

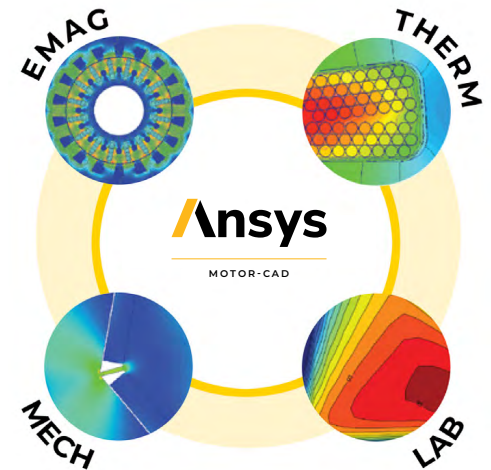
## Integrated Multiphysics Analysis Software for Electric Motor Design

Ansys Motor-CAD is the world-leading dedicated electric motor design software for multiphysics simulation of electrical machines across the full torque-speed range.

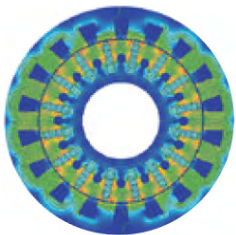
Evaluate motor topologies and concepts across the full operating range and produce designs that are optimized for size, performance and efficiency. Motor-CAD software's four integrated modules — EMag, Therm, Lab and Mech — perform multiphysics calculations quickly and iteratively, so you can get from concept to final design in less time.

With decreasing development cycles, motor designers need to make design decisions quickly, and with certainty that they will not face problems down the line. Fast calculations and streamlined data input processes leave time for Motor-CAD users to explore more motor topologies and fully assess the impact of advanced loss effects in the initial stages of a design.

Motor-CAD software's intuitive, template-based setup and embedded multiphysics expertise simplifies the design process and reduces reliance on multiple teams for specific electromagnetic, thermal or mechanical experience — so motor designers can keep more control over their designs.

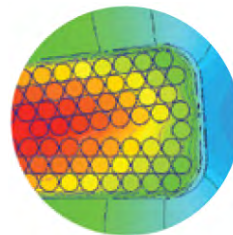


### / MOTOR-CAD: INTEGRATED MULTIPHYSICS DESIGN TOOL



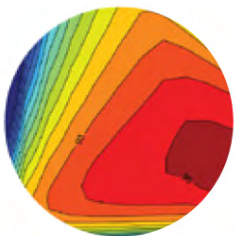
#### EMag | Electromagnetic performance predictions

Uses a combination of a 2D finite element (FE) environment and analytical algorithms for fast calculation of electromagnetic performance. Optimize designs easily with our extensive range of parameterized templates and geometries.



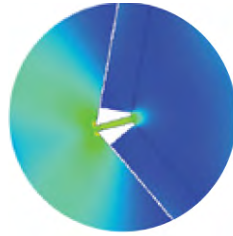
#### Lab | Efficiency mapping and performance across a duty cycle

Enables rapid and accurate analysis of any electric machine design over the full operating envelope. Carry out efficiency mapping and drive cycle analysis within minutes.



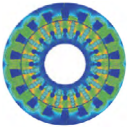
#### Therm | Thermal performance predictions and advanced cooling system design

This is the industry-standard tool for thermal analysis of electric machines, with over 20 years of successful use. Calculate the temperature of motor components in steady-state and transient operating conditions and accurately model thermal behavior within seconds of calculation.



#### Mech | Mechanical analysis

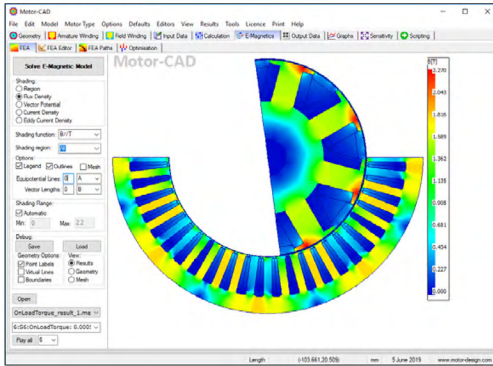
Uses a 2D FEA-based solution in Motor-CAD to analyze stress and displacement in rotors during operation.



