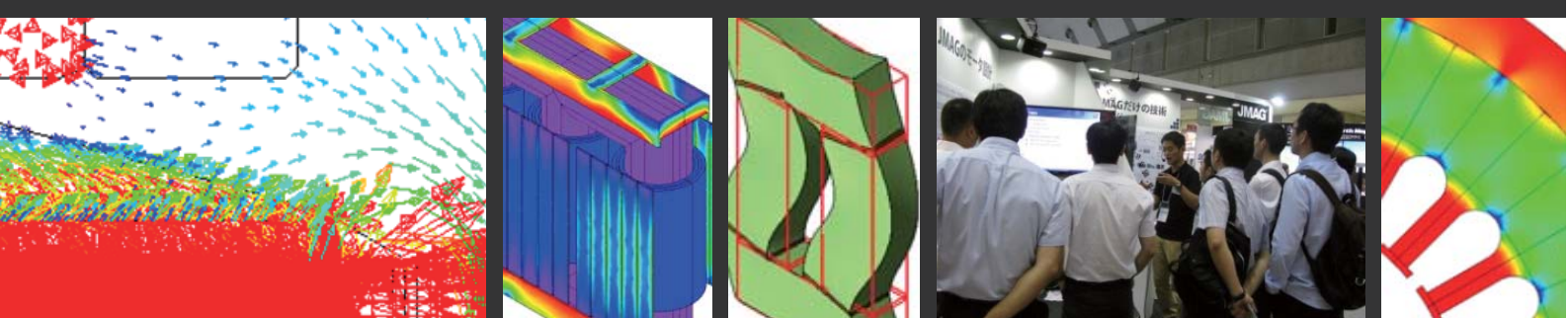


JMAG Newsletter



September, 2013

Contents

[1] Implementing JMAG Choose JMAG moving forward to 3D analysis

- Bern University of Applied Sciences -

[2] Product Report DC Brush Motor Design Example

[3] Motor Design Course Issue 1 Why have a JMAG Motor Design Course.

[4] Solutions JMAG's initiative on loss analysis

[5] Paper Introduction

Issue 5 For Those Planning to Start Analysis of Large Transformers Part 2

[6] Fully Mastering JMAG Common Questions for JMAG

[7] Fully Mastering JMAG Issue 10 Structural Analysis from A to Z

[8] JMAG Product Partner Introduction Gamma Technologies, Inc.

[9] Event Information

- 5th Seminar on Advanced Computational Electromagnetics -
- The JMAG Users Conference -
- Exhibitions and Events for September through December, 2013 -
- Event Report -



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JMAG Newsletter: Highlights of the September Issue

It's really hot outside, so we hope you are finding ways to stay comfortable. We are pleased to present you with the September issue of the JMAG Newsletter.

In this issue's Implementing JMAG, we look at the details of research being carried out by Biel School of Engineering and Architecture Prof. Andrea Vezzini, whose mobile equipment for the first commercial electronic glider released in 2001 was awarded the Swiss Technology Minister's Award, as well as pass on initiatives using JMAG for electromagnetic analysis at Bern University.

Product Report will give an overview of motor design and the initial design stages through characteristic features of the extremely convenient freeware JMAG-Express Public, employing the example of a DC brush motor design for our explanation.

JMAG is undertaking initiatives aimed at enhancing the precision of loss analyses. We'll tell you about the Seminar on Advanced Computational Electromagnetics, which was well attended when we held it on July 23. We will report on the loss analysis initiatives and JMAG's status regarding loss analyses in this issue. We will report on what level loss analysis has attained at the cutting edge of research and development, as well as what initiatives will be undertaken to enhance JMAG's precision in the future.

FAQ contains useful functions aimed at helping anybody with even a minor worry about how to conduct a better analysis and is based on questions sent to us by those actually using JMAG.

The world is filled with a countless number of research papers and technical materials. Paper Introduction sifts through some of these to find some of the best papers or technical materials to help as a guide for those starting out in large transformers' electromagnetic field simulations.

In the "A to Z" of Fully Mastering JMAG, we pick up the issue of structural analysis. You can read all about material properties and setting methods for various types of conditions in an easily understandable format. This will of course be handy for those with experience in structural analysis, but will also be beneficial for those about to start conducting these exercises.

The JMAG Newsletter is intended for everybody, from those who are currently using the product to those who have not started yet. By all means, take this chance to introduce it to someone nearby.

This edition of the JMAG Newsletter is packed with more content than ever. We hope you enjoy it.

JSOL Corporation
Electromagnetic Engineering Department, Engineering Technology Division

Implementing JMAG

Bern University of Applied Sciences, Choose JMAG moving forward to 3D analysis

The Permanent Magnet Motor Expert Group at Bern University of Applied Sciences focuses their research on permanent magnet synchronous machines with high torque and power density. The use of JMAG allows them to predict with a high degree of precision the performance and losses of their designs. Since 2008 they have started using 3D FEA to get better results for special motor geometries like dual air-gap motors or to predict the influence of different winding systems.

Bern University of Applied Sciences

The Department of Engineering and Information Technology of Bern University of Applied System is one of the largest of the six departments of Bern UAS, which was created in 1997 in response to the introduction of the Bologna Process in Switzerland. Before that the department of Engineering and Information Technology of Bern UAS was an independent College of Engineering looking back over 100 years of education services in the field of engineering.

Bern UAS is one of the best-rated UAS in Switzerland, based on independent rankings and due to its well-known results in Applied Research and Development as well as its Cooperation with Industry. It has one of the highest ratios between government funding and external funding of all Swiss UAS and has received numerous National and International Awards for its Research Activities.

In 2012 Bern UAS has conducted over 280 research programs with external funding, 45 together with the Swiss Agency for promoting Technology and Innovation, 19 together with universities and the Swiss National Fund (SNF) and 4 Programs within the European Framework for Research and Development.



Permanent Magnet Motor Expert Group

The Permanent Magnet Motor Expert Group, led since 1996 by Prof. Dr. sc. techn. Andrea Vezzini, focuses their research since the beginning on permanent magnet brushless DC and Synchronous Motors and the accompanying power electronics. During this time the group worked in close cooperation with industry and received in 2001 the "Swiss Technology Award" for the drive train of the first commercial electric glider plane.

The group includes four Professors covering all the required fields for electrical machine design: electromagnetic design and simulation, mechanical engineering (CAD), computational fluid dynamics (CFD) for the thermal management and advanced control theory.

Master Course "Design and Simulation of Synchronous Permanent Magnet Motors"

Every year Prof. Vezzini is organizing a three-day seminar for all MSE Master Students in Switzerland

called "Design and Simulation of Synchronous Permanent Magnet Motors".

The key steps in the design of electric machines using finite element analysis should be taught. This includes the basics of the electromagnetic force calculation as well as the most important steps in the dimensioning of an electrical machine.

During this course the students are taught the following topics:

- Basics of electromagnetic Energy Conversion: magnetic field, field equations, electromagnetic force and torque, electromagnetic energy
- An overview of numerical field calculation and simulation methods using finite element analysis programs especially for electromagnetic fields. Introduction in JMAG
- Exercises: Magnetic circuit: Analytical solution and numerical solution with finite element program
- Application issues of numerical methods: modeling, parameter selection, choice of suitable calculation method, discretization
- Procedure for the application of numerical methods in electrical machines and actuators: GM, ASM, PSM, SRM and actuators
- Exercises: FE analysis of magnetic circuit and operating performance of a synchronous PM motor
- Cogging and load torque analysis with FE methods

The course is a hands-on approach and demands that the students possess during a period of several weeks access to a valid version of JMAG.

JMAG has been received very well by the students, even the ones having no experience with CAE-software before. Its modern and easy understandable user interface, the self-learning studio and the different possibilities for post

processing are the key factors for its success during the workshop.

Actually, we had electromagnetic field analysis software before JMAG. But at the time, you could apparently only use the software for 2D analyses, and even then only for static magnetic field analyses. A need arose to have greater analysis precision, so we chose a number of types of software to try out and finally elected to use JMAG. The reason we did so is because its 3D transient analyses were precise and speedy, in addition to being intuitive and easy to use. This decision linked to the success of a project I will talk about later.

Work on 3 Research Areas with JMAG

We have mainly worked on 3 research areas, New Renewable Energy Sources, Sustainable Mobility and Sustainable Cooperation with emerging and developing countries below (Fig. 1).



Fig. 1 Work on 3 Research Areas with JMAG

The Permanent Magnet Motor Expert Group concentrated their research activities on two fields:

- Very compact and lightweight high performance motors
- High efficiency permanent magnet motors

Electric Motor Glider ANTARES

As an example for the research field we can discuss the case of Electric Motor Glider ANTARES (Lange Aviation GmbH, Germany)

In 2001 the Permanent Magnet Motor Expert Group received an innovation prize for this electric motor, which was the first commercially available electric

glider plane, able to self-start (Fig. 2).



Fig. 2 The first commercially available electric glider plane

Brushless PM-Motor Specifications

- Outside runner with phase voltage optimized for block commutation providing best torque density
- High torque (250Nm) at low speed (1,500 rpm) and high efficiency (92%) at low mass (28.5kg)
- Completely integrated rotor design; rotor acts as case with direct mounted propeller blades
- Air Cooling by large inside diameter, operation for 10minutes at full load
- Series Production by Servax Landert Motoren AG

At that time most of the motor design was made using analytical design tools and a 2D FEA Tool for stationary electromagnetic field calculations.

In 2012 the Permanent Magnet Motor Expert Group received another contract to develop a motor for a new generation of electric plane. The group took the experience from the Lange Glider Plane, but was confronted with the added problem of continuous operation and higher torque density demands.

The use of 3D FEA Simulation made it possible to design a dual air-gap PM machine with extremely high torque density.

The Dual Stator configuration allowed for better cooling as well the use of two independent inverters. This would increase the redundancy of the system and allow operation at half the power at higher efficiency.

Comparison of Distributed and Concentrated Winding

The use of modular non-overlapped concentrated winding enables a significant reduction of end-winding dimensions (Fig. 3). The fractional number of slot per phase per pole enables to reduce number of slots.

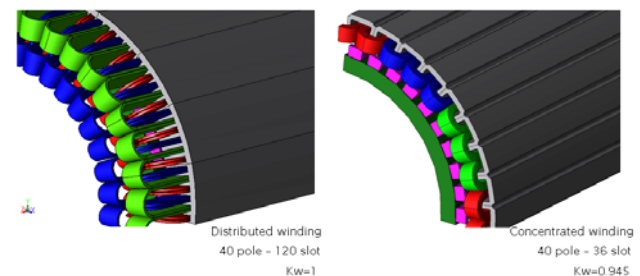


Fig. 3 Comparison of distributed and concentrated winding

The Chosen Parameters for Machine

The following Table 1 shows the resulting parameters for machine.

Table1 Chosen Parameters

Power output	32kW
DC-Link Voltage	210VDC
Rotational speed	1875rpm
Mass of active parts	14.397kg
Outside diameter of active parts	150mm
Stack length	165mm
Torque	165.4Nm
Current density*	10Arms/mm2
Power density	2.256kW/kg
Torque density	11.57N/kg
Number of turns per phase	36turns

* Current density was calculated with slot-fill factor 50%

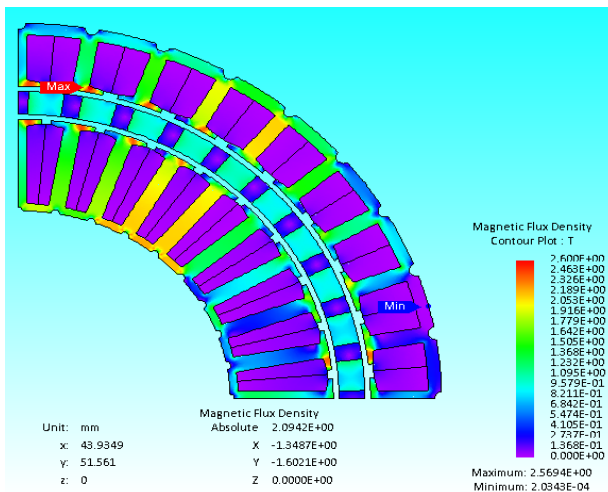


Fig. 4 Magnetic Flux Density

Loss Calculations

Loss calculations were important as input for the thermal calculations (Table 2). Lower losses would allow less material and therefore reduced weight. Most important has been the simple integration of manufacturing data (e.g. magnetic curves gained from measurements from stacked laminations vs. single sheet material data)

Table 2. Loss Calculations

Power output	32kW
Losses in winding (for temp 150 degC)	1475.5W
Iron losses in stator	227W
Joule losses in magnet	344W
Joule losses in titanium separator	304W
Input power	34816W
Efficiency	93.3%

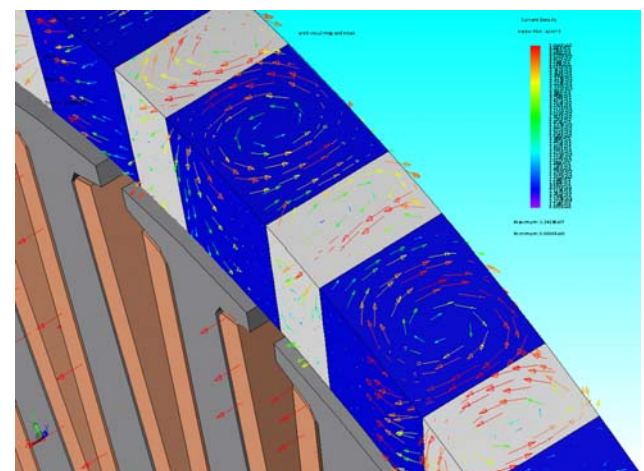


Fig. 5 Eddy currents on the surface of the permanent magnets and the magnetic rotor material

Thermal Analysis

Thermal Analysis (Fig. 6) has been done to evaluate the temperature in each part and temperature distributions. The visualization enables us to investigate on the heat flow and cooling system (Fig. 7).

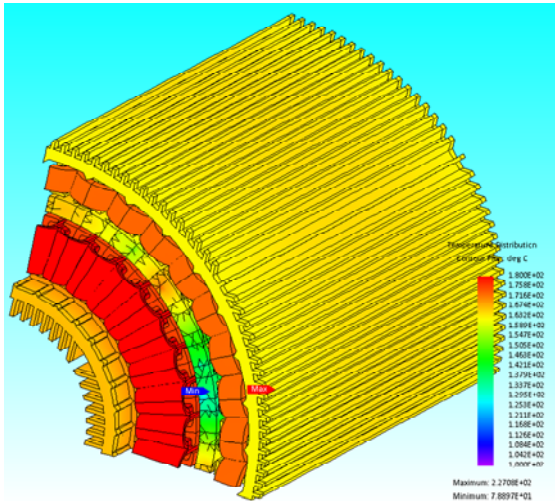


Fig. 6 Thermal analysis

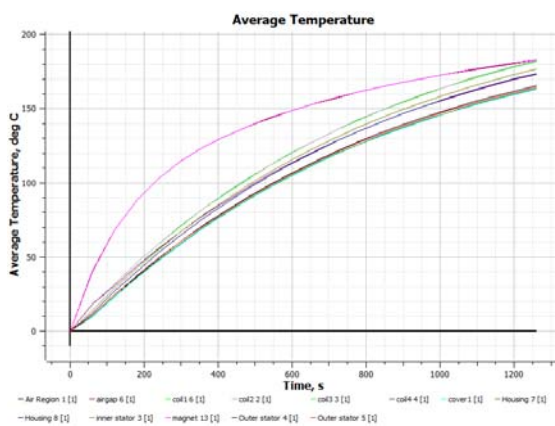


Fig. 7 Heat flow and cooling

Table 3 Heat Flow and Cooling

Part	Inner stator	Outer stator	Magnet	Inner winding	Outer winding
Average temperature after 20 min. [°C]	175	165	182	182	176

Summary

The experience has shown, that by using 3D FEA simulation, the performance and loss prediction reach a higher degree of precision.

Given the high computational speed of JMAG as well as the increasing power of today's workstation, even simulation time no longer seems to be a problem.



Bern University of Applied Sciences,
Division of Electrical
- and Communication Engineering

Quellgasse 21, CH-2501 Biel/Bienne ; Switzerland

<http://www.ti.bfh.ch/>

Product Report

DC Brush Motor Design Example

In the latest version of JMAG-Express Public released in July 2013, a DC brush motor calculation function has been added. In this issue, we'll give you an example of an actual motor design utilizing JMAG-Express Public's properties as an example of the DC brush motor functions that were recently added.

What is JMAG-Express Public?

JMAG-Express Public is a free motor design tool that we, JSOL Corporation, provide to motor designers. Simply input geometry dimensions, materials, winding and drive conditions as the design parameters and the motor properties are calculated instantaneously. JMAG-Express Public is extremely convenient for give a rough layout such as an overview design or design for initial stages (Fig. 1).

We have previously dealt with brushless motors, induction motors and switched reluctance motors. In this issue, though, we're going to look at how to respond to DC brush motors.

