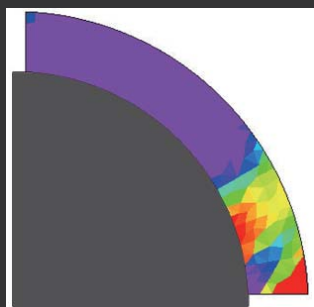
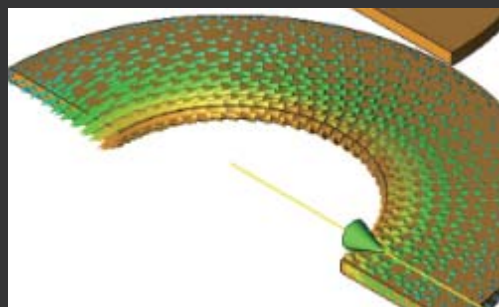
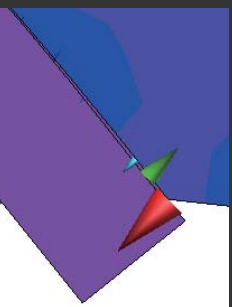


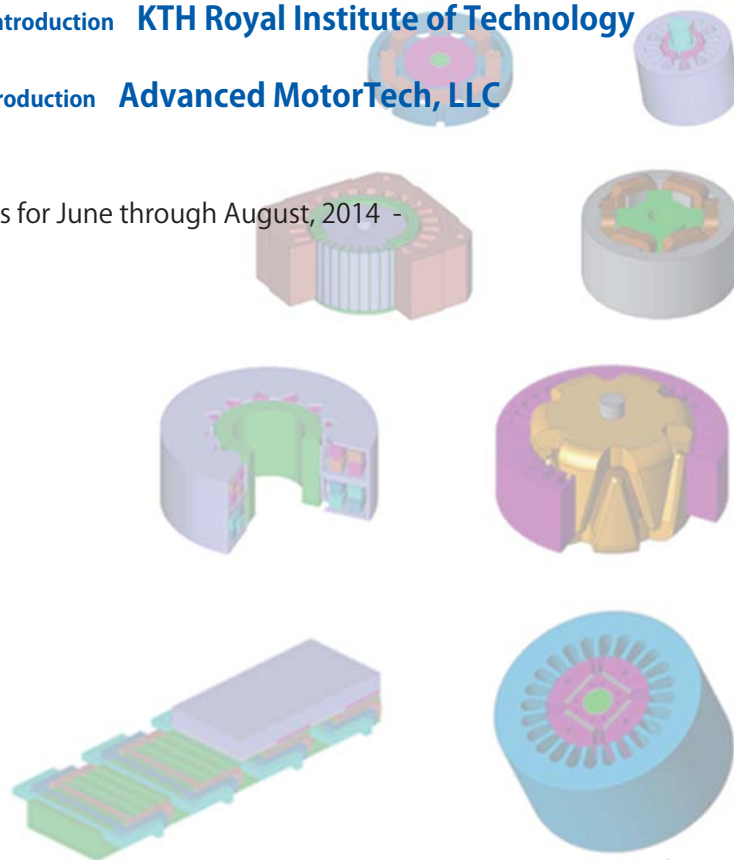
JMAG Newsletter



June, 2014

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JMAG Newsletter: Highlights of the June Issue

We've recently added some members to our JMAG Newsletter team.

With the coming of summer, a change of seasons also brings a fresh wave of inspiration.

Many of you may still be using the same version of JMAG that you started off with; how about trying out soon to be released JMAG-Designer Ver. 13.1. You'll be delighted to see improvements in performance and usability. Also, it would be a shame if any of you working on induction motor analysis missed this edition, as we will introduce new useful features and a how-to on their use for you. The need for multiphysics analysis is arising in many different areas; do you think it's about time you started incorporating this into your workflow.

The Product Report will introduce all of the unique functions in JMAG-Designer Ver. 13.1, to be released in June 2014. The key additions in this version are large scale models, magnetic materials, and multiphysics. Over 40 other new functions have been added as well. This newsletter will discuss use cases in which these new functions can be put to use. Give Ver 13.1 a try after having a look at this newsletter, and see for yourselves how much easier this version is to use.

We are also continuously adding new useful features to JMAG-Express, our motor design tool. Along with discussing three-phase induction motors and the other new features, we will also discuss how to use them, supplemented by examples of real-world motor design cases. Try using JMAG-Express for yourself and see how it can bring new levels of efficiency to your motor design operations.

The JMAG Newsletter is intended for everybody, from those who are currently using the product to those who have not started yet. So please feel free to pass this newsletter on to new users as well.

We hope you enjoy this information-packed issue and find something of value on each page.

JSOL Corporation
Electromagnetic Engineering Department, Engineering Technology Division

Product Report

Introduction of J MAG-Designer Ver.13.1

JMAG Ver.13 will be released in June, 2014.

Ver.13.1 will have over 40 additional features including large-scale models, magnetic material, and multiphysics. This product report will introduce new unique features in JMAG Designer 13.1.

Introduction

JMAG-Designer Ver.13.1 will be released in June, 2014. Ver.13.1 is equipped with new features beginning with large-scale models, magnetic material, and multiphysics. Large-scale models have improved processing speed to enhance the handling of required parts in detailed analysis focusing on large machinery and large-scale mesh. As for magnetic material, specific magnetization direction and coercive force distribution can be set on the analysis model from the GUI. Multiphysics allows the confirmation of mapping preview and data conservation of mapping data handled in the multi-purpose file output tool.

Supports Large-scale Models

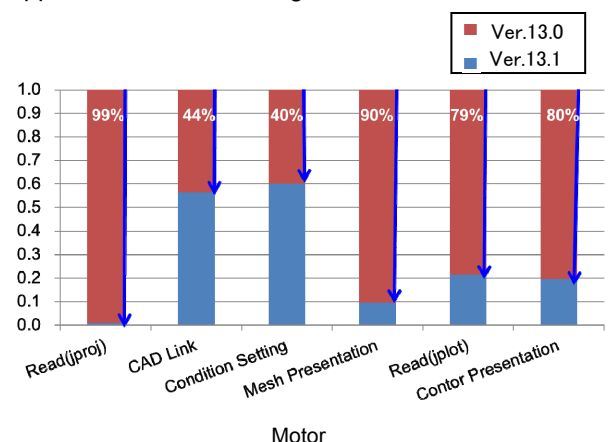
With the large improvement in solving speed with the high parallel solver realized in Ver.13.0, detailed analysis of large-scale models have become accessible to users. As a result, operation other than the solving process of large-scale models have become the theme.

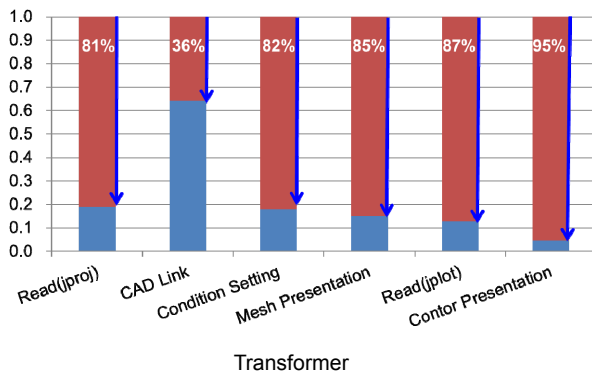
In Ver. 13.1, the operability of large-scale models have been enhanced with the acceleration of pre-post processing. Also, by removing unnecessary items from large-scale calculation data obtained in the analysis, the file size has been slimmed down, and has made efficient data

management possible.

Support for Large-scale Mesh / Models with Numerous Parts

Ver. 13.1 sets a standard of models with 1000 parts and 10 million elements with the acceleration around the pre-post, and has accelerated each function including loading and display, setting materials/conditions, and the loading of results. As applications, motors and transformers are picked up, and processing speed of each function is displayed as results in comparison with Ver.13.0 (Fig.1). Approximately how much processing time has decreased in a relative comparison by operation item is shown. It can be seen that the processing speed has largely improved for each application, as well as in general.





Application	Number of Parts	Number of Elements
Motor	1,052	8,740,820
Transformer	100	8,837,489

Fig.1 Processing speed improvement ratio for operability of each application and model information

Reduction of Result Files

We have received comments from many users that due to large model sizes and transient analyses with numerous steps, the result files became too large and that it took up too much hard drive space.

To simplify the management of result files (jplot file) of large-scale models, after confirming the analysis results in Ver.13.1, unnecessary distribution amount data and analysis steps, as well as output items can now be specified and removed. By only retaining important data, hard drive space is efficiently used.

Results obtained from magnetic field analysis of the motor in voltage drive to run an iron loss analysis is organized with this function (Fig.2). Iron loss analysis requires magnetic flux density and displacement data of the last 1 electric angle periodicity data. It can be seen that the full-set initial data had a file size of more than 1.5GB but the final stage has been shrunk to 19MB.

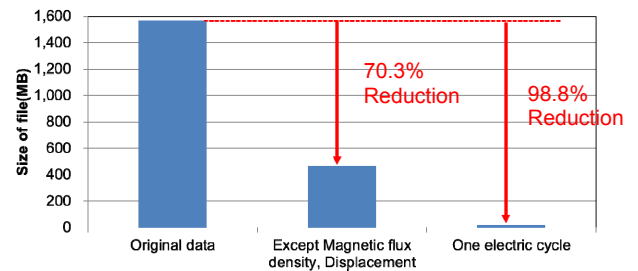


Fig.2 Change of file size after deleting output items by stages

Magnetic material

JMAG has been continually developing on the material modeling feature. Up until now, we have been adding functions focused on iron loss but from Ver.13.1, we have put emphasis on the magnet function. The function introduced here is the arbitrary magnetization direction specification function, the coercive force distribution function that can specify the arbitrary coercive force distribution and the sinusoidal magnetization function. The characteristic that is common amongst these features is that it is not dependent on creating a program such as a user subroutine but can be supported through the GUI settings.

Specifying Arbitrary Magnetization Direction

With the increase in variety of magnets used in motors, various magnetization pattern settings can be obtained in the analysis.