## / MOTOR-CAD E-MAG

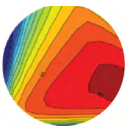
**Combined 2D finite element environment and analytical algorithms for fast calculation of electromagnetic performance.**

Quickly perform a range of electromagnetic performance tests on prototype designs with Motor-CAD EMag, including calculation of torque, power, losses, voltages, currents, inductances, flux linkages and forces. Input and optimize designs easily with the module's extensive range of parameterized templates and geometries.



Key Features	Key Benefits
Extensive range of parametrized templates including template customization capability	Comprehensive and efficient design space exploration with greater design flexibility
Automated calculation setup for various performance tests	Reduce simulation time and accelerate time to market
Computes torque, power, losses, voltages, currents, inductances, flux linkages, forces, etc.	Comprehensive analysis of electromagnetic behavior
Embedded 2D transient or magnetostatic FEA solvers with meshing and boundary conditions	Rapidly achieve accurate results
Advanced calculations of eddy current in magnets, rotor bars, and windings	Shift complex loss analysis earlier in development process — less design iteration

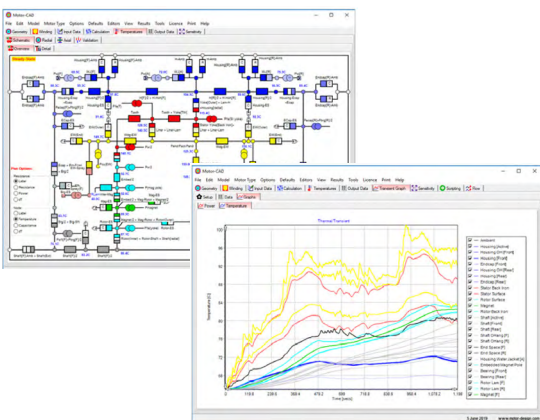
and much more...



## / MOTOR-CAD THERM

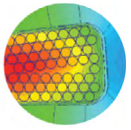
**Perform thermal analysis of electric machines with this industry-standard tool.**

Motor-CAD Therm enables designers to calculate the temperature of motor components in steady-state and transient operating conditions for accurate modeling of thermal behavior within seconds of calculation. Understanding the main heat transfer paths gives motor designers opportunities to significantly improve motor efficiency power output and make design decisions with confidence.



Key Features	Key Benefits
Temperature calculation of the motor components in steady-state and transient conditions	Enables engineers to design to precise requirements
Automated generation of thermal and flow networks	Thermal expertise is not required to set up the simulation
Radial and axial heat transfer in 3D network	All important heat transfer paths are included in the model
Detailed view and calculation of slot cross section	Detailed modeling of critical areas leads to good correlation with experimental results
Calculations with CFD, FEA, and empirical correlations	Fast simulation without compromising accuracy

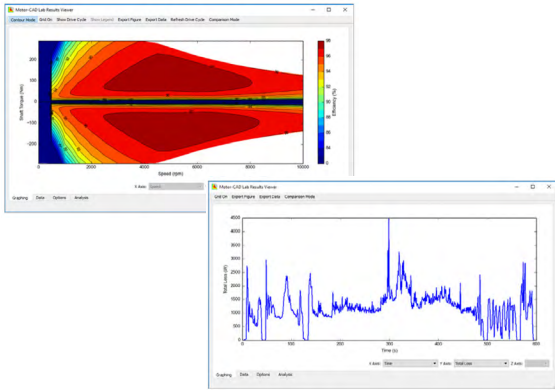
and much more...



## / MOTOR-CAD LAB

**Conduct efficiency mapping and evaluate performance across a drive cycle.**

The Motor-CAD Lab module was developed to enable rapid and accurate analysis of any electric machine design over the full operating envelope. It couples to both the EMag and Therm modules and provides outputs such as efficiency maps and torque/speed characteristics.



Key Features	Key Benefits
Connections to Ansys Maxwell 2D/3D magnetic FEA technology	Quickly generate accurate and robust maps to visualize behaviour over the full operating range
Peak torque and speed characteristics	Determine the peak motor output across the speed range
Continuous (thermally constrained) torque/speed characteristics	Determine the continuous motor output across the speed range
Performance analysis over complex driving cycles	Evaluate and optimize the efficiency of the motor for specific cycles
Maximum torque/amp and efficiency control strategies	Evaluate the behavior of a design under different control regimes

and much more...



## / MOTOR-CAD MECH

**Analyze stress and displacement in rotors during operation with this 2D FEA-based solution.**

Analyze the mechanical stress in rotors using the Motor-CAD Mechanical model.