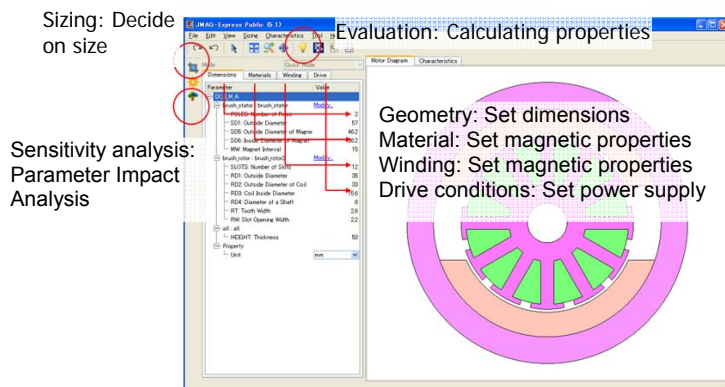


Fig 1. JMAG-Express Public Main Screen

The motor's design parameters, which are the geometry, material, winding and drive conditions, can all be set and changed in tabs. Click the Evaluate button for an instantaneous property evaluation. Click Sizing (automatically determines the size) on the left of the screen and this enables you to conduct a sensitivity analysis (design parameter impact analysis.)

Motor Design using JMAG-Express Public

Let's look at how to use the newly incorporated DC

brush motor analysis feature to perform an overview design for a motor using JMAG-Express Public. Flow of Motor Design using JMAG-Express Public (Fig. 2).

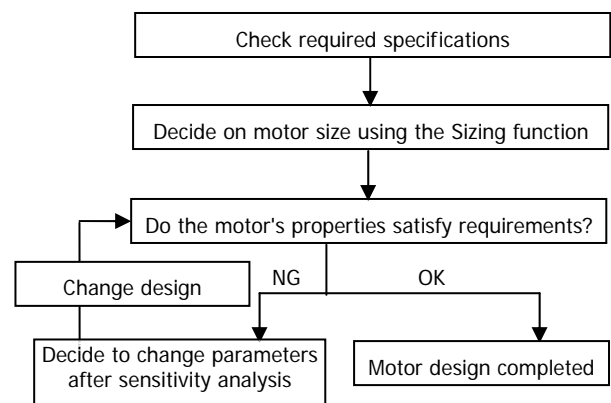


Fig. 2 Design Flow using JMAG-Express Public

Decide on the initial stage proposal using the Sizing function and then analyze the parameter that will have the greatest impact through property evaluation and a sensitivity analysis. Continue moving forward with the design, repeating the design change and property evaluation processes.

Decide the motor size instantaneously

In traditional motor design, the motor's rotor diameter D (m) and stack length L (m) would need to be input based on the desired specifications. Estimate thrust force generated in the air gap, the rotor diameter and stack length. In this case, thrust density is needed for things like experience, but there is also a need to achieve balance between the diameter and stack length, but this entails a lot of bother. Using the JMAG-Express Public we're introducing here enables automatic sizing of the motor. JMAG-Express Public has a sizing function and simply setting the desired rated output for a motor, etc. will propose a recommended geometry. Just choose a

geometry type first and there is no need for troublesome calculation, with creation instantaneous.

So, let's decide the motor size, using JMAG-Express Public's Sizing function to do so. First, decide on the geometry. Freely choose or change rotor and stator arrangements (Fig. 3).

Once you've decided on a geometry type, just input the desired specifications and JMAG-Public Express will propose a motor geometry (Fig. 4).

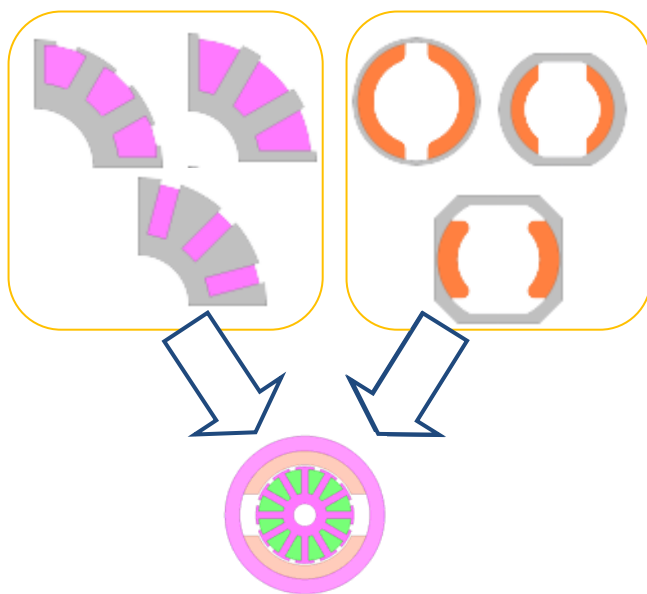


Fig. 3 Select Motor Geometry Types

To define a motor geometry, the methods available include using existing motor templates or creating new arrangements using a variety of rotors or stators.

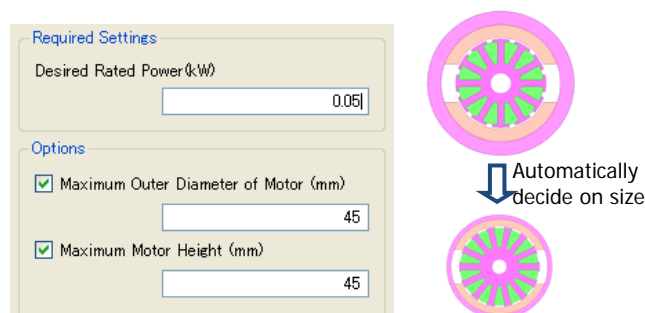


Fig. 4 Sizing Function (Input screen, <left> and Results <right>)

Push the Sizing button on the Main Window and it will open the Input screen. Define the desired output (W) and, if necessary, specify the maximum motor outer diameter (mm) and maximum motor stack length (mm) as necessary to act as controlling functions and then calculate the size.

Confirm motor properties instantaneously

Just inputting design parameters into JMAG-Express Public instantaneously calculates motor properties. For DC brush motors, you can instantaneously obtain such motor properties as the induced voltage constant, torque constant, current vs. torque properties revolution speed vs. torque properties and iron loss/copper loss properties.

Instantaneous confirmation of motor properties enables simple adjustments to satisfy detailed requirements. For example, you're satisfying requirements for rotation of 10,000 RPM and output of at least 50W, but you haven't made it to your required start-up torque of 250mNm. And you can only make your start-up current from the motor geometry 30A.

You think about increasing the number of coil turns to raise the start-up torque. But there's a limit to the number of winds that can be made in the stator slot, which means increasing the number of winds will decrease the maximum number of rotations. Inputting wire information, such as wire diameter, into JMAG-Express Public enables checking of the lamination factor within the slot, which means you can see the results of the revolution speed vs. torque properties while you make a simple decision on the number of coil turns (Fig. 5). For this case we will set the initial number of coil turns at 6 Turns, which means at a lamination factor of 26.2% there is still some room to move, so we can raise this to 8 Turns and increase the startup torque. Increasing to 8 Turns will design a motor that satisfies requirements (Fig. 6).

Winding System: Lap Winding

Number of Turns: 6 (Turn)

Wire Property

Setting Type: Round Wire Dimension

Wire Diameter: 1.2 (mm)

Number of Strands: 1

Insulation Thickness: 0 (mm)

Slot Fill Factor: 26.203 (%)

Maximum of Slot Fill Factor: 75 (%)

Correction Factor: 1

Coil Resistance: 0.0148164 (Ω)

Coil Pitch: 6

☒ Show Winding

Fig. 5 Winding Parameter Settings Screen

Winding parameter settings can be performed from the Winding tab in the Main Window. This time we set 6 Turns at a lamination factor of 26.2%, but changed this to 8 Turns with the objective of enhancing start-up torque.

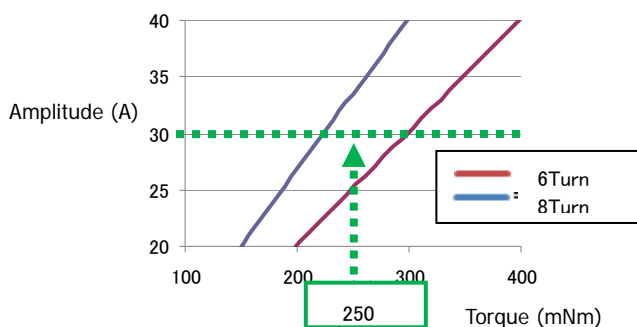


Fig. 6 Torque vs. Current Amplitude

Comparison of current vs. torque properties. Making 8 Turns at the same start-up current enabled us to obtain the start-up torque we needed to satisfy requirements.

Navigates through design change directions

If required specifications are not satisfied, it's not easy to decide which design parameter should be changed. If you're uncertain about which design parameter to change, the JMAG-Express Public sensitivity analysis is convenient. Just setting the desired motor properties in this function will indicate which design parameter has the greatest sensitivity (degree of impact) in terms of the desired result.

Say for example your objective is to reduce iron loss and want to investigate the sensitivity of each parameter in terms of iron loss. Our motor is set at 10,000 RPM and output of 50W, with iron loss and copper loss set at

about the same levels. Next, conduct a sensitivity level for each design parameter that should be considered for lowering iron loss. The JMAG-Express Public sensitivity analysis will calculate sensitivity just by specifying either the physical quantity that will be the target function for the sensitivity check or the operation point that you would like to investigate. We will specify an iron loss target function this time, setting 10,000 PRM, 50W output and torque of 50mNm as the operation point (Fig. 7).

Number of turns and rated voltage are determined in the motor requirements and can't be changed, but try setting the sensitivity here to the second-highest level and changing the teeth width to lower iron loss. Iron loss will be decided by the extent of magnetic flux over time, so the teeth width where magnetic saturation poses a problem will see increased sensitivity. Widening the teeth width lowers the magnetic flux density and enables lower iron loss (Fig. 8). Of course, broadening the teeth width will cut the coil space and reduce the lamination factor, but we have already shown how easy it is to check the coil lamination factor in JMAG-Express Public (Fig. 5).

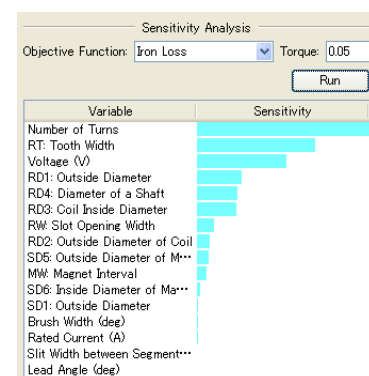


Fig. 7 Sensitivity Analysis Settings and Sensitivity

Check sensitivity through the sensitivity analysis button on the Main Window. Iron loss sensitivity for each parameter is displayed here. The display shows sensitivity is high for the number of turns and teeth width.

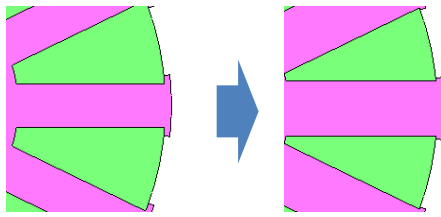


Fig. 8 Changing Teeth Width

To reduce iron loss, broaden teeth width in accordance with the results of the sensitivity analysis. Changes in dimensions can easily be carried out through settings in the Geometry tab on the Main Window.

How to Get JMAG-Express Public

You can easily get a JMAG-Express Public license from our website. Follow the instructions below to get JMAG-Express Public.

1. Download

Go to the JMAG-Express Public website page and download JMAG-Express Public.

2. Obtain a license key

Apply for a license from the same page from which you downloaded JMAG-Express Public.


3. Set the Installer and License Key

Install JMAG-Express Public and enter the e-mailed license key.

○JMAG-Express Public Website URL

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

In Closing

JMAG-Express Public will continue improve and expand functions like it has done with the regard to the DC brush motors we referred to in this issue. JMAG-Express Public is freeware, so download it and give it a try. 

(Tetsuya Hattori)

Motor Design Course

Issue 1 Why have a JMag Motor Design Course.

Many JMag Newsletter readers have expressed an interest in motor design, so we decided to do a series on the subject from this issue. But, having said that, we're analyzers and not motor design specialists. That makes it a bit rich to say we're holding a course. Nonetheless, we kick off this series with the thought that it might be useful for readers to pass on what we've learned about motor design through plenty of painful experiences in the past.

Why JMag is Holding a Motor Design Course

JMag is a general-purpose electromagnetic field analysis software with a broad array of analysis targets and handling general electromagnetic phenomena like electronic machinery. Many readers probably already know that a lot of our clients use JMag for motor R&D. That makes the precision of our analysis function development and motor analysis outstanding and many items can be implemented or conducted quickly.

In the past there used to be only a few technicians capable of motor design, and they were especially rare in the area of motor design for electromagnetic field analysis. For that reason, it was a little difficult to expect there would be an easy-to-use simulation software. Richly experienced expert technicians wanted to come up with some way of solving this issue of software that people found difficult to use.

Recently, various types of equipment use motors, so there has been an increase in technicians designing or selecting motors. That has, in turn, raised expectations about deliverance of an easy-to-use software. We obtain valuable information through such ways as the JMag Technical Support we provide on a daily basis or visiting our customers and talking to them. But, due to matters like classified information concerns, information or demands can be patchy, which prevents gaining a grasp of the overall and many of us are left feeling irritated. We, being in the position of a software producer and service

provider, came to believe that we should know how people are using JMag for designs because no matter what software we made and service provided, or what various types of software we developed or the diversity of information we provided, to know if we were contributing to our customers we also needed to learn about motor design. For example, it's the same sort of thing as an artisan who makes musical instruments who may not be good enough a performer to put on a show, but if they are able to play a little bit they still know more about using musical instruments than an artisan who has never played and thus they can also create a better musical instrument. I don't want to go on about it for too long -- some may say we're already too late to be talking about this topic. But, that's how we came to be seeking to learn more about motor design.

In addition, JMag Technical Support has also been receiving an increasing number of inquiries about motor design or evaluation and not just about how to use JMag. A perfect example of this comes with the following case. "When I do an analysis of the voltage, the torque is always negative. Is this a bug?" This was a question we were asked. Ultimately, it wasn't a JMag bug, but there was a simple reason for why the current was always running into the negative: the set number of rotations was high, which meant induced voltage became greater than supply voltage, but many people hadn't been able to realize that and continued to worry. To help these users feel at ease with JMag, we thought

we should provide them with information about motor design, which in turn inspired us to hold a motor design course where people could learn about the subject.

Textbook Project

For a few years now, JMAG has been thinking about this matter and wanted to hold design workshop seminars for people who intended to do motor design. These were small seminars for four or five people and held for beginners or others who were looking to get into motor design. The lectures' design targets were brushless DC motors and talked about such requirements as motor characteristics, identified main dimensions and went through to give an estimation of functionalities in seminars that attracted many participants. But the seminars only went for half a day, which wasn't long enough to be able to pass on what we wanted to. It was also tough for people to get the time to go through a series of seminars. That led us to think it would be better if we could provide the information in some sort of proper format, such as a textbook or reference manual.

We initially started looking around for an easy textbook accessible to motor design beginners such as ourselves, but could not find anything within Japan. This was possibly because the brushless DC motor itself was a comparatively new field of technology (or, maybe it had something to do with JMAG often being used in the brushless DC motor field).

Consequently, we decided that by arranging into a textbook form the things we were about to learn regarding motor design and associating them with methodologies for JMAG-Express and JMAG-Designer we would be able to contribute to JMAG users and potential users (bearing in mind that we're also a private company operating for profit and could not provide these things on a purely voluntary basis).

Our current concept is to use the textbook as a

sub-manual for JMAG-Express and by changing and experimenting with all sorts of design parameters within JMAG-Express teach ourselves the fundamentals of motor design. We have released a video of a motor design using JMAG-Express and posted this online at the link below. Anybody who's interested, please take a look.

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

With the release of the textbook we would like to obtain feedback so we can use this to improve the contents of the learning manual. Please help us with this and let us know your thoughts on the textbook.

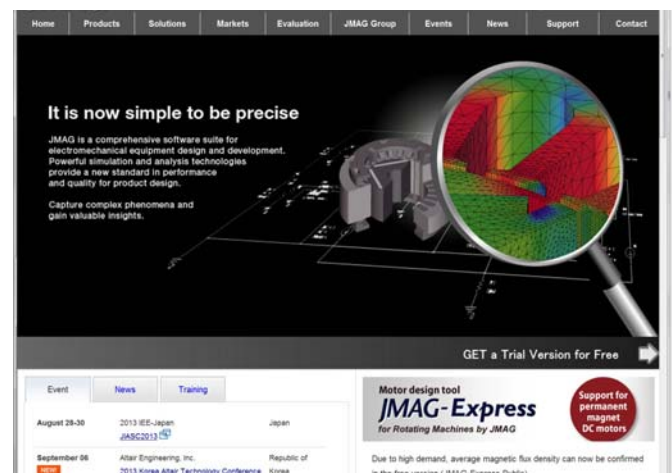


Fig. 1 JMAG International Top Page

The JMAG-Express page is accessible directly from the JMAG top page, so please check it out.