The arbitrary magnetization direction specification function can specify the distribution state of the magnetization direction of the magnet through the GUI (Fig.3). Define the orientation direction by creating an angle distribution table to each direction (X/Y direction or R/θ direction) of the rectangular coordinate and cylindrical coordinate depending on the magnet geometry. Since an arbitrary value can be entered in the table, specific orientation information can be specified.

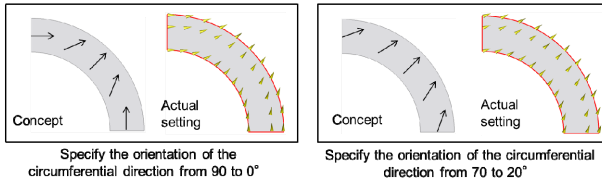


Fig.3 Example of magnetization direction specification by arbitrary magnetization direction specification function

Coercive Force Distribution

Dy diffused magnets are used in high-precision motors as magnets using rare-earth elements, and retains specific coercive force distribution. In terms of modeling, since specification of region divisions depending on the coercive force of each magnet, and coercive force / magnetization direction for each region after division is necessary, this became a lengthy process.

In the coercive force distribution function, select the rectangular coordinate or the cylindrical coordinate depending on the magnet geometry, and as the correction value, create a coercive force distribution table. By combining with the arbitrary magnetization direction specification function, the time and effort originally needed for the creation of a magnet model is decreased drastically.

Drive analysis of motors using magnets that have executed coercive force distribution correction have been run, and the results comparing magnets without correction with demagnetization state is shown (Fig.4). In contrast to magnets without coercive force distribution correction that have a maximum 33% demagnetization ratio, magnets with correction have a maximum of 10% demagnetization ratio and the range is extremely limited.

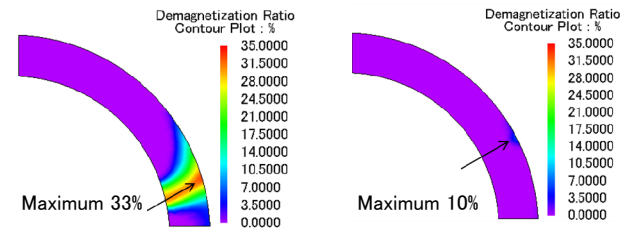


Fig.4 Comparison of demagnetization state while driving due to with / without coercive force distribution correction
Without coercive force distribution correction (left) and with coercive force distribution correction (right)

Sinusoidal magnetization

Sinusoidal magnetization supports radial magnetization, parallel magnetization, and axis direction for the radial direction, and linear direction for parallel magnetization (Fig.5).

Evaluation of motor design with magnetization pattern of sinusoidal waveform known to have few high harmonics is possible.

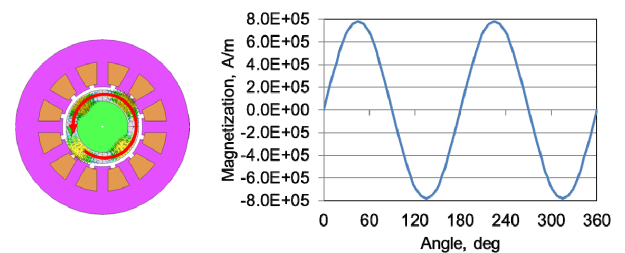


Fig.5 Magnetic distribution inside the magnet along the circumferential direction
(Apply the radial sinusoidal circular pattern)

Multi-purpose File Export Tool

The multipurpose file output tool is an important tool for analysis of results obtained in JMAg using structural analysis and thermal fluid analysis. In Ver.13.1, data conservation of map data and the addition of the preview feature in the map mode has increased its usability.

Data conservation

When running a frequency response analysis of the structure using electromagnetic force of the time series calculated in JMAg, electromagnetic force needs to be converted to the load condition for each frequency with FFT processing. When the

frequency range is wide, the file size after mapping may become a few GB and it may affect the solving speed and the loading of files at analysis.

In Ver.13.1, the user can control electromagnetic force data necessary in structural analysis from the mapping of the frequency region and the mapping of the air region. In frequency region mapping, since necessary frequency range can be specified in the analysis, conserving large amounts of data is capable compared to processes before, which mapped all frequency information (Fig.6). In mapping air regions, the output can be controlled by part and by face. It is supported even if the magnetic analysis model and the structural analysis model are different in dimension, and the electromagnetic force on the edge of the 2D magnetic field analysis model can be mapped as the electromagnetic force on the face of the 3D structural analysis model (Fig.7). In addition, the output format can be mapped as total stress, which has effect on each face of the solid and not only the map of the nodal force as before.

By combining the output control features, highly controllable analysis environments can be built.

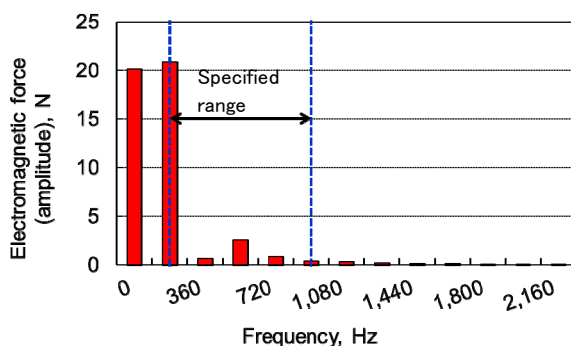


Fig.6 Mapping of coercive force specifying the frequency range

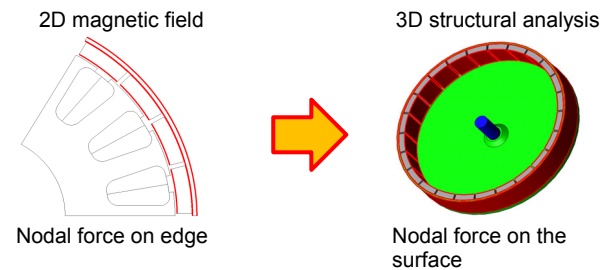


Fig.7 Mapping of coercive force by the face and by part

Confirmation of data after mapping with the preview function

The preview function allows the confirmation of the distribution state for each physical amount after mapping before running the analysis through JMAG (Fig.8). This is a handy feature that allows you to confirm if it has been mapped correctly for different mesh models. Like electromagnetic force distribution, the load data built by numerous frequencies through FFT processing can be confirmed by selecting the frequency you would like to see.

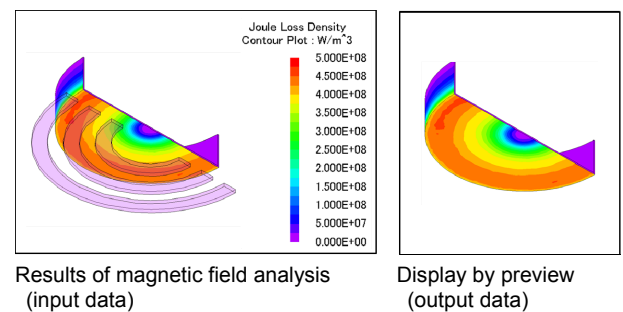


Fig.8 Data confirmation after mapping with the preview function

Eddy current loss density contour before mapping(left) and eddy current loss density contour after mapping with the preview feature (right)

Faster solver

JMAG has constantly been working on the acceleration of the solver. Although many items have been improved in Ver.13.1, this article will introduce FQ support of GPU.

Supports frequency response analysis (FQ) of GPU

Demand for GPU in the technology calculation department has increased by the year but GPU boards exclusively for calculation are sold and supported.

With this current trend, JMAG has released a beta version supporting ST/TR of magnetic field analysis from Ver.11 and official support began with the release of Ver.12.

Furthermore, starting from Ver.13.1, there is support for FQ (Fig.9). FQ is a module with high demand in the field of large-scale analyses beginning with large transformer analysis and induction heating analysis, and by combining with SMP and MPP, options for models supported in the calculation environment has increased.

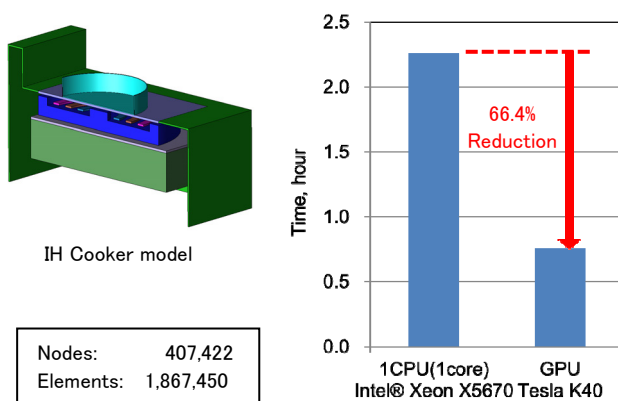


Fig.9 Comparison of calculation time between analysis of IH cooking equipment using GPU (FQ) (left) and 1 CPU (1core)

Condition Setting

Added magnetic field analysis and structural analysis functions to analysis conditions. A function has been added to perform uniform current distribution for current conditions and FEM coil conditions in magnetic field analysis. For structural analysis, contact conditions able to handle deformations and deviations due to objects coming in contact have been added.

Specification of Uniform Current

When setting a current condition or FEM coil condition on a 3D modeled coil of circular shape before, distribution with current biased in the inner radius is shown, and when flowing uniform current, the radial direction was divided numerous times to avoid the problem.

The uniform current function can uniformly specify the current distribution in the coil. With this function, it does not only make handling of coil geometries easier but it also increases the accuracy of magnetic flux distribution.

An example comparing incoming and outgoing distribution of current flow formed by disc-shaped coils is shown below (Fig. 10). Using a modeled wire model in a coil unit as a basis, differences are compared in current distribution depending on whether or not uniform current is specified in a bulk model displayed as a cluster of solids.

A graph showing magnetic flux density distribution from the center axis of the coil in the radial direction (Fig. 11). You can verify that the current distribution and magnetic flux density distribution are almost the same in a wire model and bulk model (uniform current).

