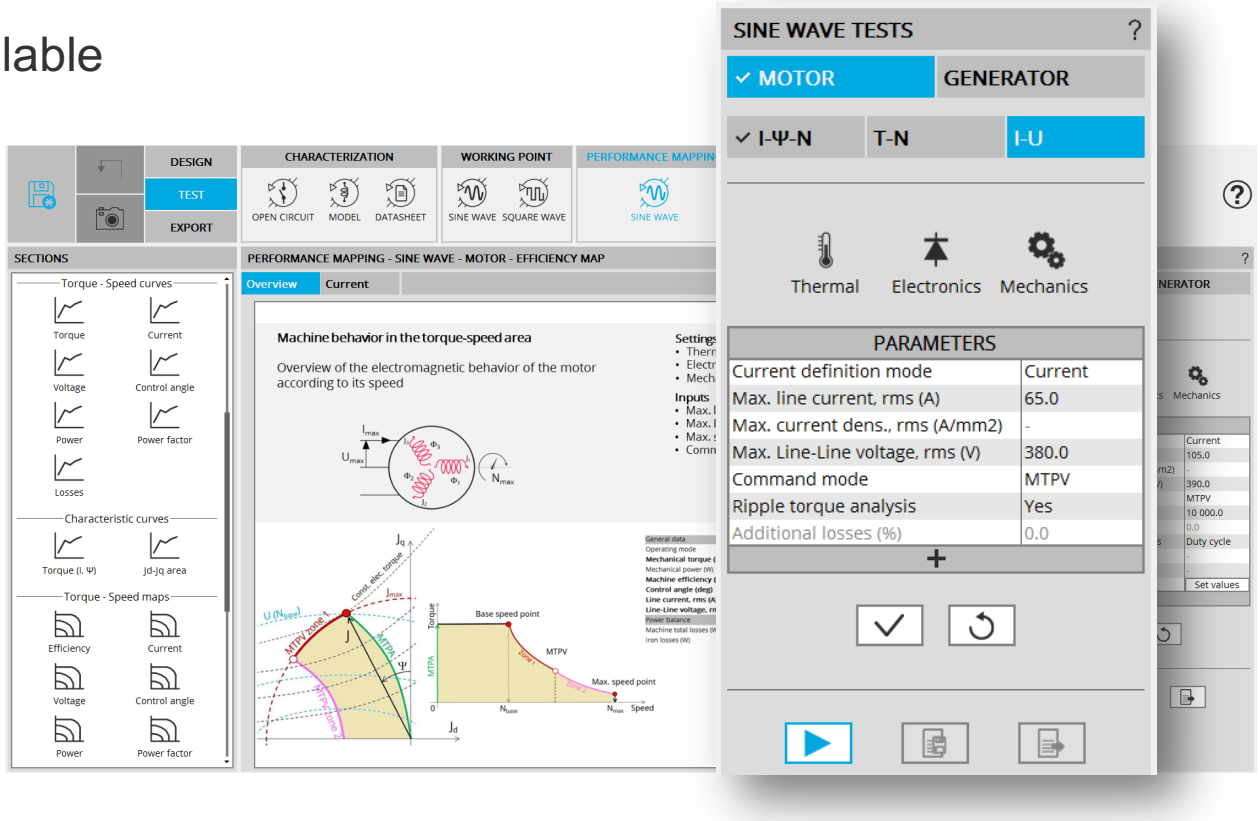
TESTING AND EVALUATING ELECTRIC MOTORS

Standard and relevant test portfolio available

Predefined tests ready to be performed

Relevant input parameters

Results are automatically illustrated



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FAST ANALYSIS WITH GOOD ACCURACY

"Flux" as Finite Element solver inside!