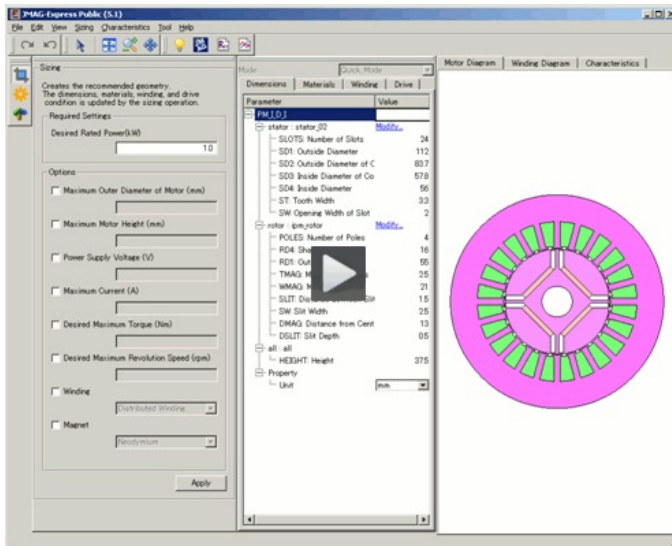


Fig. 2 Web video starting scene

A website slideshow gives a step-by-step look at motor design using JMAG-Express. In the initial stage, the sizing function is used to create a rough size, which is one of the benefits of JMAG-Express, which allows for tests of various and diverse proposals.

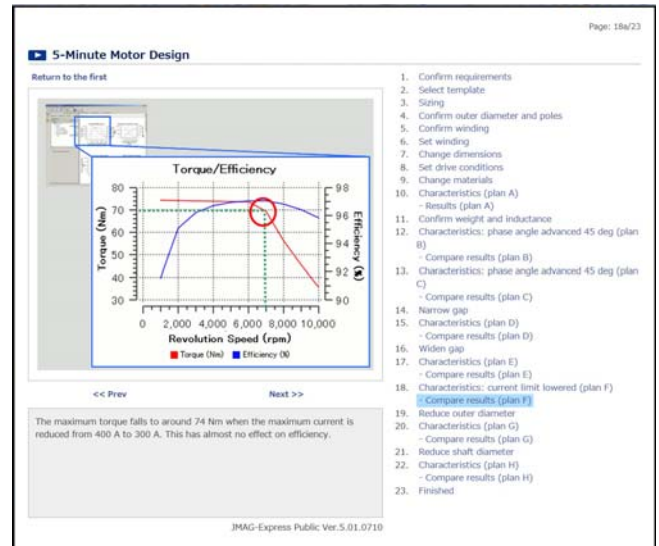


Fig. 4 Analysis results and their analysis

Space is provided below analysis results obtained from JMAG-Express with examples aimed at understanding what the results are and how decisions can be made about these results.

We'll start the design course from the next edition

The first edition of this series was mostly to inform what we will be writing about in the future. During the next Newsletter, we will start the course while using the textbook, so please prepare for that.

At the same time, we will also be releasing information on the website or through videos, so please expect to see these, too. **J**

(Yoshiyuki Sakashita)

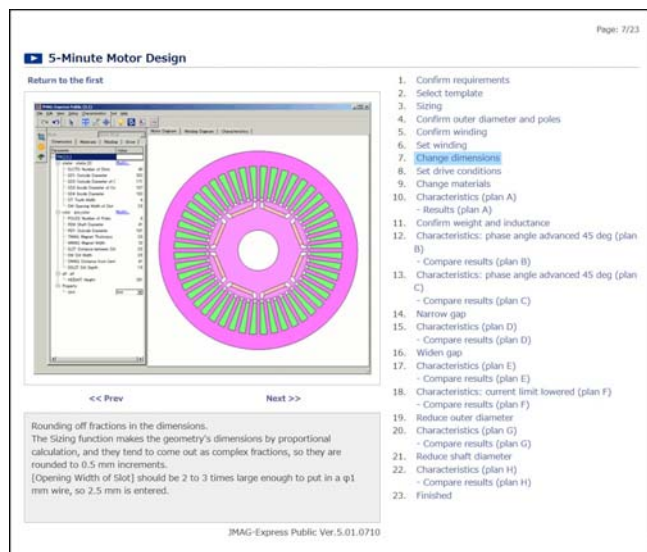


Fig. 3 Inputting parameters

A JMAG-Express screenshot above changed parameters and written explanations of those changes. The examination process is listed on the right, enabling a crow's nest view of the trial and error process.

Column: Concentrated Winding and Distributed Winding

With the motor design course we plan to give explanations while focusing on individual decisions made during the process of designing a motor. This column will pick up a particular issue about motor design, use JMAG to do a simple verification and then explain what has happened.

In this issue, I'd like to talk about concentrated and distributed winding. A general property of concentrated winding is that the coil is wound directly onto one pole of the teeth, so there is no need to wind the coil around several teeth as is the case with distributed winding. This results in enabling shortening of the coil end height, which both cuts the motor's copper loss and contains the axial direction of the motor itself. In the manufacturing process, these abilities give it benefits like enabling comparatively fewer processes or tools than for distributed winding. On the other hand, one of its weaknesses is an uneven magnetic circuit because the number of stator core teeth for each pole is kept to a minimum. This means a lower rate of magnetic flux that includes many flux linkage harmonic components, which makes it easier for generation of torque fluctuations and simple increases of iron loss, both of which are additional disadvantages.

Consequently, restrictions apply to the outer diameter axial direction dimensions. When trying to limit the height of the coil end, or torque covers a comparatively large area and the motor is in equipment prioritizing reduction of copper loss, concentrated winding is said to be effective.

(Reference materials: Takeda, Yoji, et al, "Interior magnet motor design and control," Ohmsha Ltd.)

First, perform a magnetic field analysis of concentrated winding and distributed winding. Make the analysis model rotor geometry and stack length the same and the drive conditions are also to be identical. All that should differ is the stator geometry and coil resistance (Fig. 1)

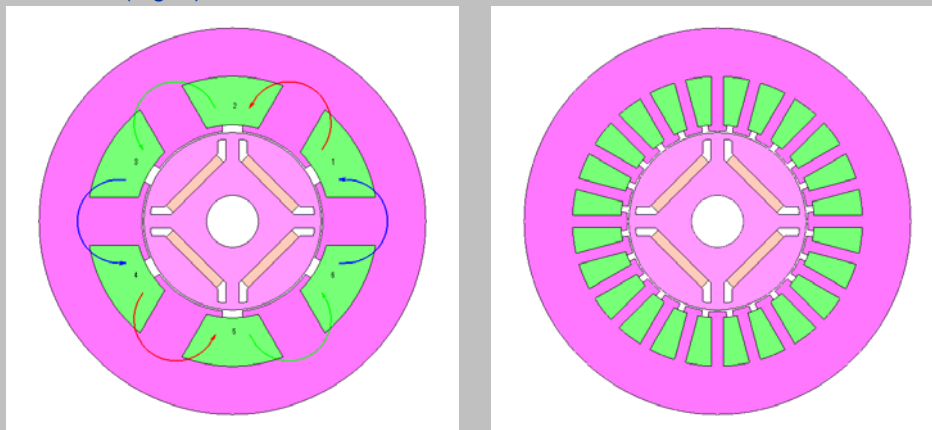


Fig. 1 Motor geometry Concentrated winding (left) and distributed winding (right)

An initial comparison of the no-load induced voltage shows a significant difference in waveforms (Fig. 2). Concentrated winding has fundamental wave amplitude almost identical to that of distributed winding, but the fewer slots means a different ratio of higher components that results in expression of different waveforms (Fig. 3).

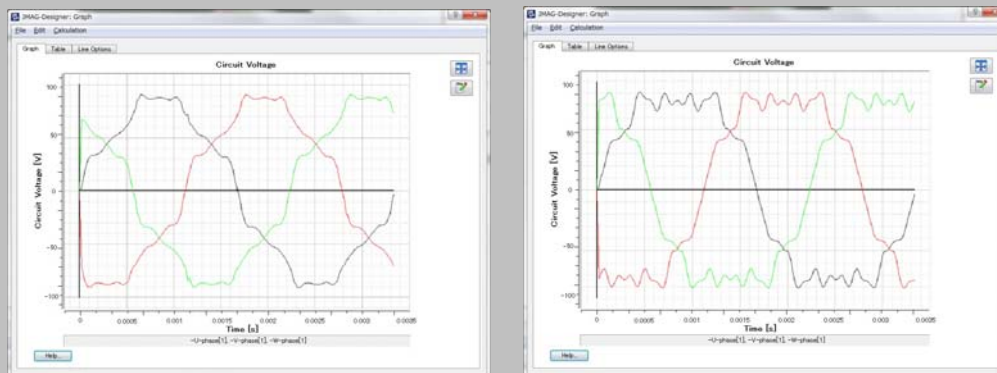


Fig. 2 No-load induced voltage waveform Concentrated winding (left) and distributed winding (right)

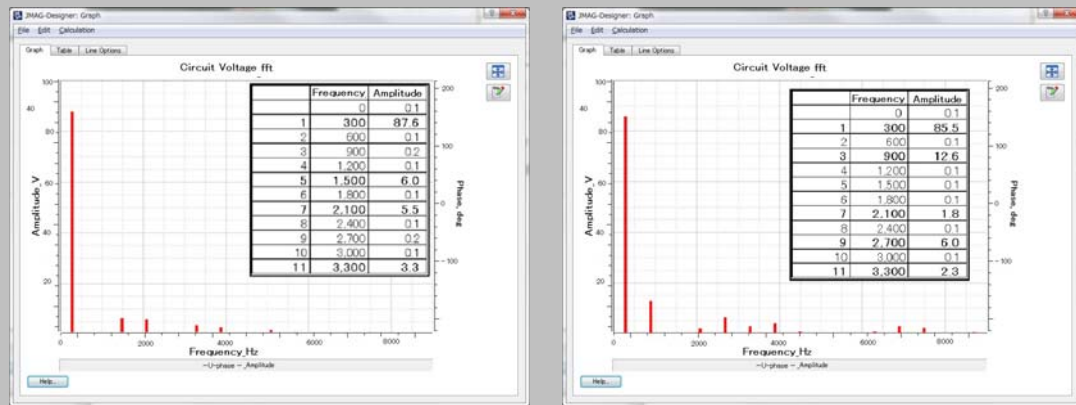


Fig. 3 Frequency components of the no-load induced voltage waveform
Concentrated winding (left) and distributed winding (right)

Looking at the analysis results of a load operation shows a difference in sensitivity in the current position. As stated earlier, the flux path is uneven in concentrated winding and field weakening controls cause reluctance torque (Fig. 4).

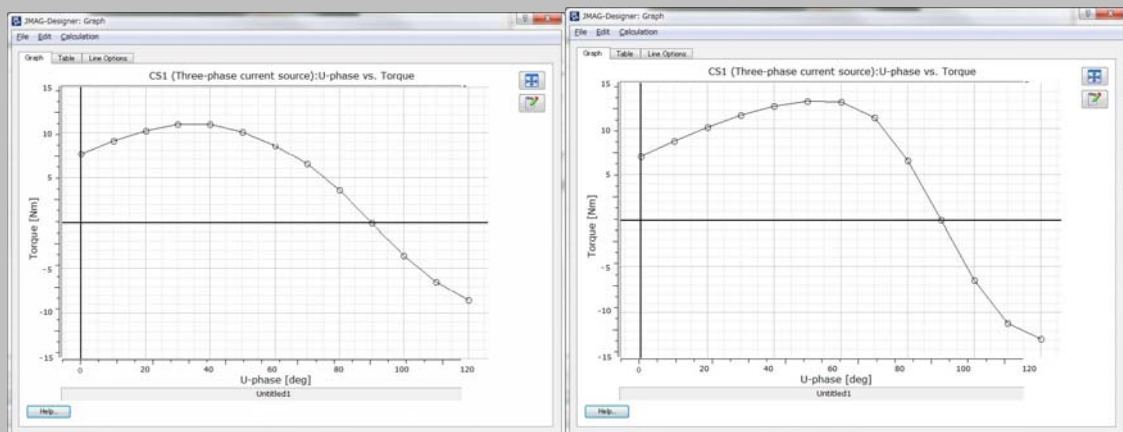


Fig. 4 Current phase/Torque properties Concentrated winding (left) and distributed winding (right)

Individual dq-axis inductance is listed below:

Concentrated winding: $L_d=1.900(\text{mH})$ / $L_q=2.163(\text{mH})$

Distributed winding: $L_d=1.412(\text{mH})$ / $L_q=2.057(\text{mH})$

The dq-axis inductance value also shows that we should not have great expectations regarding reluctance torque in concentrated winding.

A feature of the analysis loss attained was magnet current eddy loss. Concentrated winding had more significant reverse magnetic field changes than distributed winding, which increased the changes produced in the magnet's eddy current loss (Fig. 5). Heat generated in the concentrated winding magnet was 23.4 (W) compared of 2.6 (W) generated in the distributed winding magnet.

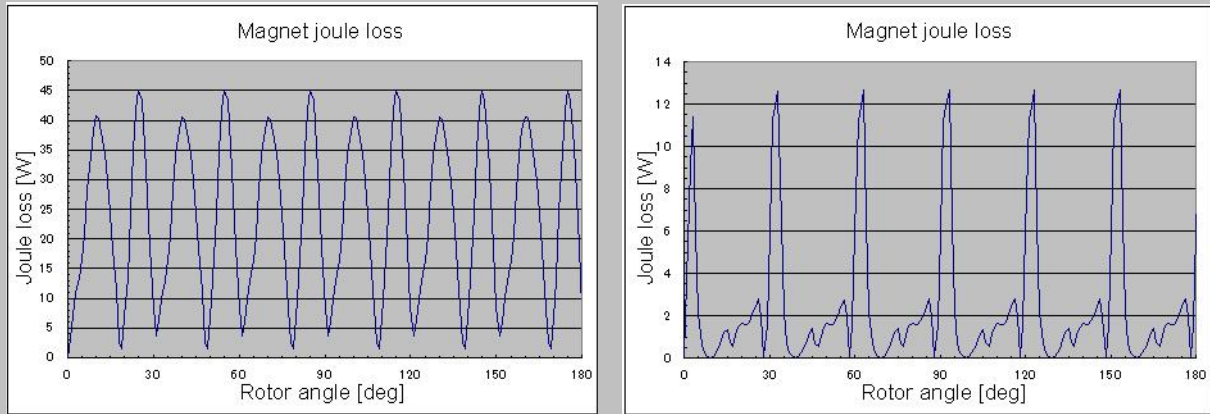


Fig. 5 Current phase/Torque properties Concentrated winding (left) and distributed winding (right)

Magnetic loss in itself does not have a great effect on the efficiency of the entire motor, but because heat is generated in the magnet, which is the most easily affected material of all those used in the motor, when actually designing you must take note of decreased performance or demagnetization caused by thermal demagnetization.

Results also showed that rotor iron loss was greater in concentrated winding than it was with distributed winding (Fig. 6). Iron loss values are below.

Concentrated winding: Stator 64.4(W)/Rotor 21.6(W)

Distributed winding: Stator 76.5(W)/Rotor 8.1(W)

* 9000(rpm)/70(Apeak)

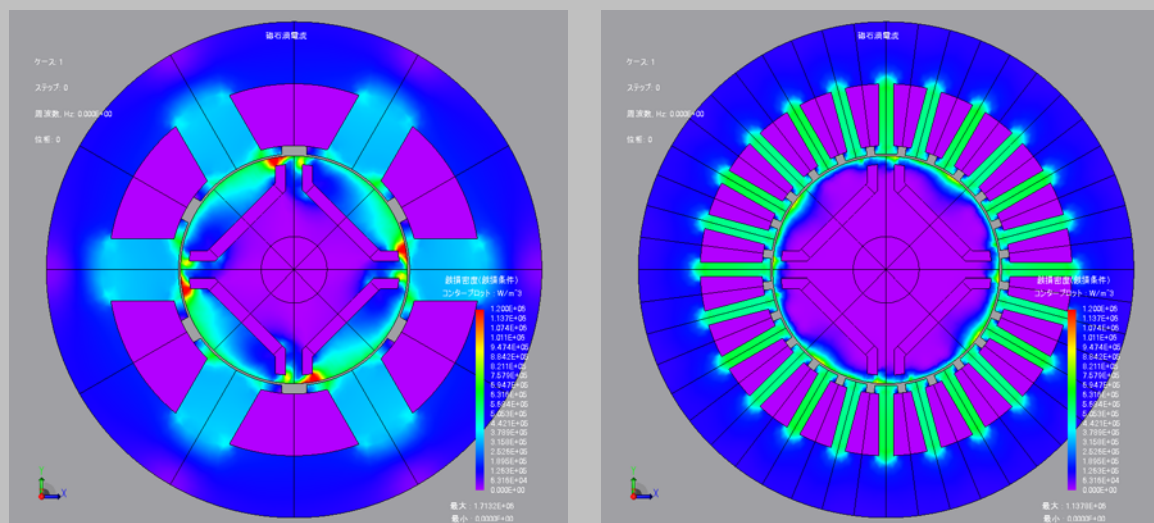


Fig. 6 Iron loss distribution contours Concentrated winding (left) and distributed winding (right)

We learned that iron loss in concentrated winding there is also a tendency for the temperature to rise easily, so care must be taken of the amount of heat generated in the rotor when using concentrated winding.

If there is a topic you would like us to cover in this column, by all means please let us know and we will try to deal with it. We are also waiting for any opinion you may have about the details of this column. Contact us using the reference below.
info@jmag-international.com

Solutions

JMAG's initiative on loss analysis

JMAG has since the late-1990s continued maintaining a materials database, model creations and analysis functions because it should be able to respond to users' actual requirements. We have continued moving forward on function development to meet the rising demand in recent years for even greater precision in loss evaluation.

