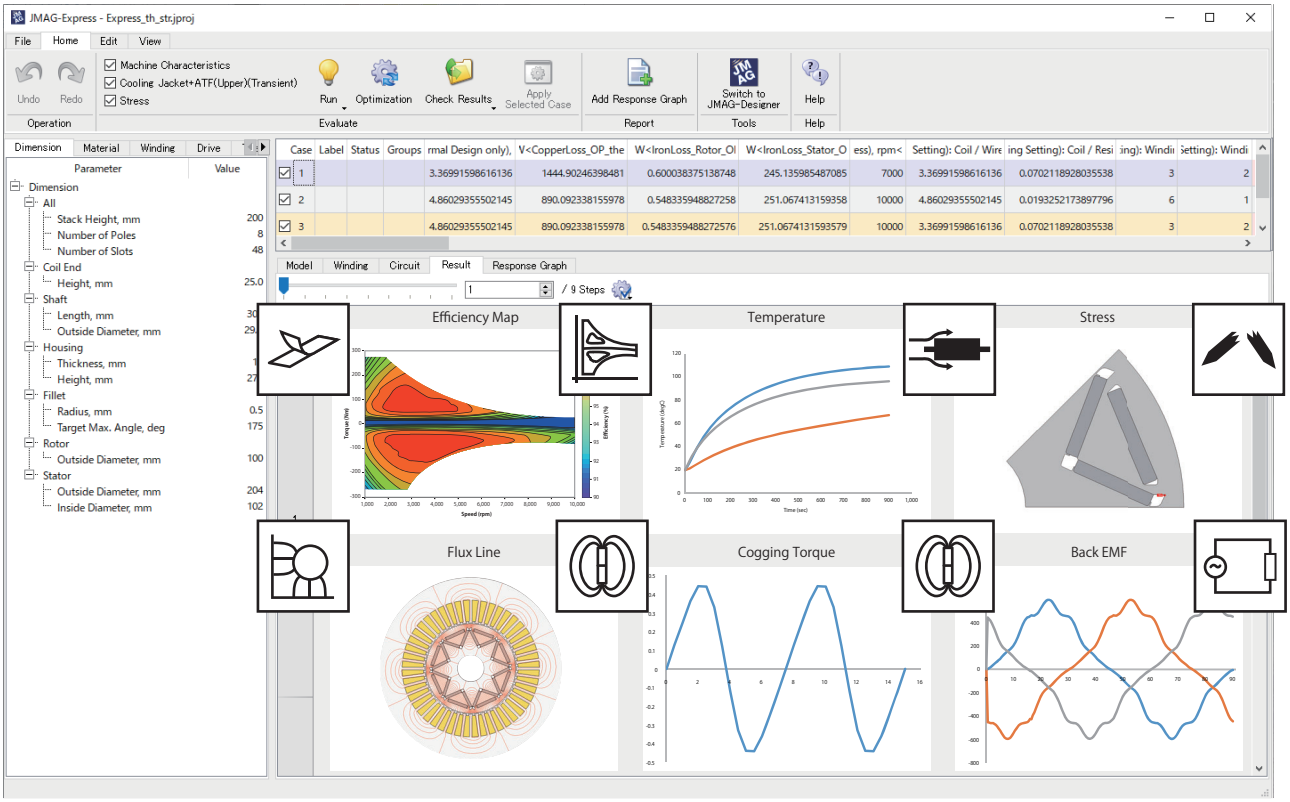
Machine Design Tool for Design Engineers

JMAG-Express

JMAG®
Simulation Technology for Electromechanical Design

JMAG-Express quickly performs multifaceted evaluation to obtain machine design that meets performance requirements.
Operations are easy with templates for motor geometry and evaluation results. The templates can be reused and you can run multipurpose optimization with the built-in engine.
Design exploration covers magnetic, thermal, structural, and control design and tests a wide range at high speed from concept design to detailed design.



Capabilities

- One-click simultaneous evaluation of magnetic, thermal, and structural characteristics of motors
- High-speed calculation makes way for evaluation of multiple motor designs
- Run a detailed evaluation in JMAG-Designer by just switching display mode
- Flexible support for analysis accuracy requirements and various applications
- Control simulation and NVH evaluation coupled with other tools

Evaluation items

You can add and reuse templates of what you want to evaluate

- Preinstalled
  - Magnetic design: machine constant, efficiency map, cogging torque, torque ripple, induced voltage, demagnetization
  - Thermal design: natural/forced cooling, cooling jacket, temperature evaluation in a drive cycle
  - Structural design: stress evaluation

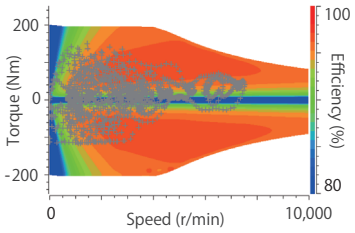
Motor types

You can add and use 2D or 3D custom shapes

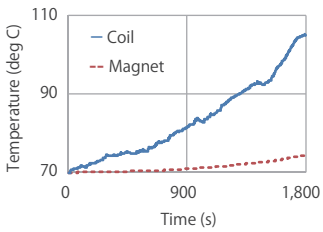
- Preinstalled
  - PMSM
  - IM
  - WFSM/EESM
  - SynRM
- Custom
  - Axial Gap Motor
  - Claw-Pole Motor
  - SRM
  - Brush Motor
  - Universal Motor etc.