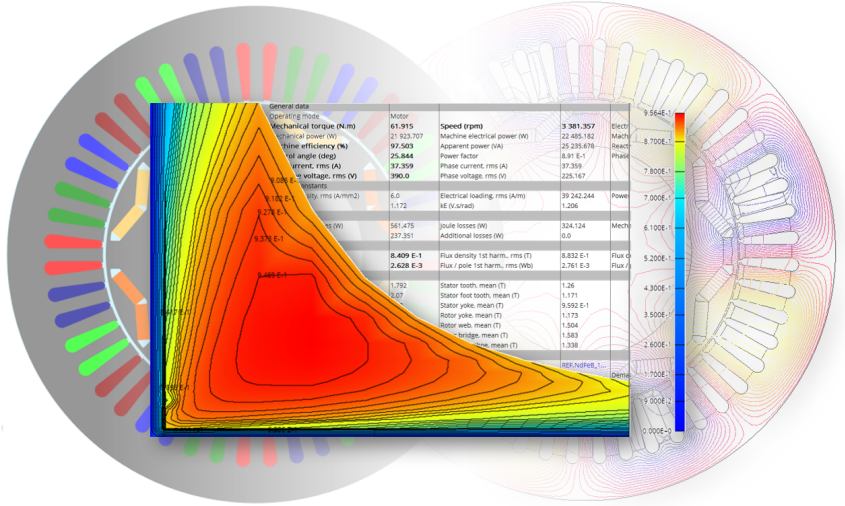
- Topologies of machines are perfectly respected
- Saturation of materials are taken into account

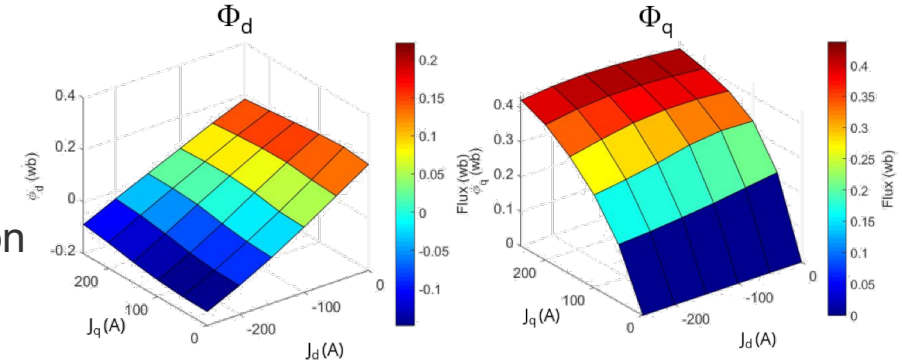
Analytical + FE computations

- Highest ratio between quick computations and accuracy of results

Processes based on optimization technology

- Response surfaces are computed to prepare optimization





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BUILDING BLOCKS AVAILABLE

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EFFECTIVE MACHINES PARTS MANAGEMENT

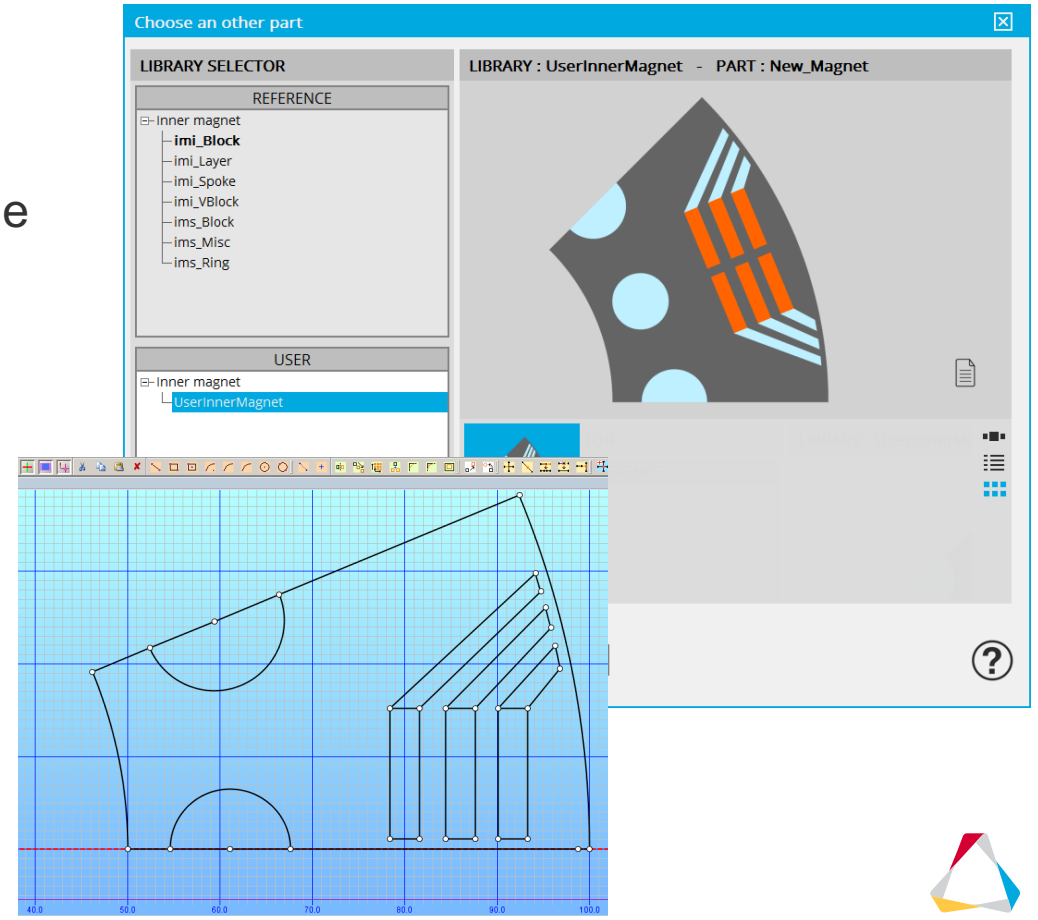
Libraries are provided with standard parts