This newsletter will show just what level loss analysis accuracy has attained and what we're going to do from now on to enhance JMAG's precision, as well as give insight into the history of JMAG's loss function development.

Overview

Loss analysis has been one of the most important issues in electromagnetic field analysis for the past 10 to 15 years. Its importance has gained even greater significance in recent years.

Loss analysis actually has a lot of diverse viewpoints when you get the lowdown on it, with different approaches required depending on the matter at hand, including analysis methods, materials modeling or comparison with measurements. Issues needing solutions and required accuracy change with the times. Greater demand for highly efficient electronic machinery means we are now being sought to analyze detailed phenomena with advanced precision.

Technological development needed to respond to heightened requirements can't be created overnight. It's the result of trial and error and producing results over many long years. Here, we'll tell you how JMAG is taking on the issue of loss analysis.

The history of JMAG's loss function development

JMAG's loss analysis functions started in the 1990s with development of an iron loss analysis tool. Since then, it has created a history of taking into account every single factor to enhance

accuracy right through to its current initiatives regarding the effects of processing deformation (Fig. 1).

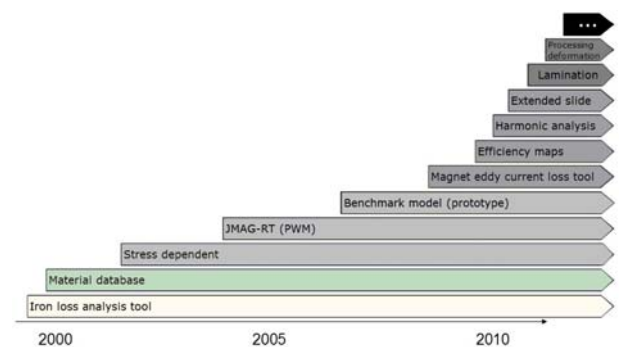


Fig. 1 The history of JMAG's loss function development

Realizing the importance of material data and incorporating its functions quickly

Built-in database function

We held the 2nd Seminar on Advanced Electromagnetic Simulation in Yokohama in 2000. The title of the seminar was "Materials Modeling in Electromagnetic Simulation." While we were there, materials manufacturers, university professors, electronics manufacturers and automakers taught us of the importance of material modeling and presented us with issues needing solutions. These evolved to become JMAG's current development policies.

That same year, JMAG began including material data (Fig. 2). JMAG was the first analysis software to include material properties of all manufacturers' material properties data. Materials data being vital is a fact nobody would likely dispute, yet JMAG was the first time it had actually been included as a function in an act enabled by the cooperation of materials manufacturers.

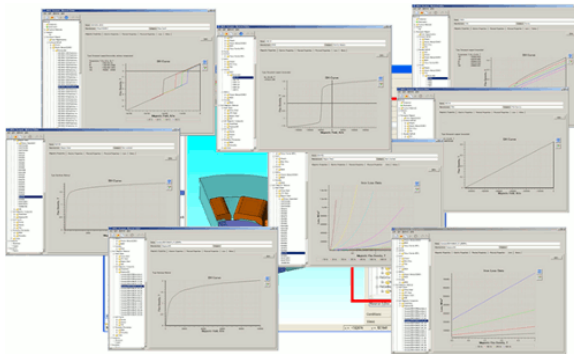


Fig. 2 An example of a material database included in JMAG

Harumi Project

Performance verification through comparison of actual measurements

We created an IPM motor (nicknamed Harumi Model 1) to evaluate the performance of loss analysis at actual work level and compared measurements and analyses (Figure 3 and Table 1). (Joint research with Shibaura Institute of Technology, 2008.) Results showed us that we could achieve favorable matching if we took care of a few keypoints. Using actual machinery and without taking any special measures for analysis we used production methods as close to normal as possible. We did not employ special methods or data for analysis. We just used the same JMAG we normally provided.

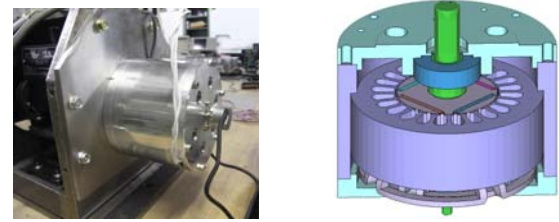


Fig. 3 Motor-bench and motor model

Table 1 Motor specifications and measurement conditions

Motor specifications		Measurement conditions	
Number of poles	4	Supply voltage (V)	150-300
Number of slots	24	Carrier frequency (kHz)	6-15
Outer stator diameter (mm)	150	Rotation speed (rpm)	1000-6000
Inner stator diameter (mm)	80	Current (Apeak)	2-20
Air gap (mm)	1	Current phase (deg)	0-80
Stack length (mm)	50		
Core material	35H360		
Magnetic material	N39UH		
Turns (turn/phase)	128		
Phase resistance (ohm)	0.46		

Keypoint 1: Measurement

- Measurement needs some care with high precision loss evaluation

- Iron loss can't be measured directly, so estimate as outlined below:

Iron loss $W_i = \text{Input } P_{in} - \text{Output } P_{out} - \text{Copper loss } W_c - \text{Mechanical loss } W_m$

- Errors for each of these elements is directly linked with iron loss error (Table 2).

Table 2 Error causes in iron loss measurement

Cause	Reason for effect	Iron loss error (Harumi Model 1)
Torque sensor resolution	The torque sensor resolution itself becomes the precision calculation output.	0.2W@1800r/min
Torque sensor temperature compensation	As the torque sensor has temperature drift properties, there will be an error output unless there is compensation made for temperature changes in the torque sensor.	0.3W/deg
Coil temperature	Resistance changes due to the coil temperature, which has an effect on iron loss calculation accuracy.	0.05W/deg
Bearing temperature	Bearing friction resistance changes according to the temperature, so failing to measure the bearing temperature will result in machine loss error.	0.2W/deg

Keypoint 2: Consideration of harmonic current

The effects of phase currents on harmonic components like PWM drive must be considered or

losses won't match (Figures 4 and 5)

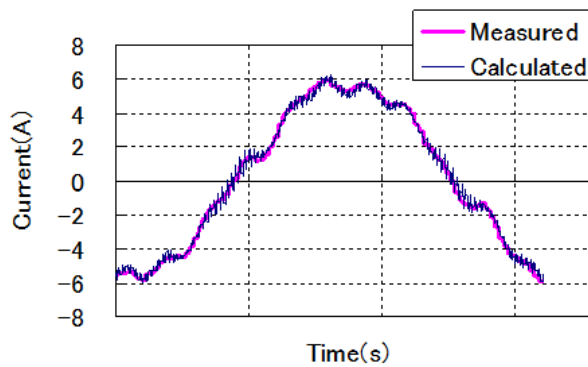


Fig. 4 Current waveform obtained from magnetic field-control/circuit link

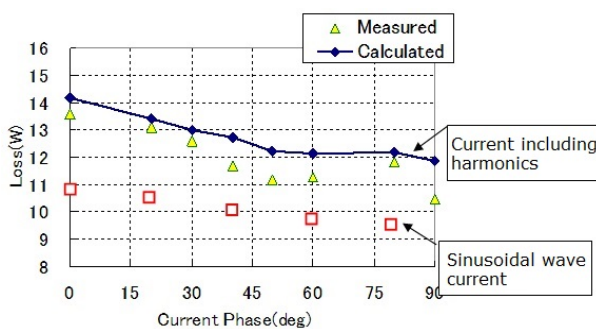


Fig. 5 Iron loss comparison

Loss analysis accuracy required from now on

Currently, if all conditions are set in place properly, analysis can be conducted with an accuracy of about 10% of actual measurements. From now on, though, greater accuracy will be required under the same, or even under a broader array of conditions. Factors that need to be taken into consideration to improve precision are shown below (Figures 6 and 7).

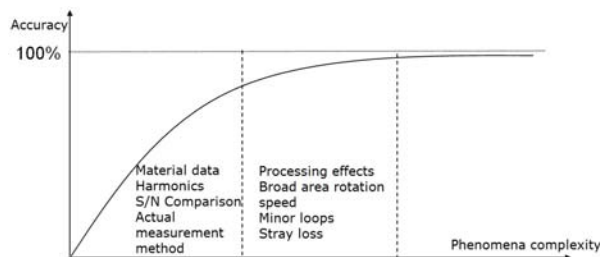


Fig. 6 Iron loss accuracy and causes

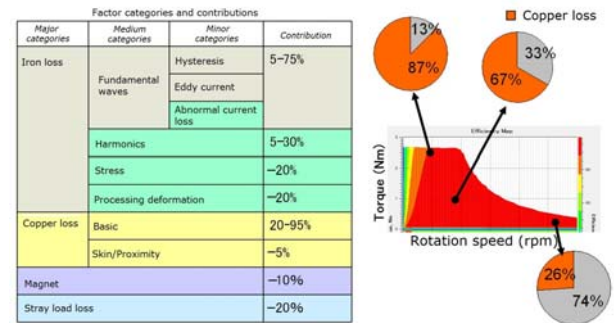


Fig. 7 Loss causes and contributions

Processing deformation effects

Deformation generated when punching laminated steel sheets effects iron loss (Fig. 8).

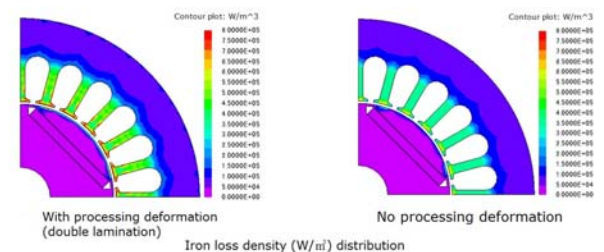


Fig. 8 Effect of processing deformation on iron loss and efficiency

Coil loss: Effects of harmonics

Skin and proximity effects generated in the wires due to harmonic components like PWM increase copper loss. Modeling wires enables recreation of the bias in current density distribution in the wiring (Fig. 9).

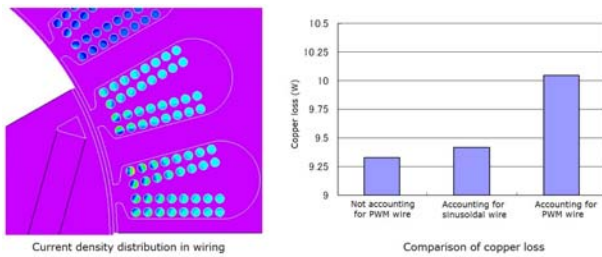


Fig. 9 Comparison of current density distribution in wiring and copper loss

Magnet eddy current loss and dividing mesh

The extent a mesh is divided significantly changes the loss value. Inserting a triangular prism element into the skin of a tetrahedral element will increase precision (Fig. 10).

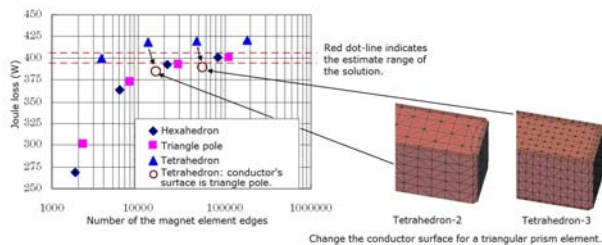


Fig. 10 Joule loss comparing number of elements by element type

Effects of stray loss

Changes in magnetic flux near the coil end or core end can produce eddy currents in the case or core surface. (Fig. 11).

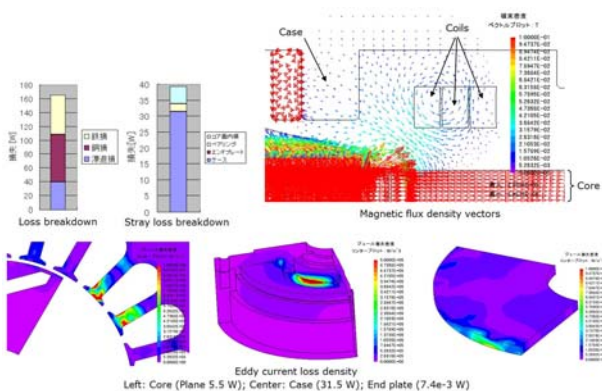


Fig. 11 Stray loss

Conclusion

We've presented you with some news about our approach to JMAG's loss analysis function development. As far as loss analysis is concerned, we showed we can currently evaluate to a level with a margin of error of about 10% if all conditions are set properly in place. We will continue function development incorporating new factors to further enhance our precision and also move ahead on technological development to accelerate evaluation of these. Expect achievements.

(Yusaku Suzuki)

Paper Introduction

Issue 5 For Those Planning to Start Analysis of Large Transformers Part 2

In this series, I would like to introduce various papers that present ways of using JMag while performing electromagnetic field simulation. In this issue, I will introduce 12 pieces (refer to [1] through [12] in Reference) of literature that will serve as a good reference for users who plan to start using electromagnetic field simulation for large transformers.

Overview

I, Takayuki Nishio from JSOL, am in charge of introducing the papers covered in this issue. The JMag Newsletter March 2013 issue introduced a paper about large transformers for those planning to start transformer analysis. As with the previous issue, this issue will introduce a large transformer textbook and a paper on stray loss analysis.

Images in this text are all self-created and have not been taken from papers or edited.

Large Transformer Textbook

This issue, I would like to introduce literature equivalent to a textbook on large transformers. I have only just started learning in earnest about transformer analysis, so a textbook comprehensively covering transformers is a necessary item, but there are not many such specialized textbooks that can be easily obtained from a bookstore nowadays.

[1] Tsuboshima, Shigehiko and Hata, Masahiro. "Zukai Henatsuki: Kiso kara oyo made (Illustrated transformers; From the basics to practical use)," Tokyo Denki University Press

This book is probably about the only one specializing in transformers that can be easily obtained. (There are, however, many books about transformers and rotating

machines.) This book provides an easily understandable introduction of the composition of transformers (materials, main body structure and accessories) through to their basic properties, wiring, operation, testing and basic designing. I recommend this book for anybody about to start studying transformers from now. Anybody with an understanding of high school physics and AC phasors can get into reading it immediately.

[2] Hagino, Shozo. "Henatsuki no unten to shiken (Operating and testing transformers) (d-book Series)," Denkishoin (He has also published another three books on transformers, but they have all sold out.)

This is an A4-sized, paperback textbook of about 20 pages, and is published as one of a series, with this particular publication dealing with transformers. Each book in the series sells for around 1,000 yen, which makes it a bargain, and the books are easy to assemble, making some publications in the series indispensable, depending on the topic.

[3] Japan Institute of Plant Maintenance, "Henatsuki no mentenansu (Transformer maintenance), (Electrical Equipment Maintenance Series)," Japan Institute of Plant Maintenance

It's not uncommon for large transformers to be used for more than 30 years, but a basic knowledge of

maintenance practices is needed to make them last that long. Maintenance is that important. There are many technicians involved in maintenance and they need to share knowledge widely. This book provides easily understandable explanations of transformer standards and structure for starters, continues with the relationship between operations and lifespan, diagnoses coil lifespan and talks about conservation and inspections. An ideal introductory book for learning about conservation maintenance of transformers.

Paper Introduction: Stray Loss

In the March issue, we provided a comprehensive introduction of large transformer analysis papers based on the Finite Element Method (FEA) in relation to electromagnetic phenomena. To sum up magnoelectronic analysis of large transformers succinctly would be to say that there are a variety of fields concerned, each of which has its own degree of maturity in terms of analysis technologies.

In this issue I would like to discuss papers on stray loss analysis, which is moving forward in the field of electromagnetic analysis of large transformers.

Searching and Obtaining Papers

Stray loss has been a field of analysis study for a long time and there are many publications about the topic, but apart from the publicly available publications I obtained through places like the Internet, please understand that the papers mentioned below came from a service the company subscribes to.

To extract papers, first go to the IEEEExplore website, search for "Power Transformer Stray Loss" and of the 125 papers that come up, extract those from JSOL's IEEE Magnetics division. At JSOL we also have joint research materials on rotating machines and stationary devices compiled with IEEJ's B Division and you can also extract items from there.

[4] Saito, Tatsu and Ioi, Akira. "Magnetic Field and Eddy Current Losses in Transformer Tank," *The Institute of Electrical Engineers of Japan Journal*, Vol. 96, No. 9, pp. 465-471, 1976

This is possibly the oldest paper to have sparked quantitative discussion on stray loss in Japan. The author actually produced an experiment on 150MVA-class test equipment (a main body and tank only), measured the magnetic flux density generated near the tank and compared the measurements with the analysis results. The analysis modeled the tank wall and by giving the actual measurements the magnetic field's strength as a boundary condition sought the magnetic flux density, magnetic flux and eddy current. As it was impossible to directly measure stray loss within the tank, several measurements were made of temperature distribution on the tank walls and then a comparison made of the tank wall temperature distribution calculations.

This paper was written in 1976, which was before electromagnetic field FEA, so uses the finite difference method as its method of analysis.