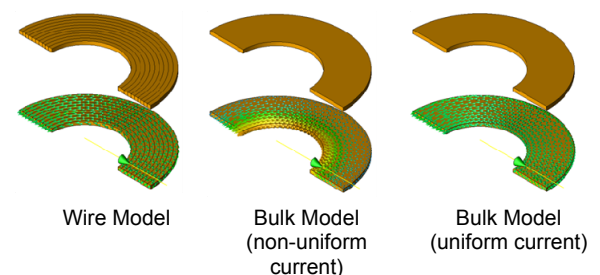


Fig.10 To the wire model and bulk model (non-uniform current / uniform current)

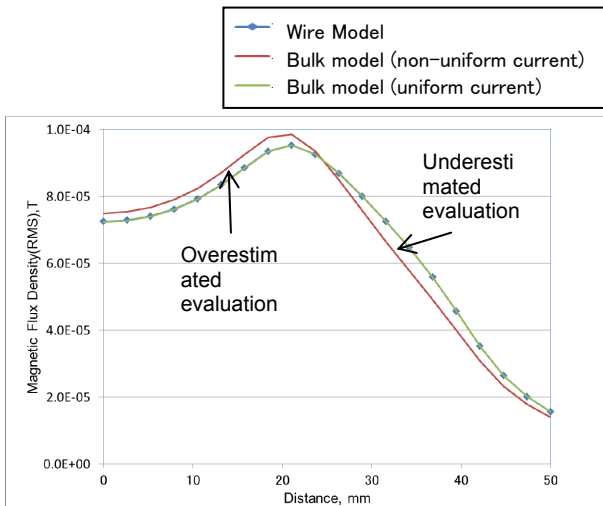


Fig 11. Magnetic flux density distribution in the radial direction based on results from fig. 10 (arrows in the figure in the direction of the magnetic flux density section).

Structural contact condition

Deformations and deviations due to objects coming in contact have to be handled in a structural analysis.

Contact condition is a condition to specify when handling objects making contact brought about by static geometry containing centrifugal force. It is possible to obtain the deviation of an object accounting for generated displacement, stress, friction due to contact.

Results are shown for contact and exfoliation produced between the magnet and rotor core due to centrifugal force generated by the rotor of an IPM motor (Fig.15). The magnet is pressed up against the rotor core due to centrifugal force, and causing pressure between them. The magnet can be checked for any horizontal deformations (Fig.12).

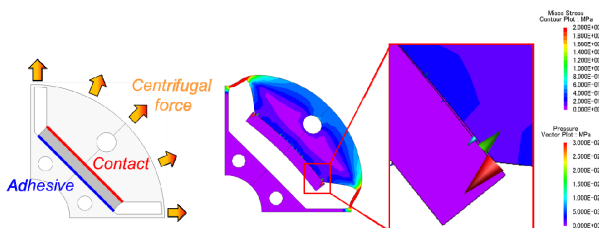


Fig.12 Example of applying the contact condition to the magnet and the rotor

Geometry Editor

Ver.13.1 has improved operability in creating a model as well as faster processing time to import a large-scale model.

Specifying Reference Axis from Coordinate Axis

In the course of model geometry generation, there are numerous operations specifying rotation axis such as revolve from a 2D region or rotation copy of a 3D geometry. Although these operations are required for each part, previous version caused a lot of hassle, such as moving the created intersection to the specified position, when specifying intersection of two planes or specifying the rotation axis off the origin.

This function allows you to set the rotation axis by specifying each coordinate axis directly as a rotation axis or specifying directional vectors that pass through the specified point (Fig. 13).

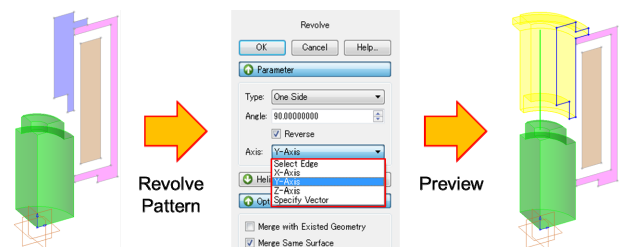


Fig. 13 Specifying Rotation Axis by Revolve

Helical Coils

Creation of helical coil geometry is now supported using the revolve function.

This function facilitates the creation of a model for the target that needs to handle helical coil geometry, such as when examining optimal coil geometry for high-frequency induction hardening, or evaluating dielectric strength or capacitance of windings including transformers (Fig. 14).

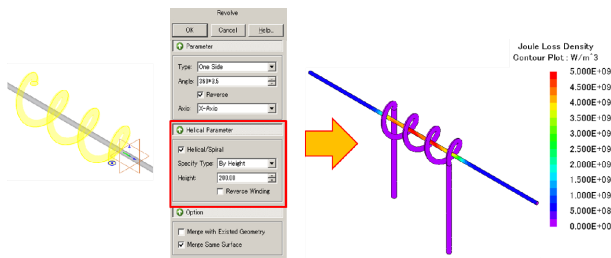


Fig. 14 High-Frequency Induction Hardening Model using Helical Coil Function

Post

Post function has added functions of averaging analysis ranges specified by the user and processing effective values.

Specifying Ranges for Graph Average Values and Effective Values

Calculation of the average and effective values of analysis result history data is now available for ranges specified by the user. This function enables evaluation of averaged output values in a constant state except for transient state (Fig. 15).

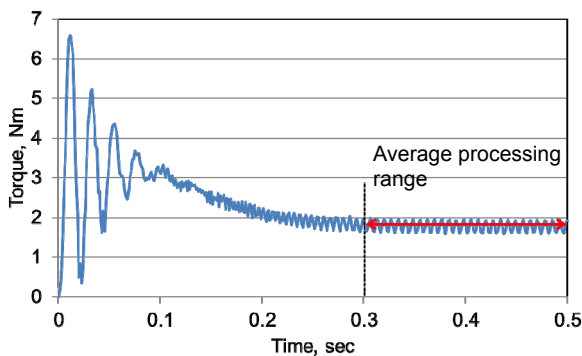
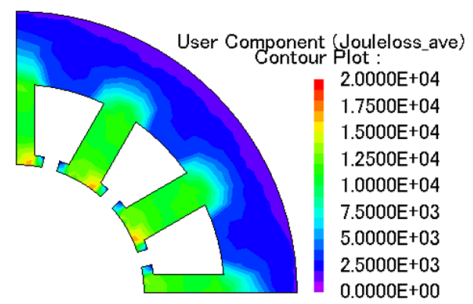
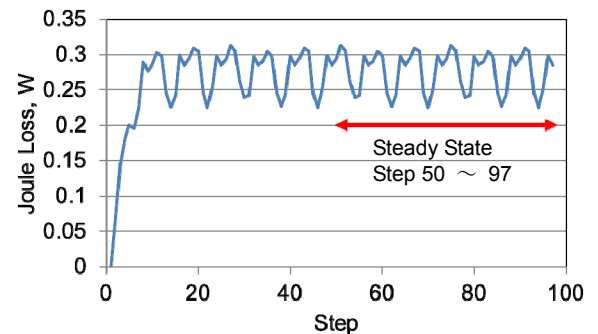


Fig. 15 Calculation of Averaged Torque by Specifying Analysis Time Range

User Component Range Specification

The new version has a function to display results of operations such as maximization, minimization and averaging for all analysis ranges based on data for each step as process for output value in the contour plot using the user component.

The new version has a function to display results of operations such as maximization, minimization and averaging for all analysis ranges based on data for each step as process for output value in the contour plot using the user component.



Time average value of joule loss density contour 50~97 step

Fig. 16 Iron Loss Density Distribution with Averaged Time by Range Specification
Above: Time average distribution graph, below: Contour figure

In Conclusion

New functions described in this issue will be explained in the upgrade seminar in June, 2014. The Event Information in this issue contains the schedule of the upgrade seminars, so please check it out.

Our website also has movie for each function.

(Takayuki Nishio)

Product Report

Three-Phase Induction Motor Design with JMAG-Express

Handy features are constantly added in our motor design tool, JMAG-Express. This article will use three-phase induction motors as an example and introduce case studies of design. We hope you will make use of JMAG-Express in improving efficiency in your design work.

What is JMAG-Express?

JMAG-Express is a motor design tool that covers examination from concept design to basic design. It also packs 2 modes: quick mode that calculates basic properties in a second and a power mode that evaluates distribution amount of magnetic flux density or loss density, time series result of cogging torque and induction voltage. Flow of motor design that makes full use of JMAG-Express (Fig.1). At the concept design stage, use quick mode for deciding on the rough layout of the motor, then use the power mode for the basic design stage and JMAG-Designer for completing the detailed design stage. This article will explain using JMAG-Express quick mode and JMAG-Express power mode.

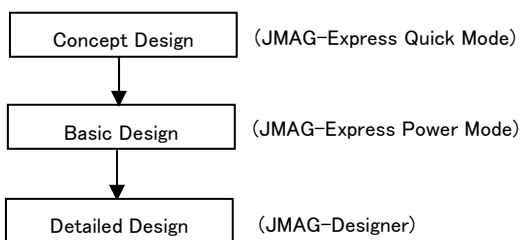


Fig.1 Design Flow using JMAG-Express

Induction Motor Design with Quick Mode

I will introduce an example of three-phase induction motor design using JMAG-Express. The geometry and desired specification of the initial

design proposal are shown below (Fig.2, Table 1). I will introduce an evaluation to fulfill an output of 0.5 (kW) at rated speed.

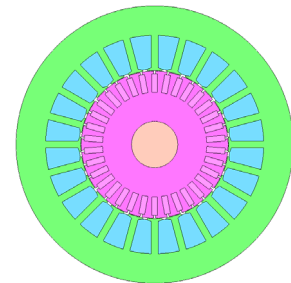


Fig. 2 Geometry of initial design proposal

Table 1 Desired specifications

Number of poles	4
Frequency	50 (Hz)
Rated output	0.5 (kW)
Rated speed	1425 (RPM)
Peak Current	50 (A)

Characteristics evaluation of initial design proposal

Create a motor geometry using quick mode. Freely selecting and modifying combinations of rotors and stators from the template is easy in quick mode (Fig.3). Desired geometries are easily created just by modifying the dimension parameters. For this case, we have selected a rectangular model for the rotor and a constant angle of gear tip

model for the stator, and by changing the dimension parameter, we were able to create a model close to the geometry of the initial design proposal (Fig.4). Results based on the specifications of the initial design proposal such as the material and winding are displayed (Fig. 5). It can be confirmed that the requirements has not been met as the rated speed has only achieved approximately 0.5 (kW).