A large number of slots, magnets or bars available

All the topologies are parameterized

Customization of parts is possible

Parts can be created from Flux2D sketcher



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POWERFUL PROJECT MANAGEMENT

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EFFICIENT PROJECT MANAGEMENT

Enhance project management

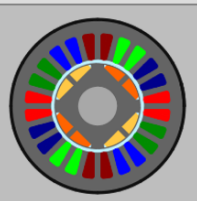
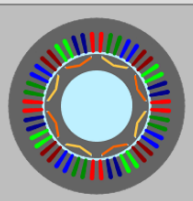
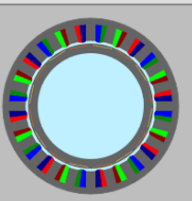
Access quickly to past studies

Manage full range of products

Quick performance comparison

An embedded comparator is available

COMPARATOR

	 UserSynchronous.Motor_1	 AutomotiveApplication.Camry_2007	 AutomotiveApplication.Accord_2005
Electrical frequency (Hz)	400.84	267.053	201.688
Performance			
Machine electrical power (W)	1.21 E5	1.195 E5	22 216.911
Reactive power (VAr)	1.226 E5	1.316 E5	17 975.375
Apparent power (VA)	1.724 E5	1.777 E5	28 576.529
Mechanical power (W)	1.149 E5	1.13 E5	20 861.002
▶ **Machine efficiency (%)**	94.953	94.563	93.897
Power factor	7.027 E-1	6.723 E-1	7.774 E-1
Mechanical torque (N.m)	91.233	269.354	131.694
Ripple mech. torque, pk-pk (N.m)	27.261	25.797	15.241
Machine characteristics			
Max. current dens., rms (A/mm2)	24.223	11.758	10.54
Electrical loading, rms (A/m)	1.487 E5	1.448 E5	68 106.242
Power density (W/kg)	7 664.047	3 807.525	1 414.944
kT (N.m/A)	2.016 E-1	8.689 E-1	5.853 E-1
kE (V.s/rad)	2.206 E-1	8.464 E-1	6.236 E-1
Phase resistance (Ω)	1.698 E-2	3.993 E-2	1.509 E-2
D-axis inductance Ldu (H)	9.305 E-4	2.771 E-3	5.15 E-4
Q-axis inductance Lqu (H)	9.426 E-4	3.206 E-3	5.171 E-4
Masses & Inertia			
Rotor mass (kg)	4.312	4.925	4.01
Stator mass (kg)	11.535	24.751	10.734

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EFFICIENT PROJECT MANAGEMENT