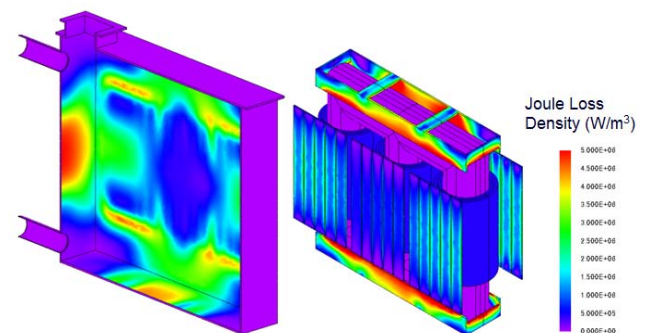


Fig. 1 Stray Loss Analysis Example of a Tank and its Interior

[5] Chen Yongbin, Yang Junyou, Yu Hainian, and Tang Renyuan. "Study on Eddy Current Losses and Shielding Measures in Large Power Transformer," *IEEE Transactions on Magnetics*, Vol. 30, No.5, 3068-3071, 1994

Stray loss analysis is needed on complicated structures

so analysis models tend to become large scale. Analysis under the theme of stray loss therefore often involves papers dealing with ingenious ways to analyze while keeping the analysis scale at a controllable level.

This paper looks at a 360MVA large transformer and handles stray analysis, including the shield. It uses the tetrahedral edge element, finite element method popular at that time, and looks for the stray loss in the tank/shield, clamp, cover plate and cover. The test compares the impact the presence of a shield has on magnetic flux density and stray loss. The transformer geometry and characteristics differ from those mentioned on the transformer in 4) above, but in a case without a shield, the results resemble those in 4 in terms of iron core directional height and magnetic flux density distribution and have characteristics common with a three-leg core-type transformer. The paper shows the method of installing shields on the tank and caused significant changes in the tank's loss. Results showed placing the shield perpendicularly cause a reduction of over 60% compared to when the shield was horizontal, coming to the conclusion that the ideal location for installing a shield was in a perpendicular state inside the tank wall.

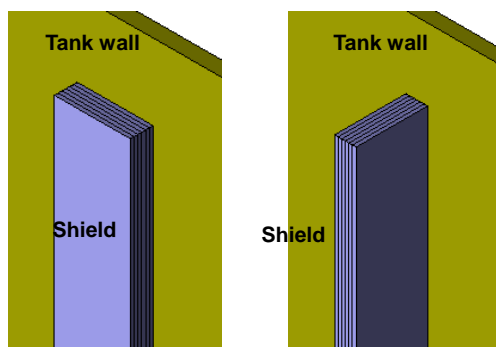


Fig. 2 Differences in Placement of Tank Shields
(Left: Perpendicular, Right: Horizontal)

[6] Kainuma, Kengo; Take, Tatsuo; Ito, Masayoshi; Tanaka, Motoo; Tsuboi, Hajime. "Eddy Current Analysis in the Tank of Three Phase Transformer," The Institute of Electrical Engineers of Japan materials, SA-00-18, RM-00-83

One reason why analysis models handling stray loss grew so large is because they are being required to have a mesh that considers eddy currents in structures.

This paper takes a 200MVA-class transformer and attempts to reduce model scale using the surface inductance method on the tank. As the surface inductance method has the feature of using a set target area as an inductance boundary, rendering exterior modeling of the boundary surface unnecessary, which enables use of a smaller-scale model. (Surface skin must be sufficiently thin, however, because the material properties are linear.) In this paper, heat analysis using stray loss as a heat source was conducted, thermaview used to collect actual results on tank temperature distribution and a comparison of the two made with the conclusion being that the analysis results were appropriate.

[7] Kurt Preis, Oszkar Biro, Gerhard Buchgraber, and Igor Ticar. "Thermal-Electromagnetic Coupling in the Finite-Element Simulation of Power Transformers," IEEE Transactions on Magnetics, Vol. 42, No.4, 999-1002, 2006

This paper also contains elements of methods to be employed to keep calculation costs controlled during a magnetic field-thermal coupled analysis. This paper looks at stray loss in a tank caused by low-pressure side bushing forming a large current and a two-way coupled analysis observing temperature change, electric and thermal conductivity and temperature dependency, as well as localized overheating in the tank. A two-way coupling analysis is problematic in terms of calculation costs on the magnetic field analysis side, but to keep these costs under control, an assumption that electrical conductivity temperature dependency will be steady is used and magnetic field analysis calculated anew in conjunction with updating the electrical conductivity, which limits the conductor generated by the eddy current and uses this for analysis. Integration of elements such

as magnetic flux density in areas not calculated anew are assigned results from initially calculated areas as boundary conditions around the conductor.

[8] Marisa Rizzo, and Janusz Turowski. "Influence of Flux Collectors on Stray Losses in Transformers" IEEE Transactions. on Magnetics., Vol. 36, No.4, 1915-1918, 2000

In an attempt to control the size of a model in a complicated 3D geometry, analysis is carried out here using a three phase magnetic flux with a sum of zero. Generally with transformers, as the phases in a three phase magnetic flux are different, the three-leg iron core needs to be modeled in its entirety, but this paper takes the three phases of magnetic density as having a sum of zero and models not only the thickness direction iron core but also the 1/2 of the horizontal direction.

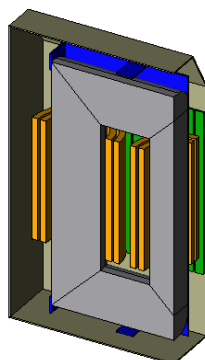


Fig. 3 Example of a Transformer 1/4 Model

[9] Takahashi, Norio; Nakau, Takaaki; Miyagi, Daisuke; Nogawa, Shuichi; Kuwata, Minoru. "3-D Eddy Current Analysis of Bevel Edge Core Reactor using Modeling Technique of Laminated Steel," The Institute of Electrical Engineers of Japan Journal, B Division, Vol. 128, No. 1, pp. 277-282, 2008.

Stray loss is evaluated by a short circuit test in the transformer, but at these times leakage flux seeps from the winding pattern into the laminated core, generating loss there. This loss is handled as stray loss because it was generated from leakage flux.

This paper is a discussion on the validity of laminated structure modeling including the homogenized method and actual measurements and is applied to analyzing stray loss in a transformer core. The authors modeled using a density model of four magnetic steel sheets only (the remainder underwent the homogenized method) and compared the results with results of all of the lamination under a density model and checked the validity of the models. They also confirmed the validity of modeling by comparing measurement results produced by actual machinery with analysis results obtained from applying this method.

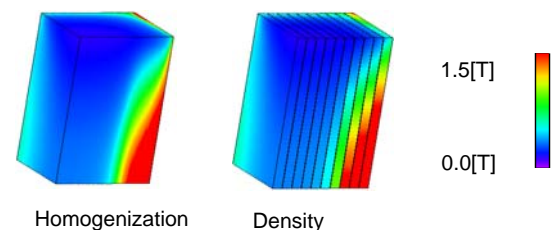


Fig. 4 Comparing Magnetic Flux Distribution between a Homogenization Model and Density Lamination Model

[10] Hayashida, Hirokazu. "Study of local heating on by IPB connection box and around metallic parts of large power transformer by 3-D Magnetic field analysis," JTAG Users Conference 2010

We have customers give presentations on stray loss analysis at our Users Conference. When Fuji Electric Co. gave a presentation, they spoke about IPB connection boxes and not transformers, but this touched on analysis of localized overheating distribution within the box caused by leakage flux generated from the busbar on the low pressure side. They showed an examination of improvements to the connection box. They also showed temperature evaluation accompanying a thermal conductivity analysis.

[11] Ruja, Costin. "Using JTAG and ANSYS for coupled thermal solution of a high current bus bar exit in GSU transformers," JTAG Users Conference 2012 in Germany

Taken from a presentation given at a Users Conference held in Germany and referring to an example of handling

localized overheating in a connection box. A coupling analysis realized after referring to loss results obtained from a JMAG electromagnetic analysis and used in thermal fluid analysis software.

[12] Yingying Yao, Chang Seop Koh, Guangzheng Ni, and Dexin Xie. "3-D Nonlinear Transient Eddy Current Calculation of Online Power Transformer Under DC Bias," *IEEE Transactions on Magnetics*, Vol. 48, No.2, 739–742, 2012

In the transformer operation stage, power transmission occurs while passing through several transformers on its way from the power generator to ordinary homes or factories. Power transmission between transformers can witness DC bias seen as ground current being superposed over the transformer circuit due to the influence of geomagnetism or solar magnetic storms. DC components have nothing to do with the phase and can cause a shift in a three-phase current, which triggers oversaturation in the core and is the cause of adverse impact on stable power supply. Handling simulations of this phenomenon requires understanding of the non-linear transient problem and the analysis load becomes a significant issue.

Discusses the effects of an eddy current generated in structures influenced by the impact of DC current circulating through two, three-phase transformers connected by a 500kV transmission cable. Three-phase transformers are bunched with a single-phase transformer to model a single-phase 1/8th geometry as a finite element model. This paper seeks to find the eddy current of structures by assigning to a finite element model a current value derived from a circuit equation including a voltage source with a DC bias. There is a need to take into account the core saturation properties of the induced voltage appearing in the circuit equation and the authors do this by incorporating the circuit equation in a magnetic flux/current table obtained from static and frequency response analyses. The results of the analysis showed that imposing a DC bias

on voltage not only shifted the current, but also sent the amplitude value skyrocketing. Remarkably, the results also showed that stray loss from the structure increased to the equivalent of double the value.

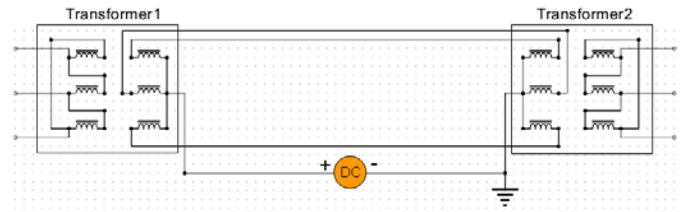



Fig. 5 Transformer Transmission Line Model Under DC Bias

In Closing

Stray loss analysis has a tendency for model scales to grow large due to complicated structures or eddy current problems, which meant they went largely untouched until about a decade ago. But progress in mesh technology and accelerated solvers and hardware have drastically changed the situation. JMAG is now actively starting to tackle these large-scale issues, starting with transformers. To close, I can say we expect to make new technological breakthroughs due to what we see through analysis. 

(Takayuki Nishio)

Common Questions for JMAG

Traditionally, JMAG has been used mainly by technicians specializing in electrical systems, but in recent years there have been more opportunities for mechanical designers and others to use it for electromagnetic designs outside of their own field. There are probably quite a few among those who have made the transition to this unfamiliar tool who worry about how they should use it to perform better analyses.

This section of the Newsletter deals every issue with questions that we receive most often to help people who are having similar kinds of problems, and make JMAG a more user-friendly tool.

The questions here cover a wide range of topics, such as "Operation Methods," "Analysis Techniques" and "Troubleshooting." Please take a look at the topics that interest you.

TROUBLE SHOOTING FAQ-926

Q1 . The region geometry distorts when conducting a geometry parametric analysis.

Multiple regions form 2D models and parametric analyses change the positional relationship between parts. I want to move the entire region, but I couldn't move the region using the geometry editor's "Move by Parallel" function.

At that point, I tried to limit the entity to be the standard and region with [Constraint (Distance)], but changing the distance caused the geometry to distort and I couldn't conduct a proper analysis.

A1 . Use [Create Constraints From Geometry] and constraints that will maintain the region geometry will automatically apply.

To avoid distorting the geometry, use functions like the distance constraint or angle constraint and ensure maintenance of the equilibrium between the entities that will form regions. If the geometry distorts when you move the entity that forms the region, it's probably because there is insufficient constraint. Check the entity causing the geometry distortion and add a constraint.

Use the [Create Constraints From Geometry] in JMAG-Designer's Geometry Editor to automatically identify places where constraints need to be set based on the state of the geometry, which enables constraint setting.

Additional information

To conduct a geometry parametric, you must set the parameters of the geometry you want to change either through the [CAD Parameters] in the Project Manager, or the constraint parameters. Parameters are registered in [CAD Parameters] and parametric values set in [Case Control].

【Other resources】

See the following Help items for more detailed information about automatic constraint settings from the geometry.

[JMAG-Designer Online Help > Creating Geometry > Creating 2D Geometry with Geometry Editor >
> Setting a Constraint on Basic Shape>Automatically Set a Constraint from a Geometry](#)

See the following Help items for more detailed information about using the case control function in a parametric analysis.

[JMAG-Designer Online Help > Analysis > Parametric Analysis > Parametric Analysis](#)

TROUBLE SHOOTING FAQ-912

Q2. Are there settings that enable retrying a license check when you failed to acquire a license?

There are times when you can't connect, such as moments late at night when the license server is undergoing maintenance. Therefore, trying to continuously operate several analyses at nighttime can cause license errors. Is it possible to retry a license check some time after a license error has occurred.

A2. Yes, you can. You can make the settings by using environmental variables.

If it's a license error generated by an error related to your network connection, it's possible to set a license check retry rather than just letting things finish with the error. Use the following environmental variables.

Environmental variables for setting the number of check retries.

Variable name: JRI_LICENSE_RETRY

Variable value: No. of re-check retries

Environmental variables for setting intervals between re-checks

Variable name: JRI_LICENSE_RETRY_INTERVAL

Variable value: Interval between re-checking for license (secs)

The following four errors are valid for these settings. Note re-checks will not occur if other types of errors arise.

- -15: Cannot connect to license server.
- -52: FLEXlm vendor daemon did not respond within timeout interval.
- -96: Server node is down or not responding.
- -97: The desired vendor daemon is down.

In addition to settings for license checks using environmental variables, depending on the upper limit of licenses, there are also settings where implementation is suspended until another analysis is finished and a license becomes available.

【Other resources】

See the following Help items for more detailed information about the license checking function.

[JMAG-Designer Online Help > Introduction > JMAG-Designer License Operations > Setting the License Check](#)

OPERATION METHODS FAQ-927

Q3. What sort of modeling should you do for a thermal transfer with air passing through it?

There are gaps between the work piece and peripheral parts. Heat passes through the air in these gaps to propagate with peripheral parts. I'm thinking about creating a model that treats the air area as a component, but is there another method to solve this problem?

A3. Use the heat equivalent circuit method. And, as there is no direct intervention of air and when the thermal radiation effect propagates heat, the radiation heat transfer boundary condition is valid.

Heat convection in part intervals isolated by gaps can be roughly categorized into that in which air has passed through or that with thermal radiation effects. In modeling convection in which air has passed through heat, the heat equivalent circuit is convenient because it significantly reduces the number of elements. The heat equivalent circuit expresses heat transfer phenomena as a lumped constant like a resistance value and gives a 1D analysis of the heat transfer phenomena as if it were an electric circuit. Taking into consideration heat transfers caused by the heat radiation effect in high temperature regions, set the surface for each part facing the radiation heat transfer boundary condition.

Using the heat equivalent circuit method

Set a heat transfer boundary condition for each of the part faces. In the heat transfer boundary condition, set the reference temperature to [Referred by Circuit Component] and specify the thermal circuit components (heat transfer boundary components) for response.

This means it is possible to send and receive plant models between different companies while concealing important information. Setting the thermal resistance component between terminals as necessary enables adjustment of the heat transfer.

The next application catalog we'll display contains a description of sample data regarding transfer of heat from separated parts using the heat equivalent circuit method. Please use this as a reference.

http://www.jmag-international.com/catalog/130_BasicGeometry_ThermalConductivity.html

Using the radiation heat method

Radiation from a specific radiation heat transfer boundary condition face and the absorbed heat generation amount (heat flux) are displayed in formulas 1 to 3.

$$I = \epsilon \sigma F (T'^4 - T_0'^4) \quad \dots(1)$$

$$T' = T + 273.15 \text{ [deg K]} \quad \dots(2)$$

$$T_0' = T_0 + 273.15 \text{ [deg K]} \quad \dots(3)$$

If I is heat flux [W/m^2], ϵ the radiant parameter, σ the Stefan-Boltzmann constant, F the configuration coefficient and T [deg C] the temperature obtained from analysis, then T_0 [deg C] is the reference temperature.

Parameters that users can specify are the radiant parameter and reference temperature only. Generally, the radiant coefficient is set with a value somewhere from 0 to 10. With JMAG, specifying a radiant coefficient value on a table in relation to a temperature will create a temperature dependency for that radiant coefficient. On the other hand, the configuration coefficient is decided by positioning of the parts so there is no need to input it.

How to use the heat transfer boundary condition to shorten analysis times

Configuration coefficients found in every element face when calculating radiation heat, entailing high calculation costs. Because of that, when you only want to consider radiated heat transfer, we recommend using the heat transfer boundary condition to treat radiation as the temperature dependency heat transfer coefficient to keep costs down.

Heat flux I when using a heat transfer boundary condition is displayed in Formula (4).

$$I = K (T' - T_0') \quad \dots(4)$$

In the aforementioned radiation heat transfer boundary formula, considering only radiation allows making a configuration coefficient of 1, so comparing this with formula (4) and having the heat transfer coefficient K as formula (5) allows consideration of thermal radiation (radiation) under the heat transfer boundary.

$$K = \epsilon \sigma (T'^2 + T_0'^2) (T' + T_0') \quad \dots(5)$$

OPERATION METHODS FAQ-928

Q4. What settings should I use for an operating object in magnetic field thermal bidirectional coupling?

A4. The ideal model will differ according to the model's geometry or analysis conditions. We recommend you use the [Virtual Movement] function if possible.