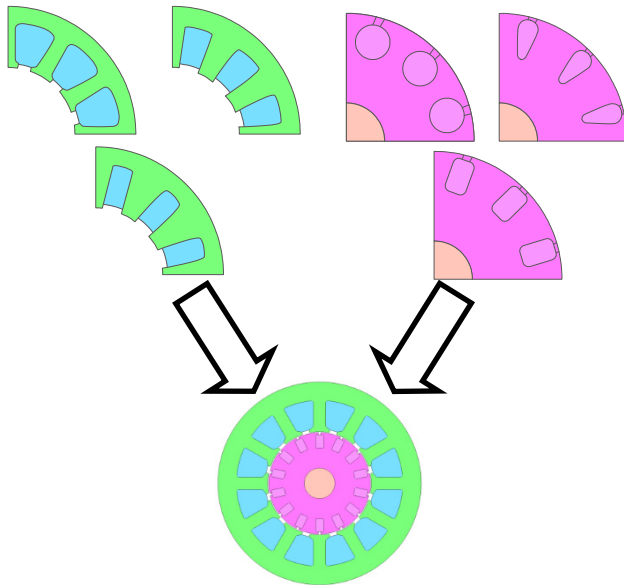


Fig. 3 Selecting geometry type

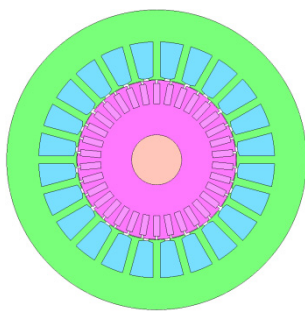


Fig. 4 Initial design proposal created in JMAG-Express



Fig. 5 Characteristics results calculated in quick mode

Performance optimization with changes in bar depth

We have evaluated whether or not motor performances can be improved by changing the bar depth of the rotor. Since the quick mode is equipped with a parametric analysis function, we used the function in deciding the depth of the ideal rotor. By selecting the variable you wish to change from the JMAG-Express data sheet, a dialog to set the parametric range will appear (Fig.6). Specify the range and the number of divisions and the parametric analysis will run when you click on the evaluation button. Once the parametric analysis is over, all case results will be displayed in one graph and easy comparison is possible (Fig. 7). Showing / hiding the graph can also be switched in the checkbox so it is easy to narrow down for examination. We will show the calculation results and bar geometry of a case where we have set the depth to 5mm like in the initial design proposal and another with 10mm (Fig.8, Fig.9). The bar depth is set at 10 mm where it is most efficient and the output meets the requirement. By changing it to 10mm, it can be confirmed that the secondary resistance decreases and the number of rotations at maximum torque has increased. Also, the output

has also fulfilled the rated output of 0.5 (kW). Increasing the depth of the bar changes the cost and the mechanical strength, so confirmation in such point of view is required separately.

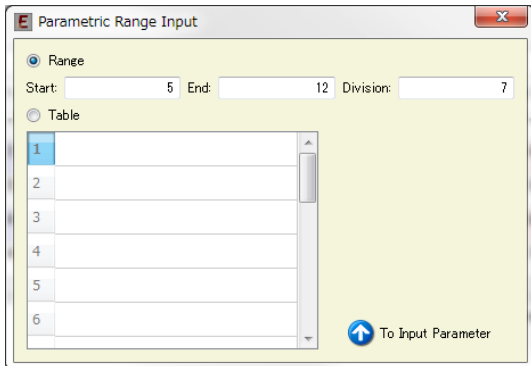


Fig.6 Parametric range settings screen

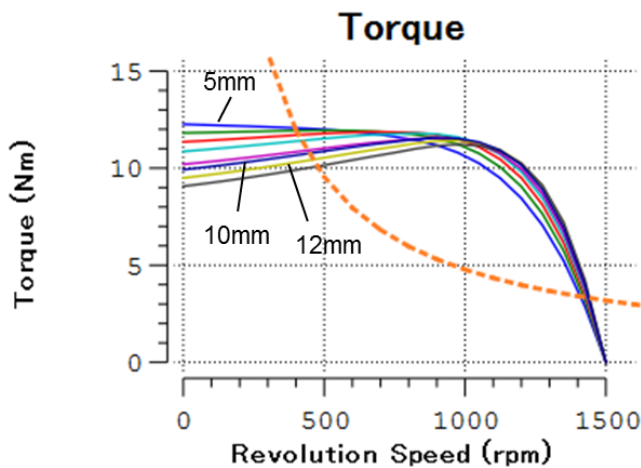


Fig.7 Parametric analysis results (bar depth 5mm-12mm)

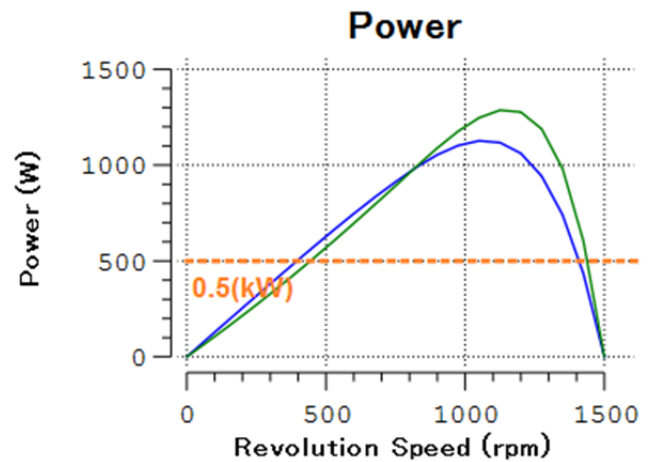
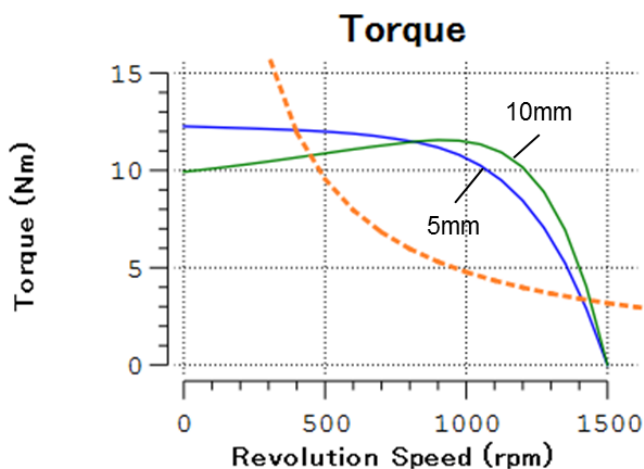


Fig. 8 Parametric analysis results (bar depth 5mm - 10mm)

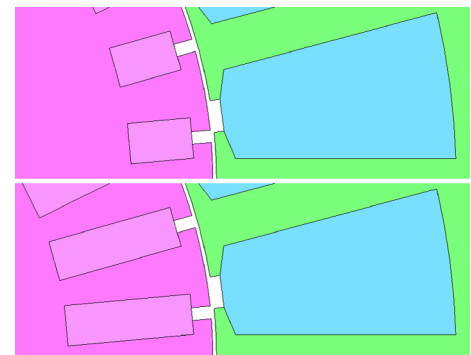


Fig.9 Bar geometry of rotor
(top: 5mm deep, bottom: 10mm deep)

Characteristics optimization with change in winding

By making effective use of the coil space, I have evaluated whether or not the characteristics can be further improved. Regularly, coil space and lamination factor must be calculated from dimensions and wire diameter on your own. However, with quick mode, lamination factor is automatically calculated from wire diameter and insulation information (Fig.10). Resistance, which changes depending on the winding type such as the coil pitch and number of layers, is also calculated automatically.

To keep the lamination factor below 40%, change the wire diameter and turns to find the ideal combination. Calculation can be done repeatedly as

calculation time takes only a second. This time, there is some room left for lamination factor, so we have increased the winding from 48 to 50 turns, wire diameter from 1.1mm to 1.2mm (Fig.11). Increasing the number of turns will increase the total resistance, but by making the wire diameter larger, the resistance per unit length and total resistance has decreased, we have been able to consequently increase the efficiency. The output rises a little with the increase in turns but the rated speed hardly changes.

Fig.10 Winding setting screen

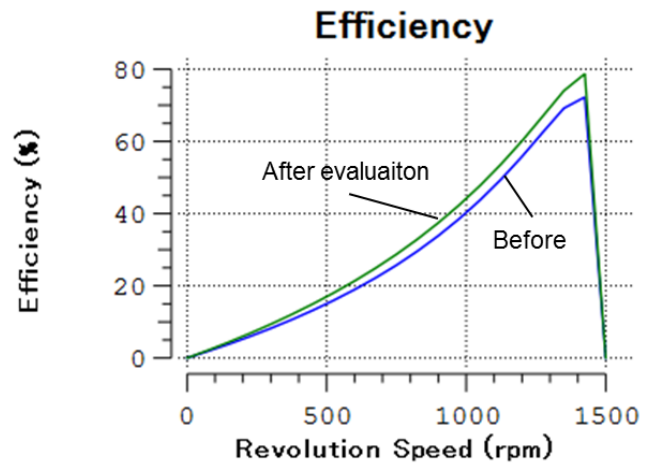


Fig. 11 Calculation results after winding evaluation

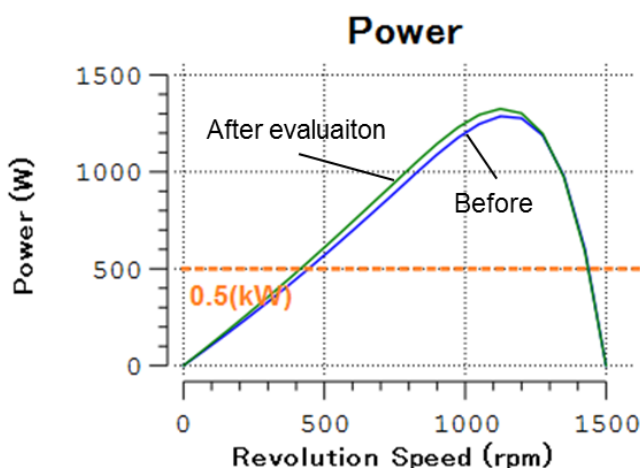
Detailed Evaluation with Power Mode

After obtaining the results in quick mode, proceed with the detailed evaluations in JMAG-Express power mode. In quick mode, we performed evaluations with the averaged value of torques and such, but in power mode, you will not only be able to evaluate the distribution of magnetic flux density and the time series result of torques and such, but characteristic evaluations accounting for transient phenomena is now also possible. Create a final design proposal using power mode.