Motor project management
with Motor Catalog

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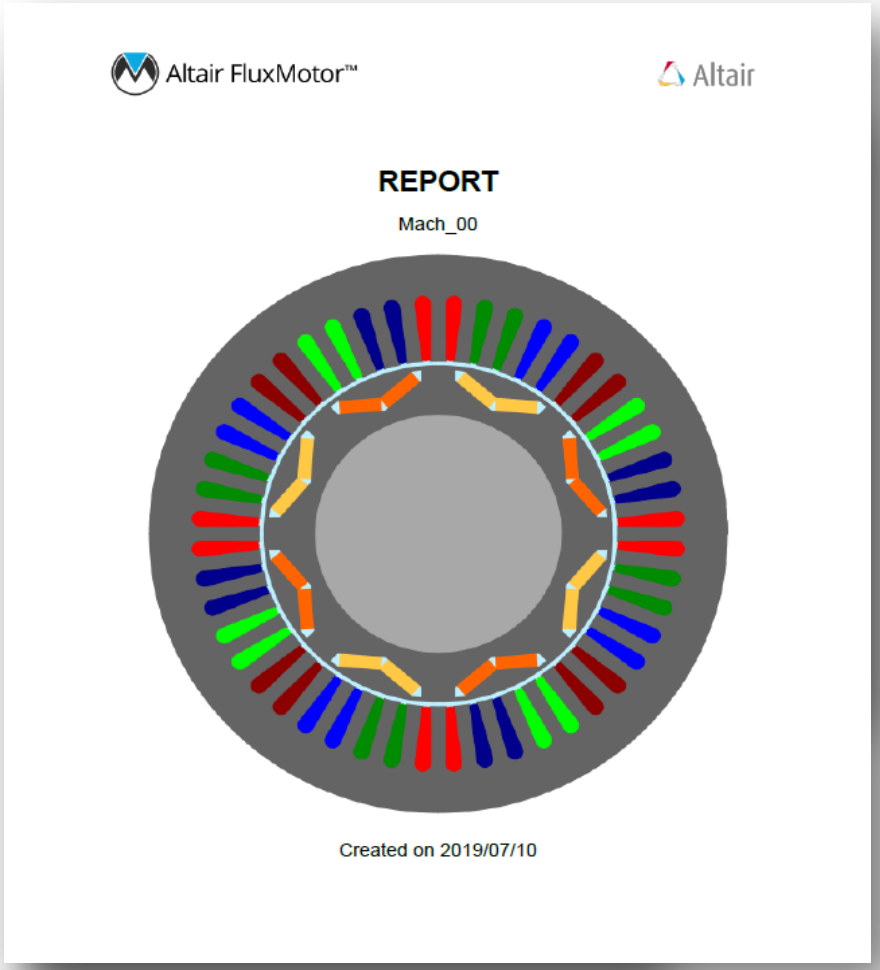
GETTING A REPORT AUTOMATICALLY

Description of all the achieved work

Design and tests

Html or pdf format

Easy machine performance comparison



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CONNECTION FOR ADVANCED STUDY

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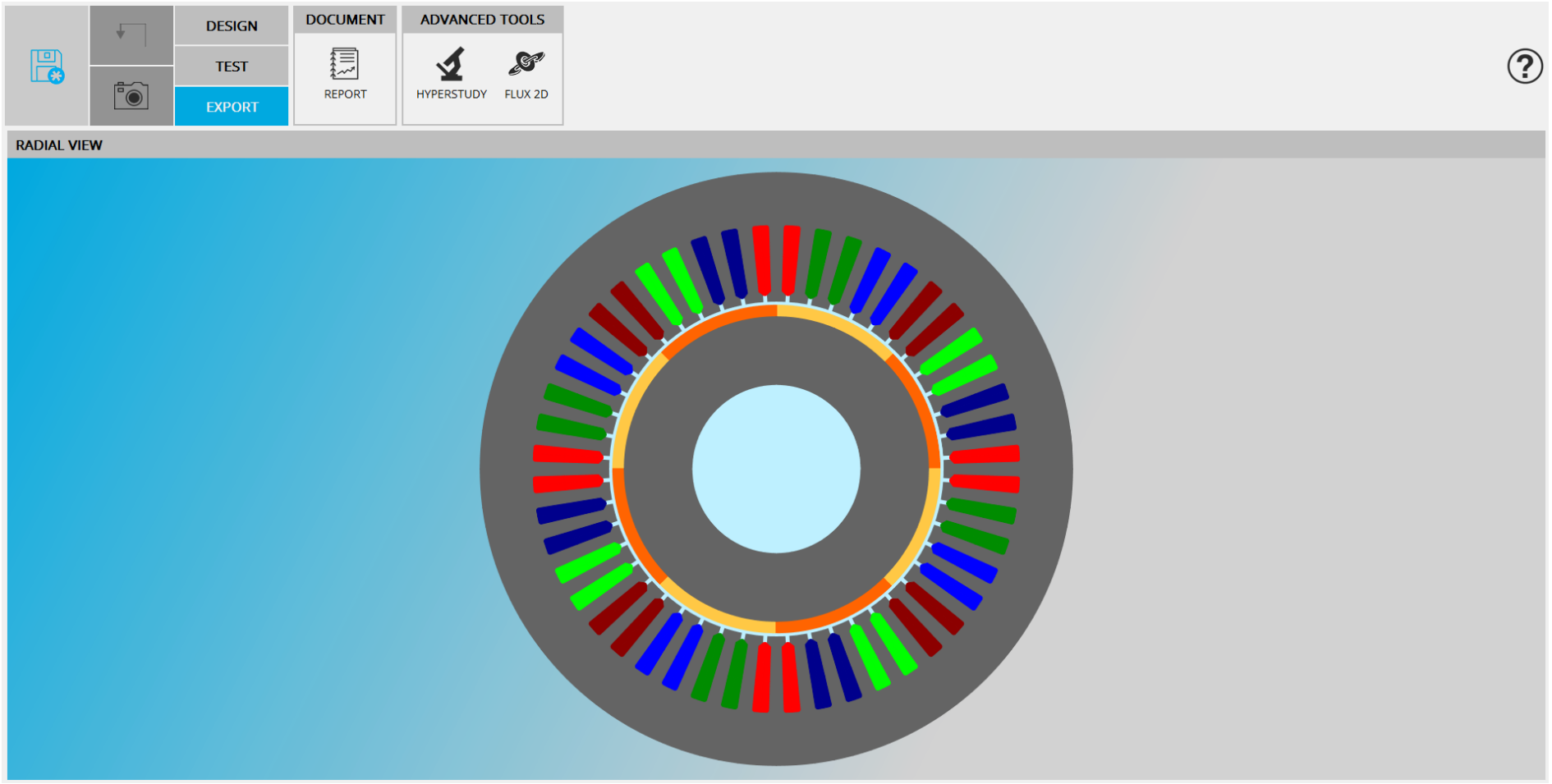
ADVANCED TOOLS...A CONNECTION TO GO FURTHER