There are three possible models depending on your approach to how to divide the mesh for air regions in the gaps between stators and movers. Here are the modeling methods, listed in the order we recommend you try them.

Standard with Virtual Movement

The effective range is extremely small, but there are enormous benefits in being able to use such limited space.

The mesh data itself won't move and only physical quantities like the temperature distribution will shift within the model,

depending on operating conditions. Flag the [Virtual Movement] check box to turn it on as the motion condition in a thermal analysis. There's no need to set a motion condition in a magnetic field analysis. Select [Standard] as the mesh type.

- **Advantage:** Total calculation time is shortened because there's no need to re-generate a mesh with each analysis step. There is no need to generate a slide mesh as air regions can roughen the mesh division.

- **Applicable models:** Models with uniform motion direction. For rotation motion, when the geometry rotation axis is axisymmetric (Fig. 1). For translational motion, when the motion direction cross-section can continue in a uniform manner for long enough (Fig. 2.)

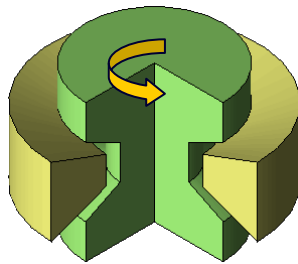


Fig. 1 Rotation Motion Model

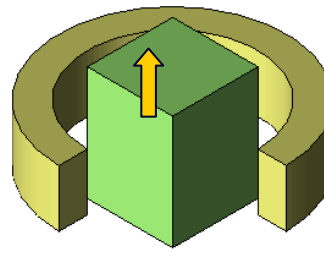


Fig. 2 Translational Motion Model

Slide Mesh

This is a useful function if the flux path is composed of things like magnetic materials.

Mesh is also generated in air regions with divisions for the mover and stator, arranging motion of the connecting face (slide face) in conjunction with mesh motion to conduct the analysis. For this reason, it's best the step intervals and slide face mesh division have an integer ratio. Select [Slide Mesh] as the mesh type.

- **Advantage:** Total calculation time is shortened because there's no need to re-generate a mesh with each analysis step.

- **Disadvantage:** There are times when the size of the air region mesh is dragged down by the number of gap face mesh divisions, resulting in it becoming smaller than necessary. With induction heating, in particular, the flux path is airborne, a wider air region is needed and the impact is significant.

- **Applicable models:** When it is possible to define the gap face of the mover and stator remaining the same from tip to tip in a cylindrical model (during rotation motion) or a flat model (during translational motion) (Figs 3 and 4).

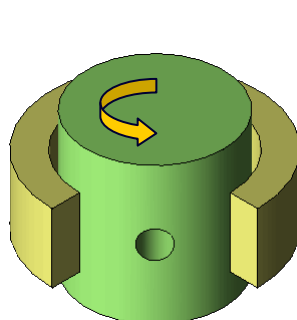


Fig. 3 Rotation Motion Model

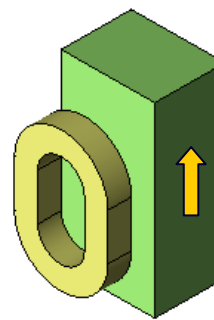


Fig. 4 Translational Motion Model

Remesh Model at Each Step

There is no limitation on the type of analysis target.

The function re-generates a mesh with each analysis step. Select [Remesh Model at Each Step].

• **Advantage:** Analysis is possible regardless of however complicated a geometry may be due to an air region being generated with each step.

• **Disadvantage:** Total calculation time is lengthened by generating a mesh with each step.

• **Applicable models:** Geometries with no rotational or translational limitations (Figs. 5 and 6)

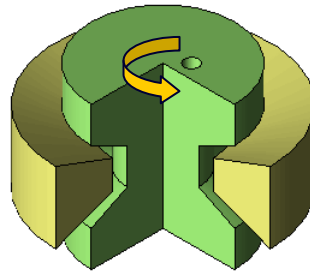


Fig. 5 Rotation Motion Model

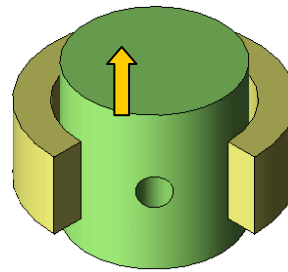


Fig. 6 Translational Motion Model

Analysis Technologies FAQ-929

Q5. Conducting an induction heating analysis but the temperature doesn't rise as expected.

A5. Check if the heat generated amount is sufficient. Estimate temperature rises at a level slightly higher than the heat generation amount obtained through the electromagnetic analysis.

In cases where the analysis result temperature is calculated extremely low compared to the targeted heating time, a correct heat generation amount (joule loss) will not be required. The heat generation amount correlates to 2 squared of the heating coil's current or the frequency 0.5 squared to 2 squared. Make sure especially to check whether the current flowing to the heating coil has been correctly input.

When checking the suitability of results, make sure to compare the items listed below with either actual measurements or estimated values.

- 1) Input power (accumulation of current and voltage)
- 2) Output power (Heat generation amount of the work piece: joule loss)
- 3) Size of the heated area and rough estimate of the amount of time it takes to heat and power necessary to do so

* In JMAG, specify the current value in amplitude. Input the effective value multiplied by $\sqrt{2}$.

Example of forecast amount of necessary power

If the work piece is the face of a cylindrical body to be heated, the rough amount of power P_{out} Pou needed to heat it from a room temperature of 20 deg to 900 deg can be estimated according to formulas (6) to (9). Ignoring the heat diffusion here will simplify the formula. The eddy current flow range is expressed by depth D and range L (Fig. 7).

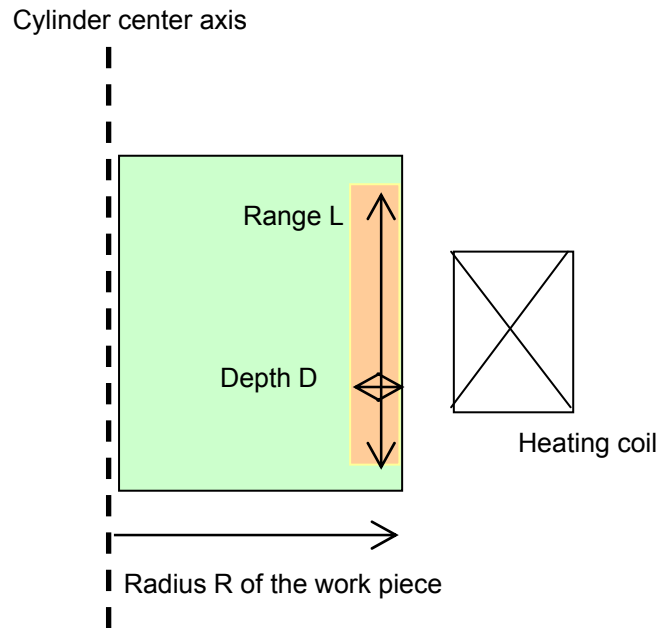


Fig. 7 Scenario Model of a Rough Estimate of Necessary Power

$$\rho C \frac{\partial T}{\partial t} - \nabla \cdot (k \nabla T) - Q = 0 \quad \dots(6)$$

$$Q = \rho C (900 - 20)/10 \quad \dots(7)$$

$$V = \pi(R^2 - (R - D)^2) \cdot L \quad \dots(8)$$

$$P_{out} = VQ \quad \dots(9)$$

Q is heat generation density [W/m³], ρ is density [kg/m³], C is specific heat [J/kg deg C], k is thermal conductivity [W/m deg C], T is temperature [deg C], t is time [sec] and V is the volume of the heated area [m³].

【Other resources】

Check out the following materials if you'd like to know more details about modeling in induction heating analysis or results evaluation.

Trends and Challenges of Induction Heating Analyses

http://www.jmag-international.com/support/en/seminar/pdf/uw2010_25.pdf

Technical FAQ on the Web

We have technical FAQ on our homepage, so check it and contact us if you have any inquiries.

<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 J MAG if you go through them. We regularly update our website FAQ. Use this together with the J MAG Newsletter to make your analysis work more effective. Please don't hesitate to use J MAG technical support if you have any questions when using J MAG. We hope you will fully master J MAG!

(Takashi Kondo)

Issue 10 Structural Analysis from A to Z

JMAG continues to evolve with each passing day. There may be functions in JMAG that even those who have already been using it will learn for the first time. There are also some useful procedures that are not well known yet. Why don't we aim at making operations more efficient by becoming familiar with new functions that we don't know about?

In this series, I would like to introduce "Things that we should know" in JMAG, as well as some advantageous applications.

Overview

Many JMAG users probably wouldn't have a clear idea of what to do if told to carry out a JMAG structural analysis. Many use JMAG for evaluation of electromagnetic phenomena, but when it comes to structural analysis many confine themselves to only limited uses, such as vibration phenomena. JMAG undoubtedly handles electromagnetic phenomena well, but we'd like to propose linking with heat transfer analysis or structural analysis as expanded functions to heighten analysis precision of those phenomenon. On the other hand, if the phenomena are simple, it's easy to do a good enough evaluation of physical phenomena using just heat transfer analysis or structural analysis.

This issue of A to Z will focus on how to handle particular types of phenomena using JMAG's structural analysis, as well as introduce material properties and various types of conditions so we can get you acquainted with structural analysis.

Analysis model dimension

Geometries handled can be either 2D or 3D analysis. If you've modeled a 2D sketch thin sheet on your JMAG geometry editor, it can be used as a 2D analysis model. Fig. 1 shows a 2D thin sheet eigenmode example. If you've modeled a solid thin sheet on your JMAG geometry editor, it can be used as a 3D analysis model. Fig. 2 shows a 3D

thin sheet eigenmode example. If using a 3D analysis, it's possible to evaluate the vertical distortion in the sheet.

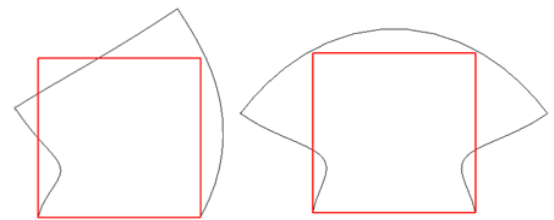


Fig. 1 Thin sheet eigenmode example (2D analysis)

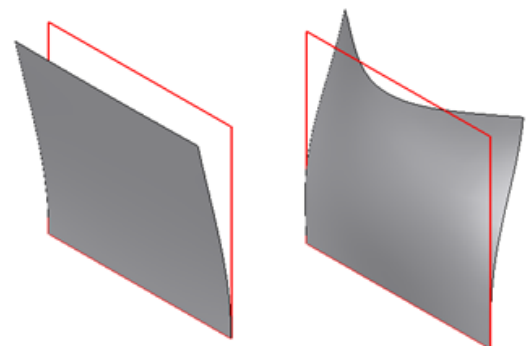


Fig. 2 Thin sheet eigenmode example (3D analysis)

Setting the Analysis Type and Study

JMAG's structural analysis handles three types of analyses: static, eigenmode and frequency response analysis. Right click the JMAG-Designer Project Manager, select the type of analysis for the structural analysis and create the applicable study.

With structural analysis, it's possible to look for displacement or stress distribution if force is applied to a particular component. A featured phenomenon

looks at handling analysis of stress distribution from centrifugal force, distortion through heat expansion, or press fit analysis if using a 2D model.

Under an eigenmode analysis, you can calculate how a particular component may distort based on its geometry, materials or constraining conditions (Fig. 3). Before analyzing vibration caused by such factors as electromagnetic force, it's possible to gain an idea of properties within the product that are susceptible to particular distortions.

Using a frequency response analysis, you can analyze vibration or sound pressure when an excitation force such as electromagnetic force operates on a particular component. Balancing frequency of the excitation force and eigenmode can cause generation of significant vibration or sound pressure.

Caution must be paid under structural analysis to mesh dependency. If using hexahedral elements, even the default first-order element enables analysis precision to be obtained. However, when using a tetrahedral element such as automatic mesh generation, select a secondary element from [Properties] in [Study]

The eigenmode and frequency response analyses will analyze objects in an eigenmode, so specify the desired eigenvalue starting frequency and eigenvalue. Calculate only the specified number in the lowest order mode of frequency higher than the starting frequency.

When evaluating vibration or sound pressure, specify a frequency and conduct a frequency response analysis. Calculate the size of vibrations from the relationship between the excitation force of the specified frequency component and the eigenmode. Defining a modal damping can specify the extent of effects a frequency's excitation force will have on frequencies around it. If the

modal damping is 1, only frequencies matching the eigenmode will be defined as contributing to vibration. If the modal damping is 0, it will be an inappropriate setting as the excitation force of a particular frequency component will be seen as contributing to all eigenmodes.

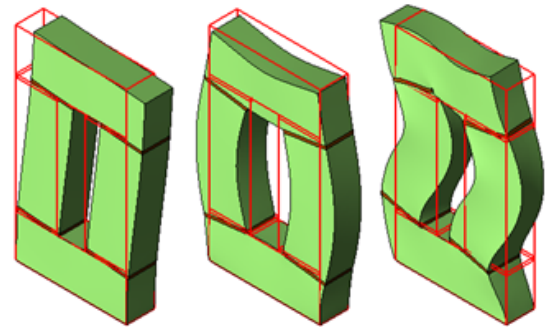


Fig. 3 Eigenmode example

Material Properties

Material properties used in structural analysis are density (g/cm³), Young's Modulus (MPa), Shear Modulus (MPa) and Poisson's Ratio. With isotropic material, Young's Modulus, Shear Modulus and Poisson's Ratio establish the relationship in Formula (1). Consequently, setting just two objects that are not isotropic materials will suffice. Normally, you would set Young's Modulus and Poisson's Ratio (Fig. 4).

$$G = \frac{E}{2(1 + \gamma)} \quad \dots(1)$$

However, G is Shear Modulus, E is Young's Modulus and γ is Poisson's Ratio.

Structural analysis can also handle thermal expansion phenomena based on temperature distribution. When handling this phenomena, specify the thermal expansion coefficient (1/deg C) and reference temperature (1/deg C), which will form the base (Fig. 1). Displacement will increase as the temperature rises.

When handling anisotropic materials, two setting methods are possible: One setting Young's

Modulus for each direction and the other using matrix specifications. For the thermal coefficient, set for each direction. Piezoelectric analysis is possible for anisotropic materials. Set the piezoelectric constant and permittivity. Set the Permittivity in the [Electric Properties] tab.

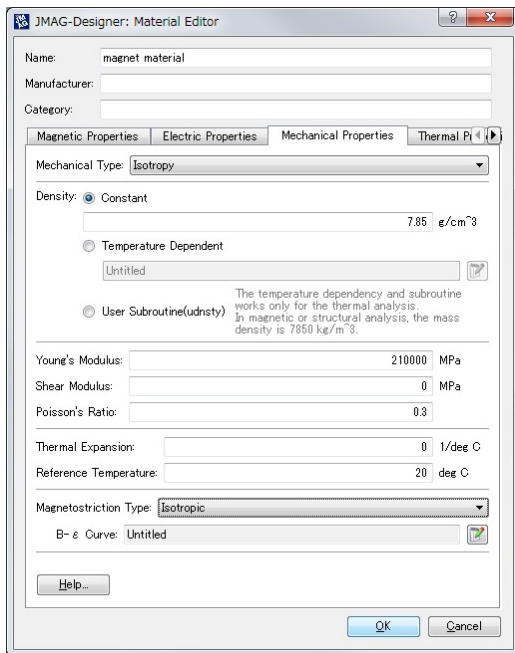


Fig. 4 Mechanical properties tab in the Materials Editor dialog box

Constraint Conditions

Structural analysis requires identification of an object to be fixed. Two situations significantly effect analysis results. These are specifying the place forming the standard for displacement and the second is being able to accurately simulate the constrained state on actual machinery. We'll now describe each of the constraint conditions.

Constraint

Can be used with all analysis types. Settings can be made to constrain movement of a specified place so that it will not morph in a particular direction. Settings are possible for all parts, part surfaces, edges and vertex. For example, if the analysis target is completely fixed to the floor, set the constraint conditions to constrain all directions

(Fig. 5, left). If the model is a partial model, set the cross-section to normal constraint (Fig. 5, right).

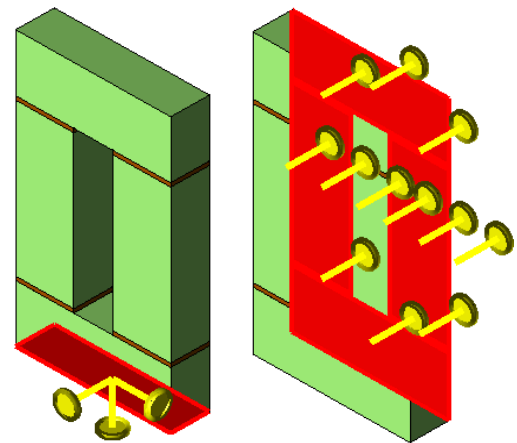


Fig. 5 Examples of complete constraint (left) and normal constraint (right)

Rigid Body

Can be used with all analysis types. All specified places have an unchanged relative position and move as one. Settings are possible for all parts, part surfaces, edges and vertex. Use a spring condition to combine the spaces between vertices when there are two or more vertices and they have a degree of freedom.