Characteristics confirmation at line start

Let's assume this induction motor starts with the most simple line start just by directly connecting to the power supply. Compared to the initial design proposal, the secondary resistance has been decreased and the start torque has been made smaller. It is a question as to whether or not it can start but with the unique induction motor feature of crawling, it is necessary to confirm if the rotation speed can be increased up to the rated speed. In order to evaluate crawling, transient phenomena needs to be accounted for, but with the use of power mode, it will be easily done.

It is also necessary to check on starting currents. It



is necessary to confirm beforehand as the size of the starting current affects the voltage source capacity connected to the induction motor, as well as the electromagnetic force that acts on the motor's coils and heat capacity. Localized magnetic saturation needs to be accounted for due to the flow of large currents but with power mode, this can easily be confirmed.

The power mode has a built-in line start analysis feature (Fig.12). The obtained results are shown below (Fig.13-15). It can be confirmed that the rated speed is achieved from the rotation results, and that it starts without any problems. It can also be confirmed that the result is below the maximum current specified in the required specifications. Leakage flux may result from localized magnetic saturation and decrease the torque. Also check to see that localized magnetic saturation and large leakage flux have not resulted from magnetic flux density distribution.

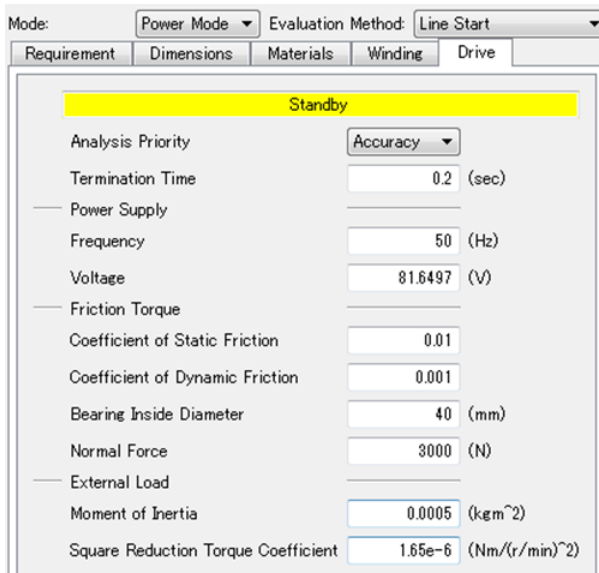


Fig.12 Settings of line start analysis

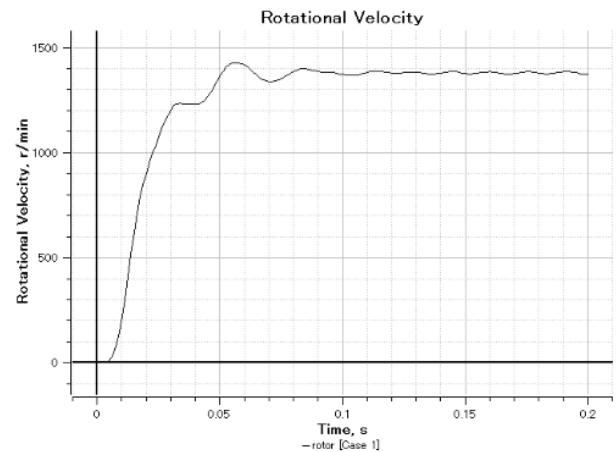


Fig.13 Revolution speed results (line start analysis)

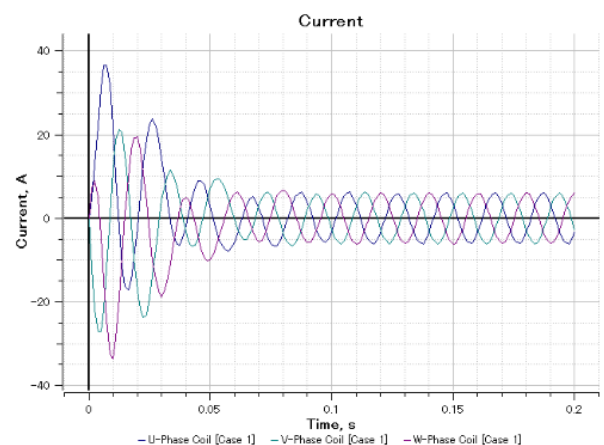


Fig.14 Current results (line start analysis)

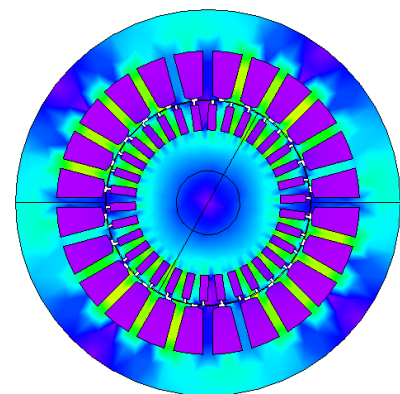


Fig.15 Magnetic flux results (line start analysis)

Start Design with JMag-Express Public

Through reading this report, I hope you were able to see that designing induction motors is efficient in

JMAG-Express, and I also hope you were able to see that quick mode alone allows you to consider induction motor design. Like JMAG-Express quick mode, JMAG-Express Public is a trial design tool that calculates basic properties in a second.

JMAG-Express Public is easy to obtain, so please grab a copy of the software and license with the method below.

1. How to Download

Access the JMAG-Express Public website and download JMAG-Express Public.

2. Obtaining a license key


Register a license key from the JMAG-Express Public homepage.

3. Install and set the license key

Install JMAG-Express Public and input the license key.

JMAG-Express Public Website URL

<http://www.jmag-international.com/express/index.html>

Lastly, give JMAG-Express a try for your induction motor designs. JMAG-Express Public is a free design tool that can be used by anybody. 

(Tetsuya Hattori)

Common Questions for JMAG

JMAG is used across a broad spectrum, ranging from advanced research and development to commercial design and educational fields. Many of you reading this newsletter may feel you still haven't fully mastered JMAG's capabilities, or perhaps feel a bit lost about how to set it up. When you come up against obstacles using JMAG, of course there's always Technical Support, but don't forget there are also FAQs on our website that you can use to solve problems by yourself.

In this issue, we will select from those FAQs four questions from the FAQ that have been asked a lot recently. We have divided the questions into three categories: Operation Methods, Analysis Technologies, and Troubleshooting, so please pick a category you would like to learn more about.

ANALYSIS TECHNIQUES (FAQ-248)

Q1. How is the maximum degree or maximum frequency of iron loss calculation determined?

A1. It is determined by the number of steps from the magnetic field analysis results as well as time.

A fast Fourier transform (FFT) is performed on the magnetic field analysis in iron loss analysis. Due to this, the maximum degree or maximum frequency of iron loss calculation is determined by the number of steps from the magnetic field analysis results as well as time.

N_{max}, the maximum degree order for of iron loss analysis, is Formula (2), which uses positive integer n that satisfies to satisfy Formula (1). f_{max}[Hz], the maximum frequency, is Formula (3).

$$2^n \leq N_2 - N_1 + 1 < 2^{n+1} \quad \dots(1)$$

$$N_{\max} = 2^n - 1 \quad \dots(2)$$

$$f_{\max} = N_{\max} / (T_2 - T_1) \quad \dots(3)$$

N₁ is the number of steps to begin a reference, N₂ is the number of steps to finish a reference, T₁ is the time[sec] to begin a reference, and T₂ is the time[sec] to finish a reference.

An example of this would be when a magnetic analysis is performed on a 4-pole, 12-slot motor with an electric angle of 1 period for 0.02[sec] in 181 steps. The number of steps to begin a reference would be 1, and the number of steps to finish a reference would be 181. For this instance, the maximum order of iron loss calculation is 181 below Formula (2); 1 is subtracted from 128, the maximum factorial of 2, and is determined to be 127th order. The maximum frequency of Formula (3) is 6,350 [Hz], which is the maximum order of 127 divided by time of 0.02 [sec].

【Related FAQs】

Please visit the JMAG homepage to view other related technical FAQs.

FAQ-263: Even if the model is the same, the iron loss result will differ if the step resolution is changed.

<http://www.jmag-international.com/support/en/faq/263.html>

TROUBLESHOOTING (FAQ-877)

Q2. An error occurred in VoltageMeasurement for MATLAB/Simulink(the Mathworks) when I was using JMAG-RT.

A2. You need to replace the electric signal block by using most recent version of JMAG-Designer (Ver.11.1 or later).

If you are using MATLAB/Simulink(the Mathworks) version R2011b or later, the electric signal block must be replaced.

In MATLAB/Simulink(the Mathworks) version R2001b, the specifications for the VoltageMeasurement block have changed, and an error will occur when executing without correcting the blocks from the previous versions.

This error can be avoided by replacing the electric signal block in the installation folder of JMAG-Designer Ver.11.1 or later.

For example, if you are using JMAG-Designer Ver.13.0, the electric signal block file can be found in the following path.

C:\Program Files\JMAG-Designer13.0\JMAG_RT\Simulink

OPERATION METHODS (FAQ-243)

Q3. Is it possible to obtain an instantaneous value for iron loss?

A3. The instantaneous value of hysteresis loss can be obtained in iron loss condition settings by selecting [Hysteresis Model], and joule loss can be obtained by selecting [Lamination Analysis].

Instantaneous values can be obtained for hysteresis loss and joule loss.

The instantaneous value of hysteresis loss can be obtained in iron loss condition settings by selecting [Hysteresis Model], and joule loss can be obtained by selecting [Lamination Analysis].

Losses obtained in [Hysteresis Model] and [Lamination Analysis] are applied to evaluations which contain superimposed direct current in a magnetomotive force (current, etc.). Hysteresis losses obtained by other means than [Hysteresis Model] and [Lamination Analysis] are appropriate for total iron loss evaluation including abnormal eddy current.