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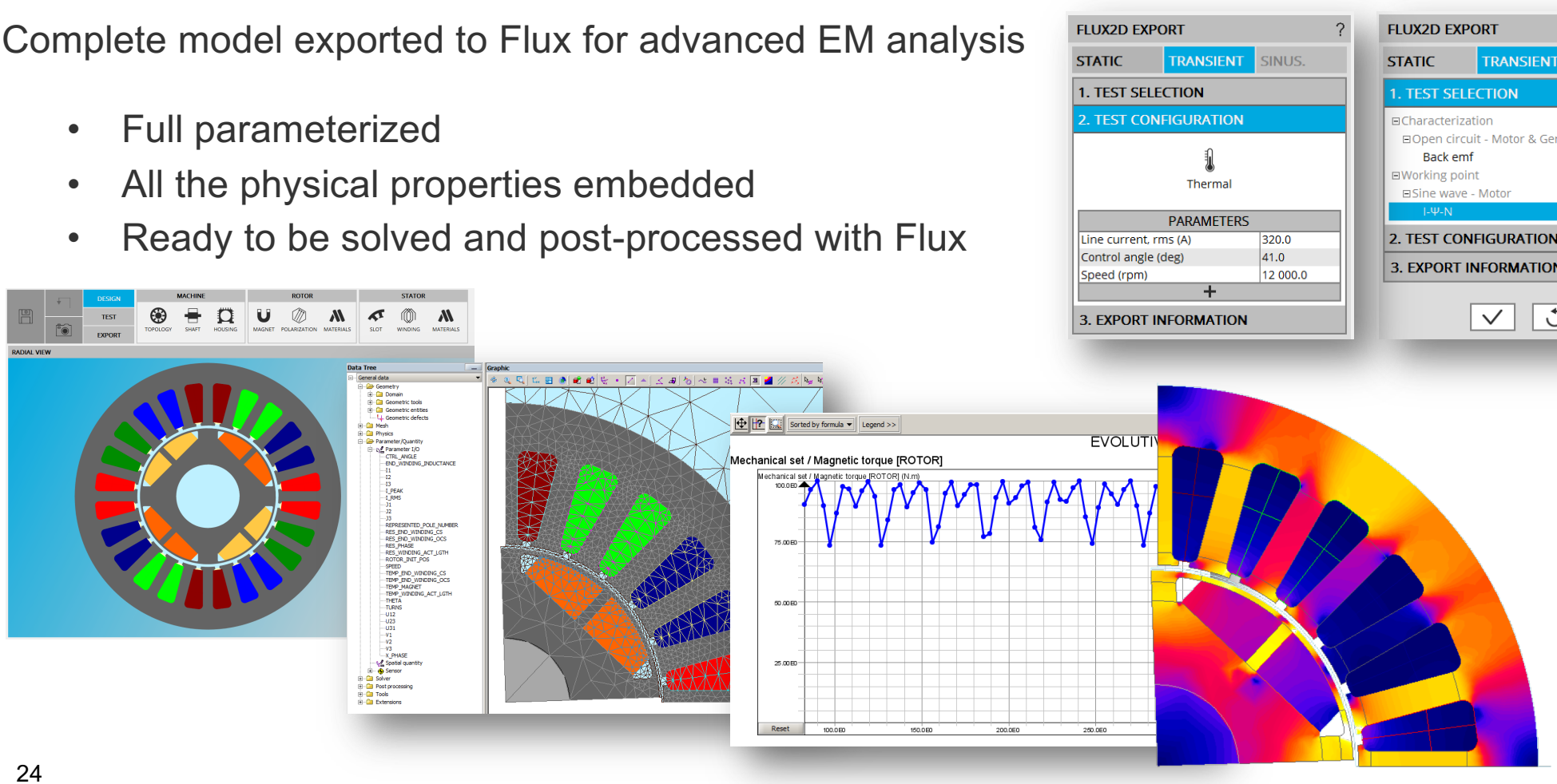
EXPORT TO FLUX 2D FOR ADVANCED EM ANALYSIS