Displacement

Can be used with all analysis types. Calculate stress distribution by specifying the amount of change a specified place will undergo in a specified direction. Settings are possible for all parts, part surfaces, edges and vertex. Setting a phase in a frequency response analysis enables simulation of phase displacement where distortion occurs between places to be displaced.

Rotation Periodic Boundary

Can be used with all analysis types. Specify the model cross-section and periodic angle when the analysis target is a partial model. Narrowing the analysis scope cuts calculation time and the memory needed for calculation.

Notes for applying constraints

Setting the rotation periodic boundary conditions for geometries with geometric periodicity can narrow the scope of the model in an effective method of reducing analysis costs. Conversely, using an ill-planned partial model for a structural analysis also runs the risk of an evaluation overlooking an eigenmode generated using actual machinery. For example, think about half models and quarter models (Fig. 6). Periodic boundary conditions are set for both of these. But there are times when a quarter model cannot simulate an eigenmode a half model has simulated. Take note of the fixed state you're working with when setting the constraint conditions.

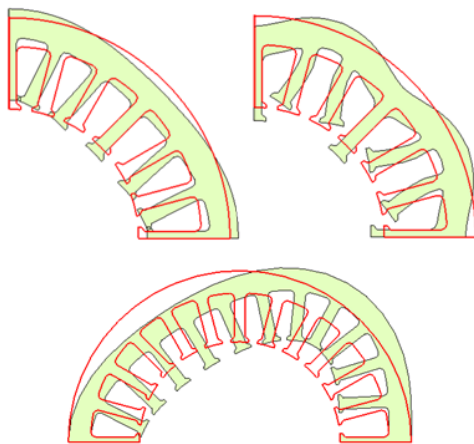


Fig. 6 Example of an eigenmode capable of simulating a quarter model (Two upper images)
Example of an eigenmode incapable of simulating a quarter model (Lower image)

Load Conditions

Force exerted on the object will distort it. Set this force in the Load Conditions. We'll now describe each of the load conditions.

Concentrated Load

Useable in static and frequency response analyses. Simulates conditions where force is exerted on a particular point. The unit of measurement is N. In a frequency response analysis, you can also set the phase

Pressure Load

Useable in static and frequency response analyses. Simulates contact pressure being applied to a particular surface. The unit of measurement is MPa. In a frequency response analysis, you can also set the phase

Volume Load

Useable in static and frequency response analyses. Simulates a body force being applied to all parts. The unit of measurement is N. This can be used, for example, to see what happens when gravitational force or Lorentz force is exerted on all parts. In a frequency response analysis, you can also set the phase

Acceleration Load

Can only be used in a static analysis. Simulates acceleration being applied to all parts. The unit of measurement is m/s^2 . This can be used, for example, to specify gravitational acceleration when slackness is generated after exerting gravitational force on all parts (Fig. 7).

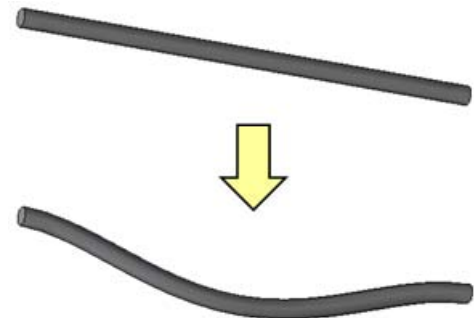


Fig. 7 A work piece slackened by gravitational acceleration

Centrifugal Force

Can only be used in a static analysis. This looks for the stress distribution generated within a part centrifugal force exerted on a part at high speed rotation. The unit is r/min. This is used, for example, with a peeling analysis of a magnet when surface permanent magnet (SPM) motors are at high speed

rotation. Set conditions for the high speed rotation parts (Fig. 8).

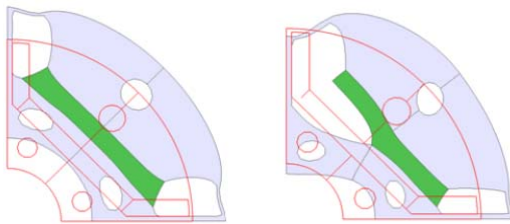


Fig. 8 Distortion caused by centrifugal force
(Left: Complete adhesion; Right: Partial peeling)

Electromagnetic Force

Useable in static and frequency response analyses. Analyze stress or distortion or conduct a vibration analysis based on the electromagnetic force sought in a magnetic field analysis (Fig. 9). Set for the parts.

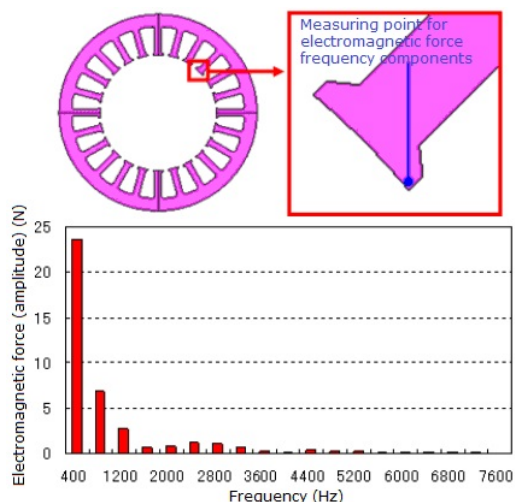


Fig. 9 Example of extracting frequency components from electromagnetic force

Temperature Load

Can only be used in a static analysis. Calculate stress or displacement amount with a thermal expansion analysis based on a specified temperature or temperature distribution obtained from a thermal analysis (Fig. 10). Units of measurement include deg C. Set all parts, part surfaces, edges and vertex.

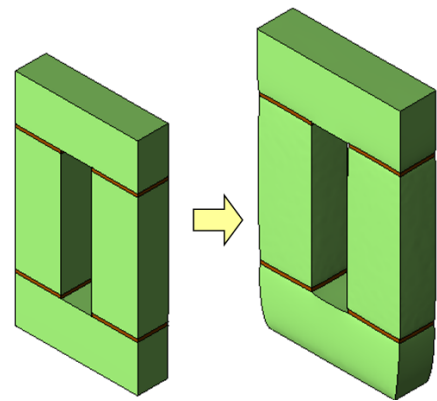


Fig. 10 Distortion caused by thermal expansion

Press Fit

Can only be used in a 2D static analysis. Selecting an edge between two objects and specifying the interference range enables calculation of stress distribution during a press fit (Fig. 11). Units for measurement include mm because it is the range of interference being specified.

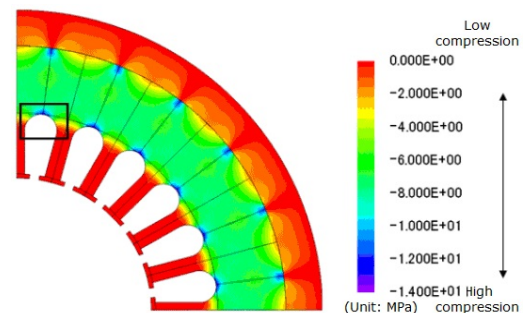


Fig. 11 Principal stress distribution obtained from press fit analysis

Spring-Mass

Gradually combining the space between two objects enables simplification of a particular part. Two functions are described below.

Spring

Can be used with all analysis types. Simulates gradual combination of two specified areas between vertices and joined by a spring. The unit of measurement is N/m. Used rigid body conditions if the relative position is completely fixed.

Concentrated Mass

Useable in eigenmode and frequency response analyses. Can be handled as a point mass without creating a detailed model of a part's geometry. The unit of measurement is g. The point mass and a modeled geometry and be joined by such items as spring conditions.

Electric Potential Boundary

Analysis using piezoelectric materials is possible. Set the anisotropy material in Parts and specify the piezoelectric constant and permittivity. Setting electric potential conducts a piezoelectric analysis when a particular part comes into contact with an electrode. Consequently, this evaluates factors such as electric potential distribution or the state of distortion. Settings are possible for all parts, part surfaces, edges and vertex. The unit of measurement is V. The phase of electric potential distribution can be set in eigenmode and frequency response analyses.

Output/Sound Pressure

When evaluating vibration in a frequency response analysis, it is also possible to evaluate the radiated sound spreading in the area after being generated by acceleration from the object surface. Two types of radiated sound evaluation plane can be used, spherical and cylindrical (Fig. 12).

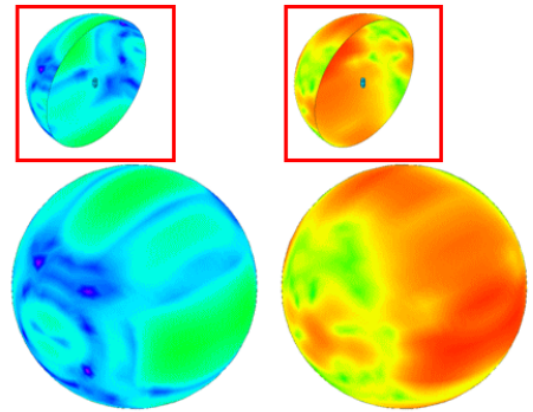



Fig. 12 Example of sound pressure distribution (Left: No peeling on spacer; Right: Peeling on spacer)

In Closing

In this edition I have talked about the conditions used in a structural analysis and described the meaning of its functions and how to use them. There's still so much more we want to tell you about conditions, so I plan to continue with my descriptions in the next edition, too. 

(Hiroshi Hashimoto)

JMAG Product Partner Introduction

Gamma Technologies, Inc.

Gamma Technologies, developer of the virtual car system GT-SUITE, and JMAG-RT have linked. Engineer Mike Arnett talks about the appeal of GT-SUITE with its engine evaluations looking over items such as fuel or noise under driving conditions and its highly regarded cooling system evaluations.

—Please tell us about GT-SUITE.

Mike Arnett GT-SUITE by Gamma Technologies offers an extensive platform for developing complete vehicle models for energy management studies, basic controls and calibration development, drive cycle analysis and powertrain architecture synthesis. Building on the market leading reputation of GT-POWER, GT-SUITE offers a comprehensive library of vehicle modeling elements such as a lithium-ion battery, electric machines, A/C circuitry, controls, cooling system elements for hardware and passenger cabin, vehicle dynamics, transmissions, acoustics, exhaust aftertreatment and flow. All of these elements can be used to build various sub-system models that can be seamlessly combined into a single model for system simulation.

—Please tell us about the areas you think GT-SUITE shows clear superiority.

Mike Arnett GT-SUITE offers a number of advantages from the system level down to the actual solver. For those interested in system simulation, GT-SUITE offers a complete template library for assembling comprehensive vehicle models for energy management analysis, controls synthesis and optimization. Additionally, GT-SUITE offers templates for more detailed analysis of the various vehicle sub-systems. With GT-POWER, users can build market leading detailed engine models for combustion, heat transfer, flow



dynamics and acoustics analysis. In cylinder emissions can also be modeled and detailed aftertreatment systems can be constructed.

One-dimensional, as well as, quasi-2D and 3D solutions are available. User can take advantage of the standard mechanisms already in place in the software, or edit these to their liking. Not only can the details of the engine be modeled, there is an extensive set of templates for constructing detailed cooling systems. Not only can cooling circuits for typical hardware be constructed, but air conditioning and waste-heat recovery systems can also be analyzed with confidence as solution is completely stable at zero flow conditions. All of these subsystems can be combined with a complete driveline vehicle dynamics model. This seamless integration of multiple models in multiple domains make GT-SUITE the ideal platform for system simulation.

—GT-Suite linked with JMAG-RT from November last year. Please tell us what you consider to be specific scenes the link will come into play.

Mike Arnett GT-SUITE has established a number of partnerships throughout the virtual development

and simulation industry. Because of these partnerships, GT-SUITE is fully capable of running coupled with other tools. This flexibility adds value to the users of both tools. In the area of electric machine modeling, GTI has partnered with JMAG and developed a specific template that allows JMAG files to be executed in GT-SUITE. This partnership offers an avenue by which detailed motor models can be tested and analyzed in vehicle models.

This allows vehicle, controls and electric machine development departments to coordinate and construct a single model that includes all of the necessary functionality for various studies. Controls development, machine sizing, base calibration and fundamental energy management analysis can be performed with this type of model.

On top of that, the process of importing JMAG-RT models into GT-SUITE is really simple. GT-SUITE has a template called JMAGMachine (Fig. 1). All you need to do is indicate where you want to save an RTT file exported from JMAG and that's it (Fig. 2). Please try it out.

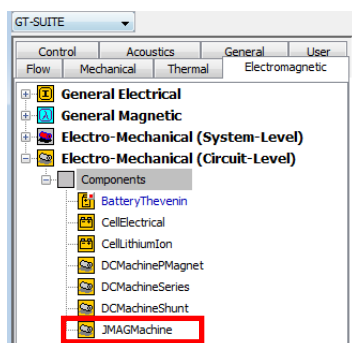


Fig. 1 GT-SUITE library menu

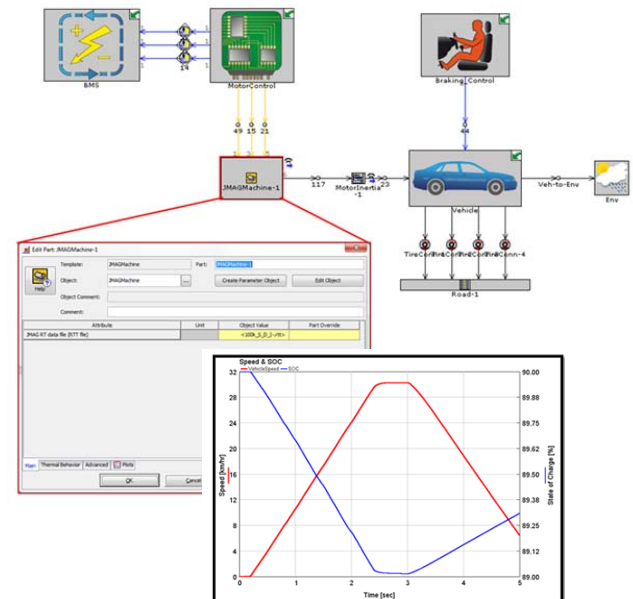


Fig. 2 Acceleration/Deceleration Simulation in GT-SUITE
Red frame: JMAGMachine settings screen
Black frame: Red = Speed Blue = State of Charge

—Simulation environments with greater precision motor models are now required to meet the need for more advanced, higher current, and more complex motor drive systems for electric and hybrid vehicles. The link between GT-SUITE and JMAG will powerfully support motor drive system simulations. Those interested in learning more, please contact our sales representatives at info@jmag-international.com



Gamma Technologies, Inc.

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Company Outline

Gamma Technologies, Inc. (GTI) develops and licenses the "virtual vehicle and powertrain" CAE software GT-SUITE. This tool is specifically designed for applications in the engine, powertrain, and vehicle industries. In addition to supplying software products, GTI provides user support and training and carries out general consulting projects using its proprietary CAE tools.

We are dedicated to building the most advanced engine and vehicle simulation tools. Furthermore, we endeavor to provide major productivity improvements for our customers through carefully designed software solutions.

<http://www.gtisoft.com>

Event Information

5th Seminar on Advanced Computational Electromagnetics Toward Putting High-Precision Loss Analysis of Motors into Practice

We held this seminar on advanced computational electromagnetics, the fifth of its type, at Trust City Conference in Marunouchi on July 23. We set the theme of the seminar as working toward actually conducting high-precision loss analyses of motors. We invited leaders in fields such as materials, measurement, applications and analysis technologies to lecture on demands concerning loss analysis in future motor development, as well as to explain latest loss analysis and evaluation methods currently likely to be developed. We would be absolutely delighted if this seminar could serve to help you find direction in your future loss analyses.

Conference Outline

Host: JSOL Corporation

Date: Tuesday July 23, 2012 13:30-20:00 (including reception)

Venue: TRUST CITY CONFERENCE MARUNOUCHI (in front of Tokyo Station's Nihonbashi exit)

No. in attendance: 165

URL : http://www.jmag-international.com/seminar/op/new_mag.html

Overview of Event

Environmental and energy problems affecting Japan in recent years have led to even more stringent demands being made for reduced energy use in electronic equipment. Motors, which are said to take up more than half the energy consumed, are expected to implement continued improvements to raise efficiency. Under these circumstances, improved efficiency is not an added value, but necessary condition.

Research and development into improving motor efficiency has been ongoing with gusto for about 20 years, needless to say with the focus on large-scale motors for many years, but also centering on small- and medium-sized motors such as those used in HEVs or air conditioners. One of the results of these efforts has been to make great strides in motor and motor driver technologies.

As part of the progress process, computers used in motor design development have been equipped with electromagnetic field analysis technology, making that technology an essential one for the development of advanced motors. The contribution made by this technology has been particularly significant in improving motor efficiency through loss analysis, which evaluates and analyzes loss, minimizing it.

However, in getting to this stage, analysis technology is now confronted with a new issue requiring a solution. As motors have evolved, there has been demand for even further reduction of loss and, indeed, analysis precision has improved

markedly. Nonetheless, there are some areas where existing analysis technology is not quite good enough. New loss analysis technologies are needed. One such technology in the field of analysis technology research may be a new method that combines with material measurement. It is still under development but on the verge of being confirmed as effective.