When comparing iron loss values obtained by methods other than [Hysteresis Model] and [Lamination Analysis], instantaneous iron loss values obtained with [Hysteresis Model] and [Lamination Analysis] are compared with time averaged values for an electric angle of one period.

【Related FAQs】

Please visit the JMAG homepage to view other related technical FAQs.

FAQ-247: Is abnormal eddy current loss accounted for iron loss analysis?

<http://www.jmag-international.com/support/en/faq/247.html>

OPERATION METHODS (FAQ-45)

Q4. How do I output the operating points of a magnet?

A4. Obtain a component parallel with magnetic flux density and initial magnetization of the magnetic field in the user component and display as a graph.

Operating points are evaluated using magnetic field and magnetic flux density components parallel to the initial magnetization of a magnet measurement point. Operating points of magnetic flux density and magnetic field are obtained in Formula (4) and Formula (5).

$$\text{Magnetic flux density:} \quad \mathbf{B} \cdot \mathbf{M0} / |\mathbf{M0}| \quad \dots(4)$$

$$\text{Magnetic field:} \quad \mathbf{H} \cdot \mathbf{M0} / |\mathbf{M0}| \quad \dots(5)$$

\mathbf{B} is the measurement point for the magnetic flux density vector [T], \mathbf{H} is the measurement point for the magnetic field vector [A/m], $\mathbf{M0}$ is the permanent magnet initial magnetization vector [A/m], \cdot is the vector for the scalar product, and $|\cdot|$ is the absolute value of the vector.

The output control needs to be first specified in order to output the initial magnetization.

It is possible to obtain the operating points in the next step using the user component.

1. Select Tools > User Components in the JMAG-Designer window.
2. Select Create from the user component screen, and input Formula (4) and (5), which obtain operation points, and input Formula (6) and (7) into each user component [Formula] field.

$$\text{Magnetic flux density:} \quad (B_x \cdot M0_x + B_y \cdot M0_y + B_z \cdot M0_z) / M0_{abs} \quad \dots(6)$$

$$\text{Magnetic field:} \quad (H_x \cdot M0_x + H_y \cdot M0_y + H_z \cdot M0_z) / M0_{abs} \quad \dots(7)$$

*Due to the user component initial magnetization being a normalized value, $M0_{abs}$ is always 1. Due to this, formulas divided by $M0_{abs}$ for Formula (6) and (7) can be omitted in the user component.

3. In [Probes] for the magnetic field analysis results, display the results of Formula (6) and (7) operation point
4. Run Graph Manager in Tools in the JMAG-Designer window.
5. Select the dataset for probes of both Formulas (6) and (7), in Transform > Combine, specify the magnetic field operating points for the X-axis, and then the magnetic flux density operating points for the Y-axis. Click OK.

6. Display the operating point graph.

【Related FAQs】

Please visit the JMAG homepage to view other related technical FAQs.

Irreversible demagnetization cannot be found even if the operating point exceeds the knee point.

<http://www.jmag-international.com/support/en/faq/586.html>

OPERATION METHODS (FAQ-309)

Q5. How can I refer to custom materials created on another computer?

A5. Materials can be exported by selecting the custom materials from the materials tree and then by right clicking on them. Importing materials is the same.


For example, Machine1 is the computer which has custom materials created on it, and Machine2 is the computer you wish to use these custom materials. On Machine1, export a JMAG materials XML file (*.xml), copy this file from Machine1 to a folder on Machine2 and then import it. This process will allow the transfer of custom materials between computers.

To export a JMAG materials XML file (*.xml), navigate to [Materials] in [Toolbox] of the JMAG-Designer window, right click [Custom Materials], and then click [Export All Materials]. Click [Import Material] to import custom materials.

Technical FAQ on the Web

We have technical FAQ on our homepage, so come take a look if you have any questions: You can search for the FAQs introduced in this newsletter by entering the FAQ ID in the "Search Technical FAQs" search box.

URL: <http://www.jmag-international.com/support/en/faq/index.html> (User verification required)

The technical FAQ is a collection of actual questions from our clients, so you might discover some new ways to use JMAG if you go through them. We regularly update our website FAQ. Use this together with the JMAG Newsletter to make your analysis work more effective. Please don't hesitate to use JMAG technical support if you have any questions when using JMAG. We hope you will fully master JMAG. 

(Kensuke Araki)

KTH Royal Institute of Technology

This edition of Implementing JMAG is brought to you by the Department of Electrical Energy Conversion, KTH Royal Institute of Technology in Sweden.

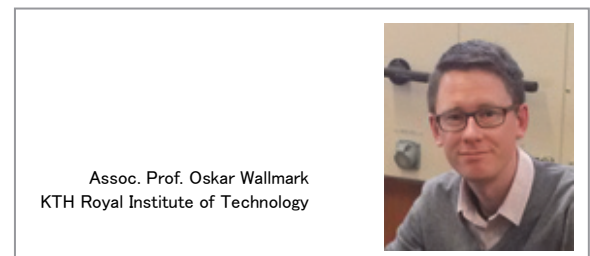
Assoc. Prof. Oskar Wallmark has been using JMAG for seven years, focusing on electric and hybrid electric drivetrains as well as the development and analysis of new motor concepts. We will discuss how the department utilizes JMAG to maximize output for sensorless control operations at low speeds and combat thermal issues for PM motors.

KTH Royal Institute of Technology

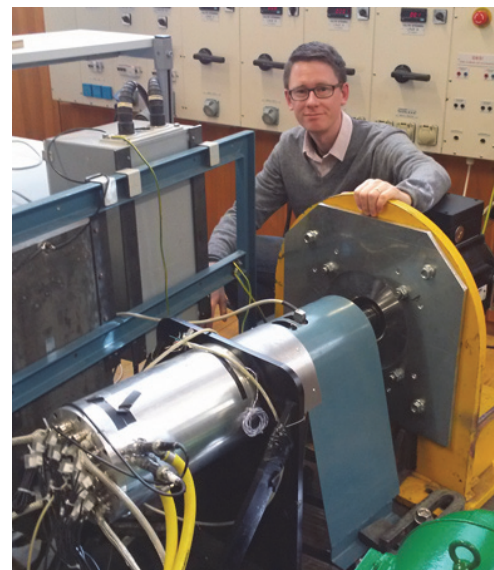
KTH in Stockholm is the largest, oldest and most international technical university in Sweden. No less than one-third of Sweden's technical research and engineering education capacity at university level is provided by KTH. Education and research spans from natural sciences to all branches of engineering, including architecture, industrial management and urban planning. KTH School of Electrical Engineering is growing quickly, both in staff and in revenue. In the last few years, the school's EU funding has increased substantially, and in seven years, the staff has grown by nearly 60 per cent, from 284 in 2007 to 441 full-time employees in 2013. Teaching faculty and doctoral students account for the majority of growth.

Reasons why you chose JMAG

At the Department of Electrical Energy Conversion, the group focusing on electric and hybrid electric drivetrains, led by Assoc. Prof. Oskar Wallmark (photo) and Lic. Eng. Mats Leksell, have used JMAG for about seven years to develop and analyze new motor concepts. Both 2D and 3D-based electromagnetic and thermal simulations



are performed. A key factor in selecting JMAG was the well-developed integration with other software, including Matlab/Simulink, which enables simulations of complex drivetrains outside the realm of solely finite-element-based computation.



PM-motor torque maximization when operating sensorless at low speeds

Magnetic saturation, cross saturation and slotting harmonics can have a substantially negative impact when operating a permanent-magnet motor without using a position sensor at low speeds. In this project, Dr. Shuang Zhao captured these magnetic nonlinearities using 2-D FEM simulations. Using a script to control the simulation process in JMAG, the required flux linkage data were computed for different currents and rotor positions in a relatively short time. The results could then be used to determine the optimal current reference trajectory that maximizes torque output at low speeds while still maintaining a stable sensorless control operation.

The results were published as S. Zhao, O. Wallmark, M. Leksell, "Low-speed sensorless control with reduced copper losses for saturated PMSynRel machines," IEEE Transactions on Energy Conversion, vol. 28, no. 4, pp. 841-848, 2013.

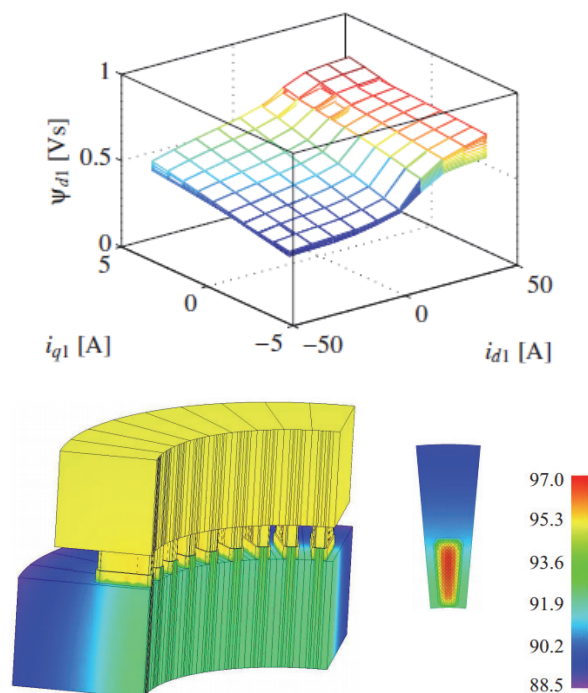


Fig.1 (top): Flux linkage as function of currents and rotor position (scripted JMAG output); (bottom): 3D-FEM based thermal analysis

Thermal analysis of PM motors

Placing an electric machine in a vehicle's engine compartment while sharing its cooling system with the internal combustion engine can be thermally challenging for the magnet and insulation materials used in the machine. To avoid excessive hotspot temperatures, enable an effective thermal design, and maintain the possibility of downsizing the electric machine and/or its cooling system, an accurate knowledge of the temperature distribution in different parts of the electric machine under various cooling and operating conditions is required. In this project, Dr. Shafigh Nategh used JMAG as a tool when developing and evaluating a novel thermal model of a PM motor for use in an automotive traction application.