Complete model exported to Flux for advanced EM analysis

- Full parameterized
- All the physical properties embedded
- Ready to be solved and post-processed with Flux



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EXPORT TO FLUX SKEW FOR ADVANCED EM ANALYSIS

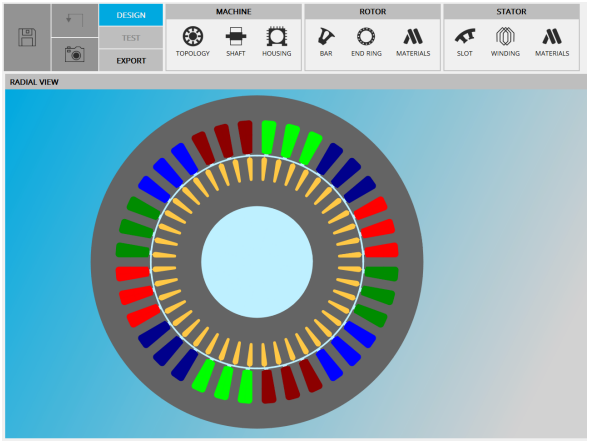
For induction machines

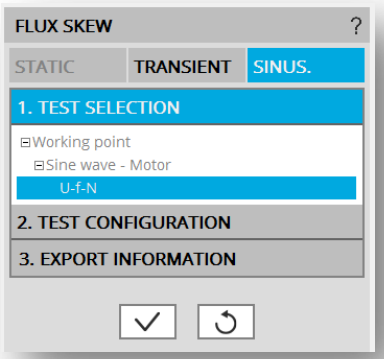
at any time, the Flux Skew model ready to be used