Main functions of JMAG-Express

■ Efficiency map and temperature evaluation during drive cycle



Efficiency map and operating points for driving mode



Time history of temperature

Temperature for specific parts during WLTC driving mode

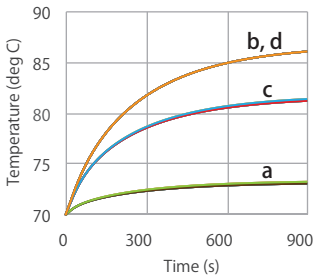
Create efficiency maps quickly. During WLTC mode drive, you can also check the efficiency, loss, and more. These loss histories can then be referenced in thermal design, and the temperature history of the parts can be evaluated. After running WLTC mode drive, the magnet and coil temperatures have increased by 5 deg C and 35 deg C, respectively.

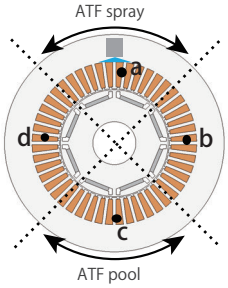
■ Evaluate part temperatures and investigate cooling specifications

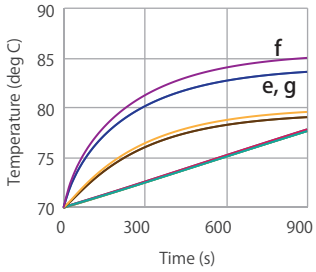
Temperature evaluation of motors cooled by cooling jackets and ATF spray

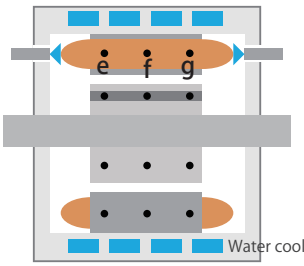
Thermal circuit models are available for general cooling types for motors. Multiple temperature evaluation points are established in the axial and circumferential directions in addition to the temperatures for each part. Temperature evaluation is then run accounting for the deviations in cooling that occur as a result of each cooling type.

From the graph, it can be seen that temperatures are higher at the coil ends where the ATF spray is not directly applied, as well as the middle of the coil. This occurs even within the same coil.



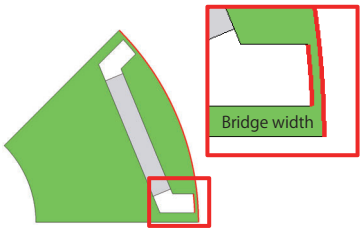




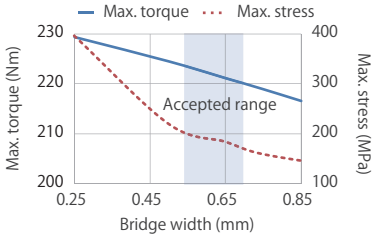


● Temperature evaluation points

■ Simultaneous evaluation of magnetic and structural characteristics



Rotor shape and design variable



Bridge width, maximum torque and stress

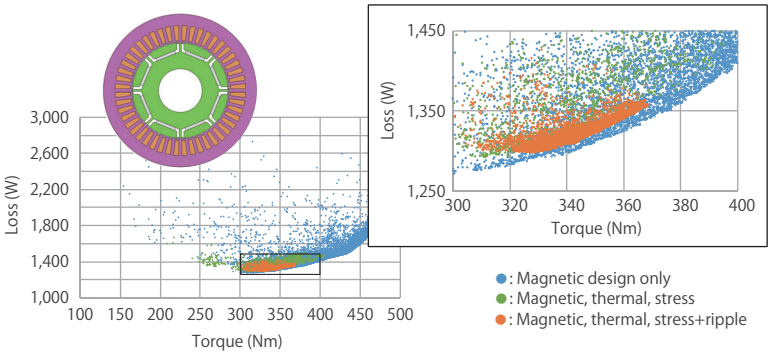
Design plans that meet requirements for maximum torque and maximum stress

Evaluated maximum torque and maximum stress with design variable of the bridge width. When making bridge width wider, stress decreases but the maximum torque is also decreased. Both requirements of torque and stress are fulfilled around 0.65mm.

■ Design exploration using the built-in optimization engine

Design exploration results that vary depending on the constraint conditions to account for

9 geometry dimensions are the variables for an 8-pole, 48-slot IPM motor. Parameter optimization is run with average torque maximization, torque ripple minimization, and loss minimization as the objective functions. By accounting for not only magnetic characteristics as a constraint condition in the early stages of design but also design requirements such as thermal, stress, and ripple, even more appropriate design plans can be narrowed down even faster.



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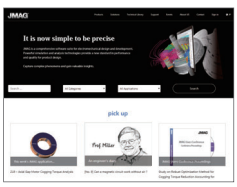

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