The results were published as S. Nategh, O. Wallmark, M. Leksell, and S. Zhao, "Thermal analysis of a PMSRM using partial FEA and lumped parameter modeling," IEEE Transactions on Energy Conversion, vol. 27, no. 2, pp. 477-488, 2012.

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JMAG Solution Partner Introduction

Advanced MotorTech, LLC

Advanced MotorTech is a JMAG solution partner who provides consulting services for motor design using JMAG. This issue introduces some of their consultation activities and examples of how they employ JMAG.

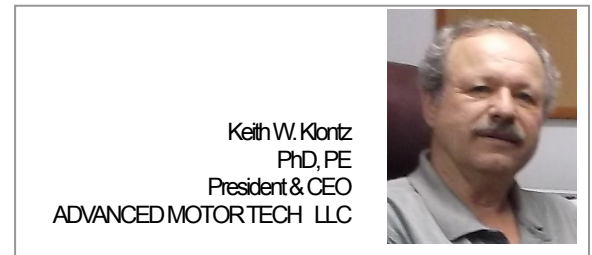
Project engineering services as a consultant for motor design

Our consulting services range from design/concept phases to redesigning and upgrading customers' current products using JMAG FEA. We also do mechanical engineering, drawing, prototyping and testing, and directly integrate JMAG FEA with CAD software.

We primarily design hybrid PM motors and induction motors with high efficiency and high power density for vehicles as well as wind energy generators ranging from kW to MW. We also design motors and generators such as axial flux motors, linear motors, etc. for industries and any other applications. We do patent review and assist customers in applying and proving patents for new ideas, new concepts and new applications.

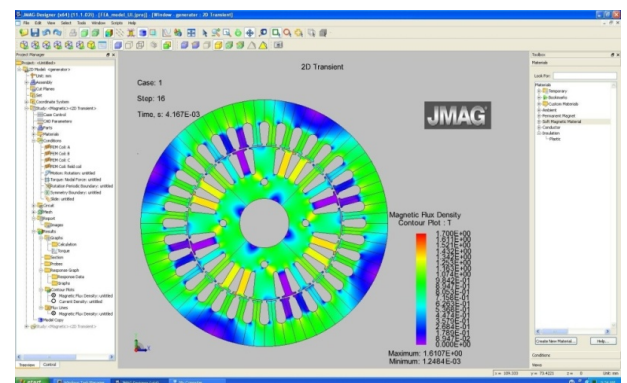
Using JMAG

As a part of their curriculum, university students experiment with electrical machines in power laboratories; however, they aren't familiar with internal generator parameters such as flux density in teeth, air gap flux, current and torque ripple, etc, so we designed and provided a synchronous generator for a university in Illinois, USA. We also included an educational package for the students so they can learn CAD drawing, CAD with JMAG FEA integration, and using JMAG FEA to build models and calculate magnetic field parameters. We also perform



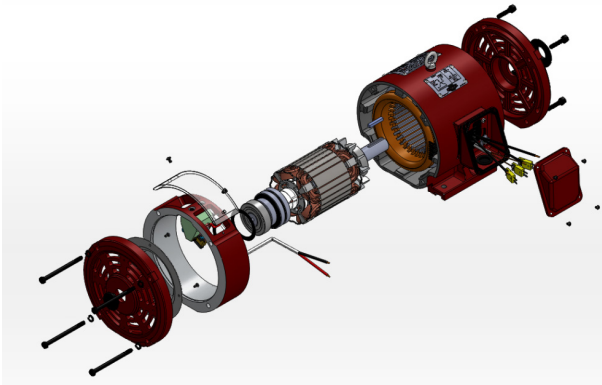
comparisons between test data and JMAG FEA and see how accurate FEA software is.

The synchronous generator is 1.5kW with 230V rms line to line voltage at 1800rpm. We perform JMAG FEA calculations to meet specifications, as well as obtaining and plotting all the parameters of magnetic field for the students to learn. We also provide the students with JMAG FEA models, and they learn how to use FEA to simulate a synchronous generator.

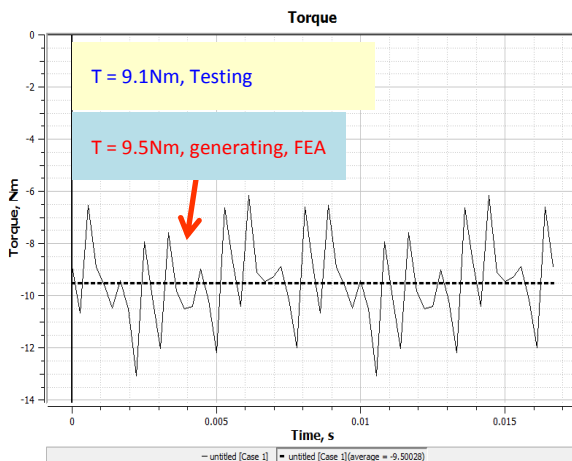


We create CAD drawings for this synchronous generator and integrate CAD with JMAG FEA. The students can learn how to design and build an electrical machine in an integrated environment and also learn current CAE technology trends. Additionally, the students are encouraged to

integrate JMAG FEA with MATLAB/Simulink (Mathworks) and other circuit simulators to evaluate synchronous generator controllers.



We perform comparisons between FEA and test data, and teach the students how to understand the FEA and test results. For example, we compare the FEA torque and tested torque. We find that the calculated FEA torque is a little higher than tested torque, so we show the students that the calculated FEA torque doesn't include iron loss, and we have to subtract torque due to iron loss from the calculated FEA torque. After that, we can explain what the calculated FEA torque is, how to calculate it, and what iron loss is. The students learn losses for electrical machines by understanding FEA and the test data. Finally, the students learn about FEA and get to know this popular tool used in the world of industry.



Upcoming training courses

Upcoming training classes for this year include Electric Motor Technology for Non-Engineers, Switched Reluctance Machine Design, and Brushless DC & Interior Permanent Magnet Machine Design.

Electric Motor Technology for Non-Engineers will be held May 7-9th, 2014 in Baltimore, Maryland at the Embassy Suites Baltimore at BWI Airport. This course focuses on providing a foundation of the technical principles of electric motor design, construction and operating principles important to motor sales, customer service and other non-technical motor support activities.

Switched Reluctance Machine Design will be offered October 8-10th, 2014 in Raleigh, NC. This course emphasizes design for application-specific SR motors and for design features and tools to achieve specifications such as torque, power density, speed, low noise, etc. The goal is to learn SR machine design and performance based on electrical, magnetic, mechanical, and thermal interactions.

Brushless DC and Interior Permanent Magnet Machine Design – Taking Theory to Practice course will be held November 18-20th, 2014 in Dallas, TX. We use basic motor principles and years of experience to increase the understanding of designing permanent magnets into any BLDC or IPM machine design. Special emphasis will be placed on design differences and new trends in BLDC/IPM motors, including reduction of magnet cost, replacing rare earth magnets with ferrite magnets, new analysis techniques and design options to achieve cost, efficiency, power density, and torque per amp requirements.

More information regarding courses can be found at www.advancedmotortech.com.


What is your primary business as a motor design consultant?

We specialize in using shop-floor experience and common sense when applying advanced theoretical concepts. Our engineers use analytic calculations and analysis to develop unique, intuitive and parametric design variations for electric machines. Through experience, we are able to identify the properties, opportunities and trade-offs of motor/magnetic designs to achieve performance targets such as power density, efficiency, and cost reduction. We must be able to handle the computational workloads required in finite element analysis (FEA) and work on 3D modeling of unique, theoretical concepts. The 3D models are put under a rigorous stress test and analyzed for specific results. We are capable of predicting the results of many designs as well as identifying the specifications for an optimized, efficient machine by using JMAG software. Choosing JMAG as our software tool allows easy integration into SolidWorks, our CAD (Computer-Aided Design) software, used for creating professional manufacturing blueprints. JMAG has been an established company for over 30 years and delivers the specific results we require. With the help of JMAG, we can incorporate co-simulation to a product to include specifications, such as manufacturing costs and power requirements in every design to provide our customers with the best product we can offer. We take full advantage of our niche in the marketplace to build strong relationships by using our experience, common sense, and ability to provide services tailored to our clients' needs.

What criteria determine the software you use as your tool?

We probably need two tools. One is machine design software and it can do quick and multiple calculations for motor design like JMAG Express. Another is for deep simulation for magnetic field analysis like JMAG Designer (FEA). The FEA software should be popular in Market. This FEA software needs to accurate, fast and friendly.

What do you expect of JMAG?

We hope JMAG will perform faster calculations than other FEAs and continue to develop Express as a professional motor design tool. 

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Event Information

Exhibitions and Events for June through August, 2014

JMAG will hold exhibitions at events both in Japan and overseas. Please stop by our booth and take a look at JMAG's activities. We would like to take this opportunity to introduce events and exhibitions for June through August, 2014.

Engineering with Cloud Seminar

A lecture will be open.

Conference Outline

Host: IBM Japan Ltd

Date: Friday, June 13

Venue: IBM Japan Main Office (Japan: Tokyo / Chuo-ku)

URL: <http://www-06.ibm.com/ibm/jp/cloud/event/eocs/index.html>

JSOL engineer, Mr. Suzuki will provide a lecture at the seminar hosted by IBM Japan.

Cases considering the sharing of process management of development and design data over cloud is increasing. Likewise, cases using cloud for its speed and cost are increasing for HPC and CAE engineering.

We will introduce practical cases of SoftLayer and JMAG that have recently been added to the IBM cloud lineup.

2014 European Altair Technology Conference

A booth will be open.

Conference Outline

Host: Altair Engineering, Inc.

Dates: Tuesday, June 24 -Thursday, June 26.

Venue: Dolce Munich Unterschleissheim (Munich, Germany)

URL: http://altairatc.com/EventHome.aspx?event_id=2

At the JMAG booth, we will introduce case examples for clients considering mechanical design / thermal design simultaneously, and not just electrical design with magnetic field analysis. Product evaluation with only magnetic field analysis allows a larger perspective of product evaluation than before. Please see the presentation at the booth for case studies.