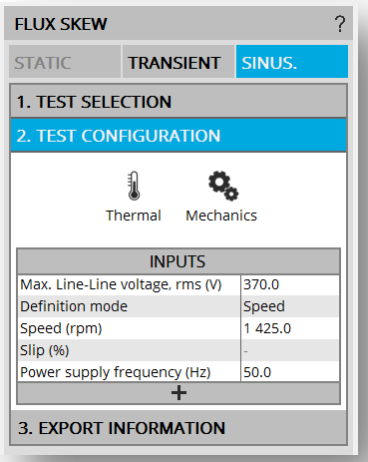
Full parameterized

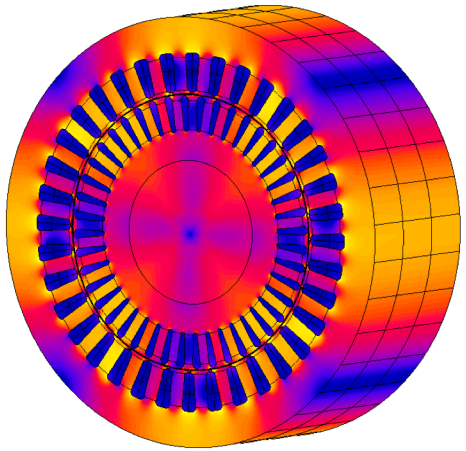
All the physical properties embedded

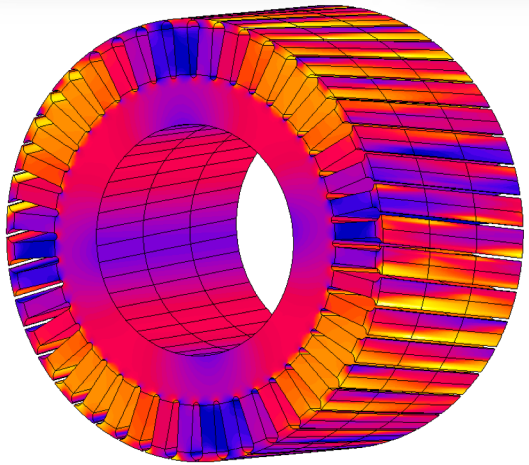
Ready to be solved in Flux Skew Environment











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EXPORT TO FLUX SKEW FOR ADVANCED EM ANALYSIS

Designing and testing
induction machine squirrel cage
in few clics

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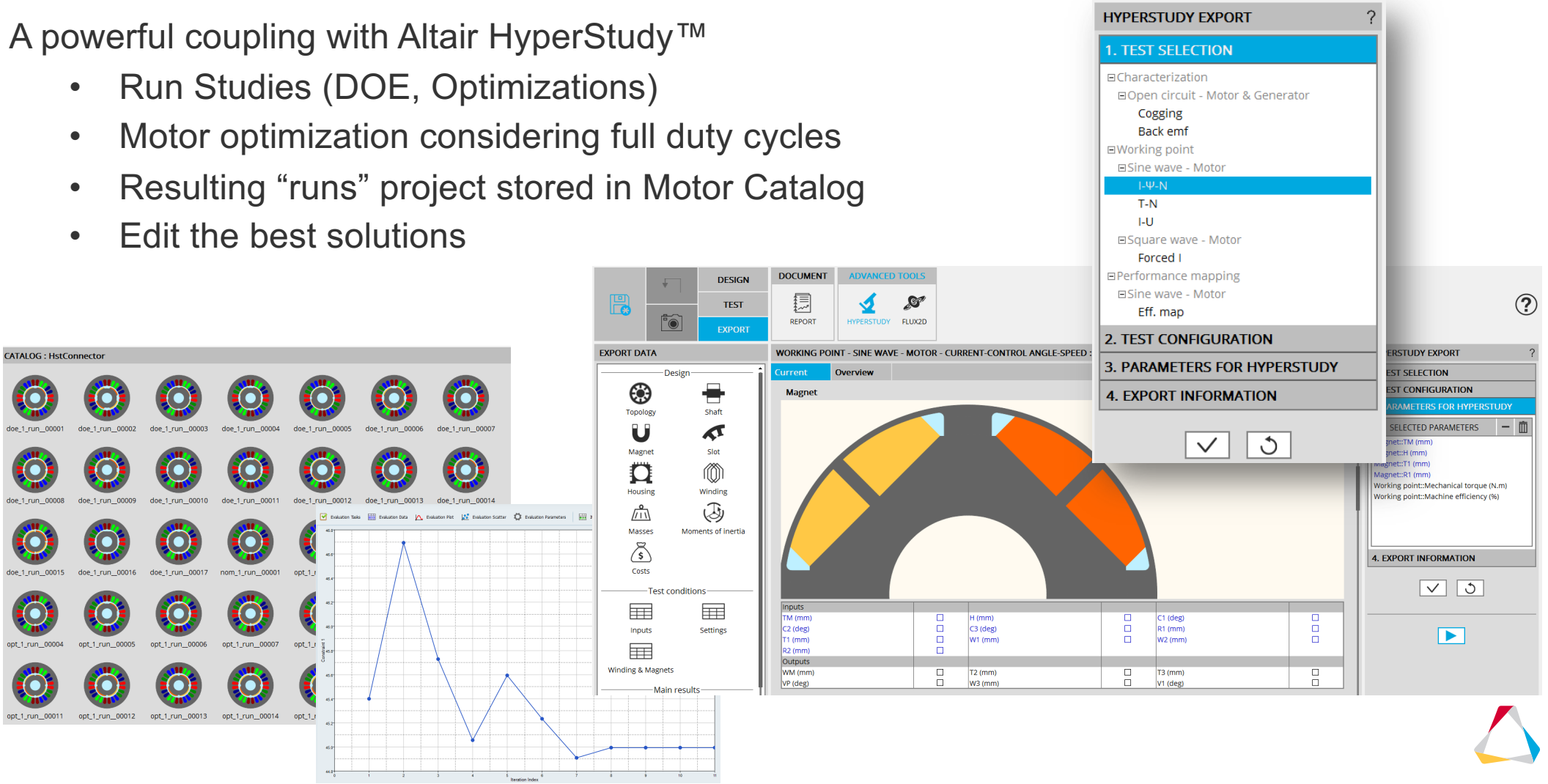
PERFORM OPTIMIZATION – COUPLING WITH HYPERSTUDY