Key Features	Key Benefits
Radial force analysis using EM FEA solver	Rapidly evaluate time and space force harmonics across the operating range
Modal analysis of the stator structure	Evaluate the displacement of the stator
Acoustic modeling — spectrograms and spatiograms	Assess the noise output of the machine design and identify issues early in the design process
Calculate stress and displacement using Mechanical FEA solver	Facilitates multiphysics optimization of the electric machine, enabling the maximization of design performance
Rapid solvers for both NVH and stress analysis	Enables comprehensive design space exploration, iterative design processes, and better design decisions

and much more...

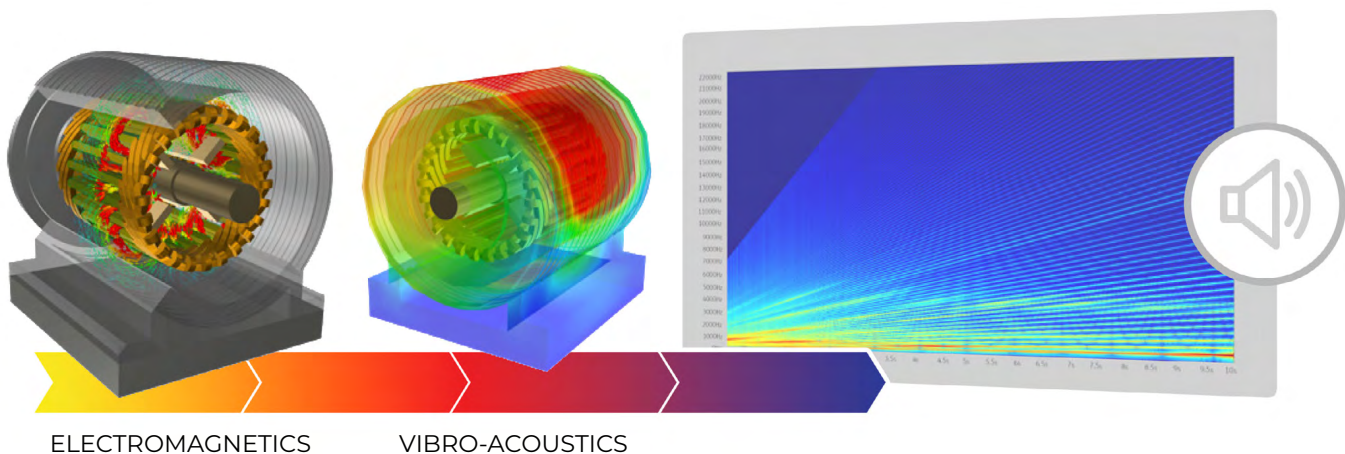
## / DETAILED MODELING ANALYSIS AND VALIDATION

Motor-CAD is linked to Ansys Maxwell to perform detailed design and validation after the initial design. Maxwell can execute rigorous 2D and 3D performance calculations of a machine, including the motion-induced physics caused by linear translational and rotational motion, advanced hysteresis analysis, demagnetization of permanent magnets, and other critical electromagnetic machine parameters.

Maxwell is integrated into Ansys Electronics Desktop (AEDT), where it can share the same CAD source and be coupled to Ansys Mechanical, Ansys Fluent, or Ansys Icepak. Mechanical's stress, thermal, CFD, and acoustic solvers provide important multiphysics capabilities required for a detailed analysis of the electric machine. Losses calculated by Maxwell can be used as inputs to the thermal or CFD solver to calculate the temperature distribution of a machine and evaluate cooling strategies.

Electromagnetic forces and torque calculated in Maxwell are used as inputs to the stress solver to analyze deformations and further assess potential vibrations. The ability to perform an in depth multiphysics analysis with Ansys' powerful solvers truly sets Ansys Motor-CAD apart from the competition.

Motor-CAD can be seamlessly integrated into automated processes using the PyMotorCAD automation interface, making it incredibly straightforward to set up scripted workflows. In addition, Motor-CAD integrates with Ansys optiSLang using a dedicated design optimization UI, enabling users to set up complex multiphysics multi-objective optimization studies within minutes.



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When visionary companies need to know how their world-changing ideas will perform, they close the gap between design and reality with Ansys simulation. For more than 50 years, Ansys software has enabled innovators across industries to push boundaries by using the predictive power of simulation. From sustainable transportation to advanced semiconductors, from satellite systems to life-saving medical devices, the next great leaps in human advancement will be powered by Ansys.

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