JMAG-Designer Ver.13.1 Version Upgrade Seminar

We will be releasing JMAG-Designer Ver.13.1 on early June, 2014!

Conference Outline

Host: JSOL Corporation

Date: Tokyo: Wednesday, June 25; Osaka: Thursday, June 26; Nagoya: Monday, June 30

Venue: JSOL seminar room

URL: <http://www.jmag-international.com/jp/seminar/v-up/v-up131.html>

This seminar will introduce JMAG-Designer Ver.13.1 set for release on June, 2014. In addition to new features, there will be a demonstration introducing upgraded functions as well as functions we hope you will try out.

We hope you will feel the usability and experience the latest features of JMAG-Designer Ver.13.1.

Coil Winding, Insulation & Electrical Manufacturing Exhibition

A booth will be open.

Conference Outline

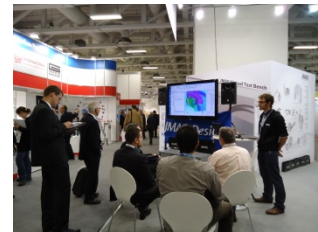
Host: i2i Events Group

Dates: Tuesday, June 24 -Thursday, June 26.

Venue: Messe Berlin (Berlin, Germany)

Booth number: 1.1 / C11

URL: <http://www.coilwindingexpo.com/berlin/>



Coil Winding, known to be one of the world's largest exhibitions gather products related to coil such as winding machines, motor stators and insulating paper.

The JMAG booth will have demonstrations focusing on analysis cases of motors and transformers, as well as JMAG-Designer Ver.13.1 set for release in June. There will also be a booth presentation that has received high acclaim over the years.

Terakoya BM Juku / Early 2014 Lecture "Basics of Magnet / Magnetic Material Magnetic Field Analysis Technology"

A lecture will be open.

Conference Outline

Host: The Japan Association of Bonded Magnetic Materials

Date: Friday, July 18

Venue: Toyo Technical Technology Interface (TI) Center (Japan: Tokyo / Chuo-ku)

URL: http://jabm.la.coocan.jp/registration_terakoya.html

JSOL's engineer Mr. Nishio will serve as instructor at a "terakoyajuku" meeting held by the Japan Association of Bonded Magnetic Materials. He will present topics from the basics of electromagnetic analysis to the use of JMAG in analysis examples for magnets and magnetic materials, aimed at people who are not yet using magnetic field analysis.

TECHNO-FRONTIER 2014

A booth will be open.

Conference Outline

Host: Japan Management Association

Dates: Wednesday, July 23 - Friday, July 25

Venue: Tokyo Bigsite (Japan: Tokyo / Etou-ku)

Booth number: 3C-201

URL: <http://www.jma.or.jp/tf/>



TECHNO-FRONTIER is the largest specialist trade show in Asia where development designers and production engineers gather from a wide variety of fields, including motor technologies, EMC and noise reduction. JMA's booth will include presentations for various analysis targets and business uses. There will be demonstrations of new products including JMA-Express and JMA-Designer Ver.13.1 set for release in June.

NIWeek 2014

A booth will be open.

Conference Outline

Host: National Instruments Corporation.

Dates: Monday, August 4 - Thursday, August 7

Venue: Austin Convention Center (Texas, United States)

Booth number: 1010

URL: <http://www.ni.com/niweek/ja/>

NI WEEK is a large conference gathering approximately 3600 engineers worldwide.

At the JMA booth, we will introduce coupling cases between motor HILS of NI Corporation and JMA-RT. Please come see the JMA-RT high-precision plant model demonstration.

JMA Users Conference in Taiwan

JMA user conference will be open.

Conference Outline

Host: FLOTREND CORPORATION

Date: Thursday, August 21, 2014

Venue: To be determined (Taiwan)

URL: Announced in July

JMA user conference will be hosted by our distributor, FLOTREND Corporation. Beginning with a keynote speech, there will be case studies introduced by JMA users, as well as introducing the latest solutions using JMA. Please join us for a great opportunity to collect information of uses and technical trends of magnetic field analysis.

2014 IEE-Japan Industry Applications Society Conference

A booth will be open.

Conference Outline

Host: IEE-Japan Industry Applications Society Conference secretariat


Dates: Tuesday, August 26 - Thursday, August 28

Venue: Tokyo Denki University Tokyo Senju Campus (Japan: Tokyo / Adachi-ku)

URL: <http://www.gakkai-web.net/gakkai/jiasc/hp14/>

A booth will be open at the IEE-Japan Industry Applications Society Conference. Beginning with an introduction of JMAG-Designer 13.1, there will be a demonstration as well as advice for optimization such as increasing efficiency of your work. Please drop by at the JMAG booth when participating in the conference.

JMAG-Designer Ver.13.1 set for release in early June will be presented at each venue.

Booths and seminars are currently being planned all over the world. Check the website for booth information. 

<http://www.jmag-international.com/jp/event/index.html>

(Tomomi Igarashi)

Event Information

Event Report

Attendees report on events held from April through May, 2014. We hope you will attend our next event.

85th Technical Meeting Program "Magnetic Material Industry Today, Trends of Use and Technology"

A presentation was held.

Conference Outline

Host: The Japan Association of Bonded Magnetic Materials

Date: Thursday, May 15

Venue: Langwood Hotel (Tokyo / Arakawa-ku)

URL: http://jabm.la.coocan.jp/symposium/No85_agenda_jp.pdf

The technical meeting hosted by The Japan Association of Bonded Magnetic Materials is hosted twice annually. Mr. Yamada of JSOL Corporation held a lecture titled "Trends of Magnetic Field Analysis Technology" at the first technical meeting this year. Many of the attendees were young members of the association.

There were many inquiries related to whether there is support for the processing of materials.

JMAG will continue to improve for the sake of helping construction of network related to materials.

(Toshie Furubayashi)

NAFEMS Deutschsprachige Konferenz 2014

A booth was open.

Conference Outline

Host: NAFEMS Ltd

Date: Tuesday, May 20 - Wednesday, May 21

Venue: Kongresshotel Bamberg (Bamberg, Germany)

URL: <http://www.nafems.org/2014/dach/>

A booth was open at the conference hosted by NAFEMS Ltd. Titled "Best Practices", new technologies, tools, and platforms were presented.

On the first day, JMAG users, Mr. Mohammadali, Mr. Pascal Bayrasy, and Mr. Klaus WofSalari of Fraunhofer-Institute for Algorithms and Scientific Computing SCAI held a lecture by the name of "Gekoppelte Simulation für die thermische Absicherung von elektrischen Komponenten" and introduced thermal coupling simulation using JMAG and MpCCI.

The lecture

(Thiebaud PFISTER)

SIMULIA Community Conference

A booth was open.

Conference Outline

Host: Dassault Systemes SIMULIA

Dates: Tuesday, May 20 - Thursday, May 22

Venue: Rhode Island Convention Center (Rhode Island, United States)

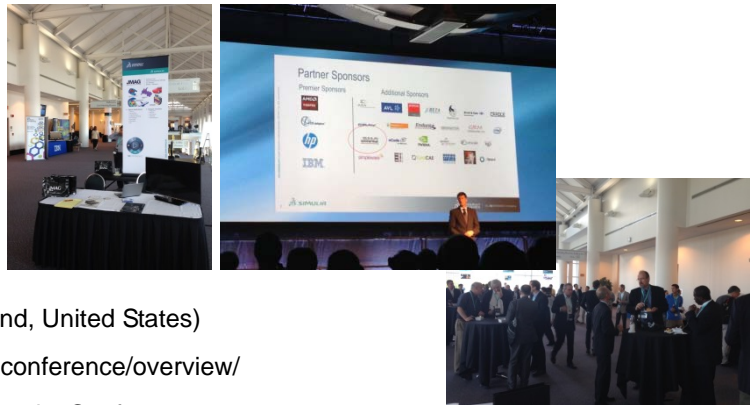
URL: <http://www.3ds.com/events/simulia-community-conference/overview/>

Approximately 700 users attended SIMULIA Community Conference.

SIMULIA presented their plan and vision of "3D experience" and attracted the users' attention.

Many Abaqus users interested in structural analysis dropped by at the JMAG booth. Various analysis cases of JMAG and coupling cases with STAR-CCM+ were introduced at the booth presentation.

(David Dibben)



Automotive Engineering Exposition 2014

Presentation at the theatre of Synopsys Japan Limited Company booth.

Conference Outline

Host: Society of Automotive Engineers of Japan Inc.

Date: Wednesday, May 21 - Friday, May, 23

Venue: Pacifico Yokohama (Japan: Kanagawa / Yokohama-shi)

URL: <http://expo.jsae.or.jp/>

JSOL engineers, Tani and Nishio held a 15 minute presentation at the theatre inside our technical partner, Synopsys Japan Limited Company's exhibition booth.

In our presentation titled "Introduction of High-Precision Motor Model JMAG-RT that Drives Model-Based Design," we introduced the fact that with the coupling of Saber and JMAG, high-precision motor drive simulations can be built.

Rain and wind were heavy for the 2 days but we had many attendees and we collected latest technology and technical information related to cars. Beginning with Synopsis Japan, the venue introduced solutions of MILS, HILS using JMAG-RT at the booth of our technical partner. JMAG will continually put focus on MBD.

(Takayuki Nishio)



MathWorks Day in Hamamatsu

A booth was open.

Conference Outline

Host: MathWorks Japan

Date: Tuesday, May 27

Venue: ACT CITY Hamamatsu Congress Center (Japan: Shizuoka-ken, Hamamatsu)

URL: <https://www.mathworks.co.jp/company/events/seminars/seminar90342.html>




A lecture regarding model-based development cases and latest simulation technology in the automobile field was held on MathWorks Day. Approximately 150 attendees debated over the trends in the latest automobile industries and simulation technologies.

At the JMag booth, we introduced the high-precision motor plant model JMag-RT and demonstrated motor characteristics by the JMag-RT Viewer.

JMag will continually advance as a motor model provider to connect automobile makers and suppliers.

(Yusaku Suzuki)

We have reported mostly exhibitions and seminars hosted in Japan from April to May. JMag will not only provide technical support but will also continually provide high-quality products to assist high-precision and high-efficiency for the customer. 

Writer: Tomomi Igarashi