A powerful coupling with Altair HyperStudy™

- Run Studies (DOE, Optimizations)
- Motor optimization considering full duty cycles
- Resulting “runs” project stored in Motor Catalog
- Edit the best solutions



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PERFORM OPTIMIZATION – COUPLING WITH HYPERSTUDY

Exploring the Potential of an e-Motor Concept with Early Optimization

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DEMO

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AS A CONCLUSION… BENEFITS

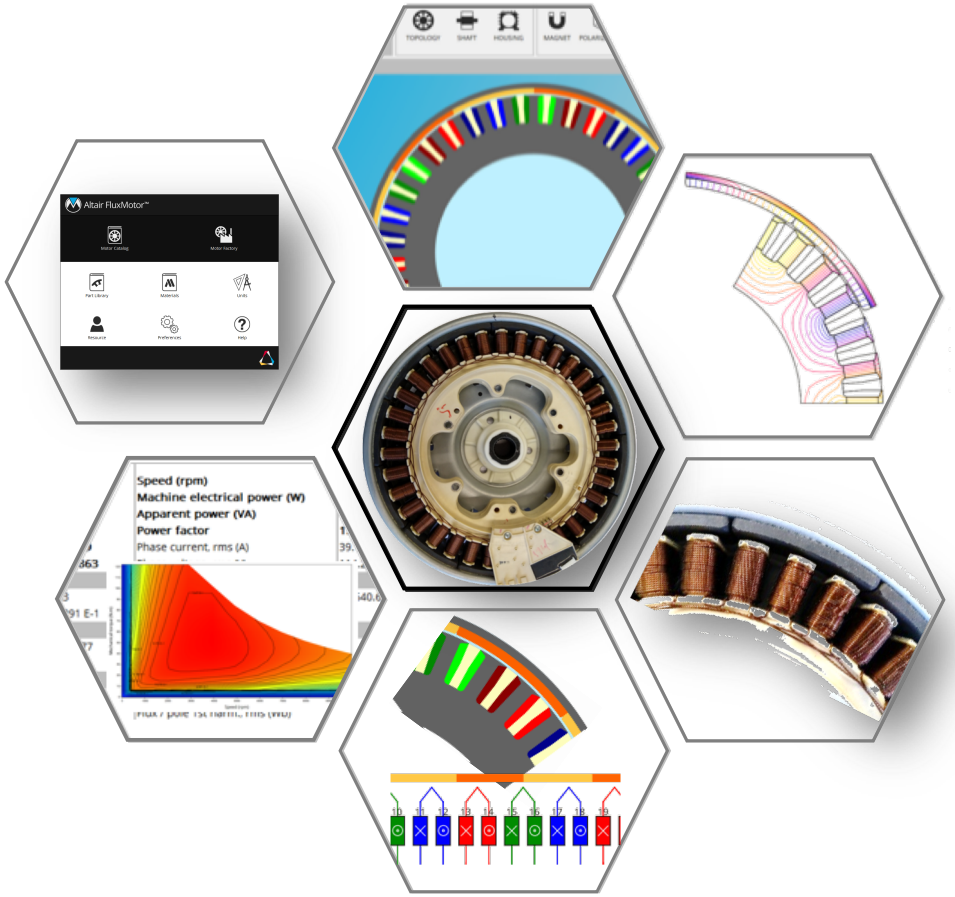
High productivity gain

Addressing a broad range of users

Fulfill all the design tasks

Good accuracy

Connection for advanced study



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THANK YOU

ANY QUESTIONS ?