For this seminar, we invited leaders in various fields and had them lecture, expressing their demands regarding future loss analysis in motor development and talking about the latest likely loss analysis developments and evaluation methods. We would be absolutely delighted if this seminar leads to discussion between participants about directions to take from now,

Relationship of current/voltage needed for drive

As explained earlier, we realize energy is an issue and demand for greater efficiency in electrical machinery is growing. Up until now, efforts toward achieving greater efficiency, that is, reducing loss, have not been especially active. It has been a situation where even cutting loss by, say, 1% for example, while maintaining cost has not been easy to achieve.

What is needed to break this deadlock? Well, one approach may be to utilize material properties. That's easier said than done, though. While it is necessary to combine the wisdom from the four connected fields of materials, measurement, application technology and analysis technology to make full use of material properties, we have realized that we are lacking in three of these fields. Because of this, we would like to provide our users with the best analysis functions we have developed while receiving guidance from experts from these different fields.

The first field is measurement technology. For example, it is necessary to correctly grasp the effects on behavior, temperature dependency, frequency dependency, and loss due to processing strain, including minor loops, for the magnetic properties of magnetic steel sheet. Precise equipment and technique is needed for this. For this field, we have invited Professor Fujiwara from Doshisha University.

The second field is application technology. It is necessary to understand electric devices such as motors and transformers, and to use the right processing on the right materials and arrange them in the right way. Further, it is also important to understand, for example, the phenomena in a motor controlled by an inverter. This requires expertise and experience in both electric device design and controls. We have invited Professor Akatsu from Shibaura Institute of Technology for an overview of the future of motor development, Mr. Kometani from Mitsubishi Electric Corporation for the field of analysis of large-scale rotating machines, and Mr. Yamagiwa from Daikin Industries, Ltd. for the field of analysis of mid-sized rotating machines.


The third field is materials development. Thanks to attempts to make full use of materials in product design, design needs have become clear down to the detailed particulars. To make these a reality, technologies for measuring and analyzing materials accurately and for materials development are needed. We have invited Mr. Toda from JFE Steel Corporation in the field of materials.

Measurement, application and materials are three fields that have been joined by a fourth field; that of the development of analysis technology, which we at JMAG will continue to work on.

In Closing

We had considerably more applications to attend this seminar than we had foreseen, which once more showed us how interested people are in working toward higher precision loss analysis of motors, the theme of the event. Our lecturers also gave extremely interesting presentations full of interesting details. We would like to use this space to express our gratitude.

Results of a questionnaire we conducted on the day of the seminar showed that more than 90% of respondents felt that loss analysis was a priority issue in motor design and that 98% wanted to have loss evaluation precision with a margin of error within 10%. Just 21% of companies were able to conduct their own material measurements. JMAG will continue to move forward with research and development and continue to strive for greater precision in loss analysis while also maintaining the material data we get you to use.

We had a quiet gathering after the seminar had finished. It appears participants had been impressed by the quality and quantity of the presentations as they exploded into action for an extremely enthusiastic discussion. Several people also gave their best wishes of encouragement to JMAG. More about what happened at this seminar will be presented in the Event Information section. 

(Yusaku Suzuki)

Seminar Program

13:40	A direction of the future motor development and requests for the motor analysis technique.: Prof. Kan Akatsu, Associate Professor, Faculty of Engineering, Electric Engineering, Shibaura Institute of Technology This presentation estimates a direction of the motor future development and the required motor analysis techniques matched with the development are pointed out. The background of this estimation is based on a request of the shorter development term due to the necessity of the consumption energy reduction, the rare metal crisis and the technical progress in the developing countries. Adding that the developing machine type becomes various, not only PMSM but also IM, Syn.RM and SRM, the multi physics analysis including the stress analysis, vibration analysis and so on is also required. From these trends, the presentation shows the road map of the motor development, the future analysis techniques are requested based on the recent analysis techniques.
14:20	Property Evaluation of Magnetic Materials and Recent Progress of Their Modelling Methods: Prof. Kouji Fujiwara, Department of Electrical Engineering, Faculty of Science and Engineering, Doshisha University In order to achieve the higher accuracy of numerical simulation of electromagnetic fields, property evaluation of magnetic materials and their modelling methods are indispensable. Practical discretization methods of partial differential equations governing spatial distribution and time variation of electromagnetic fields have been proposed. However, material modelling still has hard problems to be solved. In this presentation effects of several material properties such as anisotropy, hysteresis and stress independence on machine characteristics are reported
15:00	The Subjects of Large-scale Loss Analysis: Dr. Haruyuki Kometani, Advanced Technology R&D Center Electromagnetic Systems Dept., Mitsubishi Electric Corporation The examples of the large-scale loss analysis in large-sized rotating machines are shown, such as the analysis of eddy current loss generated in the end region of large generators. And constructions of the analysis system which is needed when analyzing are shown. Moreover, the problems for putting large-scale analysis in practical use are shown.
16:00	The present conditions and problem of the loss analysis in the PM motor: Mr. Akio Yamagiwa, Chief Researcher, Environmental Technology Laboratory, Daikin Industries, LTD. In IPMSM model suggested in the Institute of Electrical Engineers of Japan and PMASynRM which was studied by Li-EAD project of NEDO, We compare the experiment with the result of the loss analysis using JMAG and introduce the present level of the loss analysis. In addition, We will introduce the problem of loss analysis becoming necessary for practical use in future.
16:40	Recent Development and Application Technology of Non-oriented Electrical Steel Sheets: Mr. Hiroaki Toda, Senior Researcher, Steel Research laboratory, Electrical Steel Research Dept., JFE Steel Corporation

	<p>Recently, there has been a growing need for improving motor efficiency in response to environmental problems such as global warming and energy problems. This leads to a strong demand for further improvement of non-oriented electrical steel sheets. In this presentation, a newly developed high flux density non-oriented electrical steel (JNP Core) and its evaluation results of the characteristics in induction motor are reported after the introduction of conventional electrical steel sheets.</p> <p>Motor cores are often subjected to compressive stress by heat shrinking etc. It is well-known that material iron loss deteriorates largely by compressive stress. It is effective to reduce material magnetostriction in order to suppress the deterioration of iron loss due to compressive stress. Therefore, 6.5% Si steel sheets shows the lowest deterioration ratio of iron loss under compressive stress because the magnetostriction is almost zero. Furthermore, Si-gradient steel that has 6.5% Si content in the surface layer also exhibits a low deterioration ratio of iron loss under compressive stress.</p>
17:20	<p>Taking on JMag: Dr. Takashi Yamada, JSOL Corporation</p> <p>PRECISE ESTIMATES OF LOSS USING ELECTROMAGNETIC FIELD ANALYSIS ARE INDISPENSABLE TO ACHIEVE SMALLER SIZE AND HIGHER EFFICIENCY IN ELECTRIC AND ELECTRONIC DEVICES. SINCE WE AT JSOL RELEASED THE FIRST VERSION OF JMAG OVER 30 YEARS AGO, WE HAVE MADE MANY TECHNOLOGICAL DEVELOPMENTS TO SUPPORT CUSTOMER NEEDS.</p> <p>FOR LOSS ANALYSIS FOR MOTORS IN PARTICULAR, WE HAVE BEEN AT THE FOREFRONT IN TAKING ON NEW TECHNOLOGICAL DEVELOPMENTS, BY PROVIDING IRON LOSS CALCULATION TOOLS BASED ON STEINMETZ' EMPIRICAL FORMULA, INCLUDING AN IRON LOSS MATERIALS DATABASE, PROVIDING MAGNETIC FIELD AND LOSS CALCULATION FUNCTIONS ACCOUNTING FOR STRESS DEPENDENCY, ETC., AND MANY OF OUR USERS HAVE MADE USE OF THESE FUNCTIONS. AT THE SAME TIME, WE HAVE PROVIDED USEFUL TECHNIQUES TO OUR USERS WITH PROPOSALS FOR LOSS ANALYSIS METHODS ACCOUNTING FOR CIRCUITS AND CONTROLS, DEMONSTRATING THEIR UTILITY IN STUDIES WITH ACTUAL MACHINE MODELS. HOWEVER, THE LOSS ANALYSIS THAT HAS BEEN USED UP TO NOW WILL NOT BE SUFFICIENT FOR DEMANDS FOR HIGH PERFORMANCE IN THE MOTORS THAT WILL BE USED IN THE FUTURE, AND A NUMBER OF ISSUES HAVE GARNERED CLOSER ATTENTION. FOR EXAMPLE, ISSUES LIKE, "I'D LIKE TO IMPROVE IRON LOSS CALCULATION ACCURACY BY CONSIDERING HYSTERESIS," "CAN I BALANCE ENERGY INPUT AND OUTPUT WITH THESE TOOLS?" AND "ACCOUNTING FOR SKEW IN AN INDUCTION MOTOR WILL TAKE TOO MUCH CALCULATION TIME..." RIGHT NOW AT JSOL, DEVELOPMENT IS PROCEEDING IN AN ATTEMPT TO TAKE ON THESE PROBLEMS OF HIGH-PRECISION LOSS ANALYSIS IN AREAS SUCH AS INCLUDING A HYSTERESIS MATERIALS DATABASE, DEVELOPMENT OF HIGH SPEED CALCULATION FUNCTIONS FOR EDDY CURRENT LOSS AND HYSTERESIS LOSS IN ROTATING MACHINES, AND HIGH SPEED CALCULATION OF MOTORS WITH ROTOR SKEW.</p> <p>This seminar will present a part of these technological developments, as well as showing a road map for development of high precision loss calculation. We humbly ask that you share your opinions regarding our company's efforts.</p>
18:00	<p>Social gathering</p> <p>There was a wonderful blending of technology based on the theme of loss analysis and bolstered by the rich input of information obtained from the seminar.</p>

Event Information

The JMAG Users Conference

Applications to take part in this year's JMAG Users Conference will start in October. JMAG Users Conferences are planned to emphasize engineers communicating with each other. They are an excellent chance to collect information on ways that electromagnetic field analysis is being used and other topics, so please attend if you are able.

JMAG Users Conference in Japan

Conference Outline

Host: JSOL Corporation

Dates: Wednesday December 4 - Thursday December 5, 2013

Venue: Tokyo Conference Center - Shinagawa (Tokyo, Japan)

URL: <http://www.jmag-international.com/event/conference2013/>



An Overall Picture of the Users Conference

We at the JSOL Corporation would like to provide a Users Conference that gives our customers an opportunity to communicate with each other. We have prepared a wealth of contents again this year, enabling all participants to spend a worthwhile time regardless of their proficiency with JMAG, so it's accessible to everyone those using the software for the first time through to veteran JMAG users. Anybody can feel at ease at the JMAG Users Conference, including those who have never taken part before.

Presentations

We have invited leaders in every field to provide our keynote presentation, for starters, as well as to give presentations during sessions on such topics as motors, induction heating and transformers.

Workshops and Seminars

This year we will also hold the workshops that were so popular last year. We would like to see participants use this as an opportunity to mix centering on technology and to discuss freely about the future direction of analysis technology, make requests regarding JMAG functions or bring up other topics. Seminars (lectures) are given by the actual developers, which not only provides a deep understanding of JMAG, but they are also available to give direct responses to your feedback. The hands-on seminars are exactly what they promise to be, giving the chance to actually use JMAG on a computer by taking on the challenge of thinking about a new analysis field.

●Workshop Themes

Structural/Vibration Analysis Modeling	<p>We will conduct a review of modeling methods for motor or transformer vibration analyses.</p> <p>We have newly added to JMAG as well new features supporting magnetostriction calculation and transient structural analysis.</p> <p>We will review development, centering on an introduction of new functions, and exchange opinions on solutions for modeling initiatives we'll take on for the future (like precision or phenomena we should consider).</p>
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So much can be done J MAG's Induction Heating Analysis	To give a detailed analysis of induction heating phenomena used in production technology requires multiphysics analysis incorporating electromagnetics, heat and structure. Our review will look into how we can do this practically.
Large Transformers Latest Analysis Information	We'll review large transformer modeling methods. New features have been added to J MAG, including the issue of modeling detailed parts required for modeling thin sheers or dealing with large-scale modeling. We will also exchange opinions on a review of J MAG features for large transformer analysis requirements and initiatives we should take for the future.
High Precision Material Modeling	We will introduce J MAG-Designer Ver.13's new features, centering on high-precision loss analysis and material modeling features such as processing deformation response as we exchange opinions on high-precision material modeling.
Parametric Analysis, Optimization Putting to Practical Use	J MAG's optimization function's appeal lies in its simplicity. J MAG-Designer Ver.13 is even easier to use. We'll propose methods for using J MAG's parametric analysis together with the optimization analysis.
Proposal for Small Multiphysics	Consideration of multiphysics makes operation costs an issue as it requires production of complicated models and linking all sorts of different software. J MAG has improved its interface with multiphysics in mind and can drastically reduce operation costs. We'll make a proposal for how complicated multiphysics can be made simple and what approach to take to create small multiphysics.
A Multi-Purpose Export Tool connecting electric and machinery models	We have developed a multi-purpose export tool in response to a request that we enable J MAG analysis results to be exported to other software (for example, exporting J MAG magnetic field analysis results to another company's structural analysis system). There are so many different types of software to tie up with and a huge variety and diversity of objectives to use them for, so we'll use this opportunity to review the function and see how well we've come to meeting your requirements.
Getting even more use out of J MAG-RT models	We will exchange opinions on J MAG-RT to find out ways that J MAG-RT models can be put to even greater use. We will take on reduction of model generation time, an issue needing a solution for J MAG this financial year. We will review the results of efforts in this direction and exchange opinions from the model generation side and the model use side (controls, system design, ECU verification) to determine the issues we need to solve from now.
Reusing Analysis Data	Have you ever thought along the lines of, "Hey, we've already done an analysis like this," or "I'd love to be able to just refer to a calculation efficiency we've done before"...? We'll exchange opinions on effective use and reusing of analysis data (models, analysis).
J MAG Recommended in-House Training	When thinking about J MAG's in-house development have you ever been bothered by worries like what sort of operations manuals we should have or what kind of employee training would work best? JSOL will propose a number of case studies for participants to talk about.

●Seminar (Lecture) Themes

Introduction to J MAG-Designer Ver 13.0	We introduce the latest features on J MAG-Designer Ver. 13.0, our latest software version scheduled for release in December.
Here's How to Use J MAG's Geometry Modeling Function	Here's what we can do to strengthen J MAG's modeling functions. We use this seminar to show how you can make models so they get as close as possible to actual geometries. It's not just to give a general introduction of features.
Using J MAG Results Analysis and Analysis Functions	In addition to the existing contour and vector plots, magnetic flux lines and section graphs, we've added to results processing features including difference calculation and distribution amount FFT. Now, we'll show you how you can put these advanced features to use.
Using J MAG for High-Precision, High-Speed Calculation	High speed and high precision usually trade off against one another. But with J MAG, specializing in analysis objectives to develop functions has enabled us to achieve high precision at high speed. We will show you how we have done this, using examples.
J MAG Solution for direct action motors	We use actual case studies to show you how to use J MAG functions on direct action motors such as actuators, solenoid valves or injectors.
Design an Induction Motor in J MAG-Express	We propose using J MAG-Express as a design tool and not just as software. We will display a design examination method of the induction motor design process and T-shaped equivalent circuit.
Design an IPM Motor with J MAG-Express	We propose using J MAG-Express as a design tool and not just as software. We will show you how J MAG-Express is a useful design tool as we go through the IPM motor design process.

●Seminar (Hands-on) Themes

Induction Heating Analysis Started in J MAG	J MAG uses induction heating phenomena in a wide array of fields such as IH cooking, and heat treatment processes, starting with high-frequency induction heating. We use J MAG in a hands-on manner to find out what kinds of analyses are possible.
Hands-on Seminar High Frequency Transformer and Induction Power Supply	This is a hands-on seminar for those about to start using J MAG and they can get experience with things like switching transformers, reactors and analysis of induction power supplies.
General Electromagnetic Field Analysis Software J MAG-Designer Hands-on Seminar	Get hands-on experience operating J MAG-Designer, an electromagnetic field analysis software, directly see the GUI, experience the rich material database, high-precision mesh, high-speed calculation and powerful results process.







Hands-on Seminar for JMAG-VTB, an analysis automator platform	Even as electromagnetic field and coupling analyses diversity and accelerate, simply selecting the right conditions for some evaluation objectives can now be extremely complicated. JMAG-VTB is a platform that automates such complicated tasks. And here you can actually get a feel for using it.
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Exhibition Zone


We set up a JMAG booth to give an early glimpse at the exhibition zone into the latest JMAG-Designer release, Ver.13.0. Be among the earliest to try out the software's new and improved features.

There are also plans for a variety of JMAG's technical partners to set up booths, starting with materials makers who provide materials databases and including hardware and software vendors, domestic and overseas measuring equipment manufacturers and prototype and design consultation companies. The JMAG Users Conference conveys through its partner companies a variety of worthwhile information about electronic machinery development.

Sponsors

Company	Exhibition content
ETAS K.K.	HIL test system for motor controls with high fidelity FPGA-based JMAG-RT model ETAS LABCAR is the high-end hardware-in-the-loop test environment for all automotive applications. The system is used for closed-loop tests of motor controllers of electric or hybrid electric vehicles. Therefore, the motor controller is connected to the ETAS open and flexible FPGA board which contains a high fidelity inverter and spatial harmonics JMAG-RT model.
dSPACE Japan K.K. 	High fidelity HILS with FPGA based motor model (JMAG supported) In order to simulate the motors used in Hybrid vehicle on HILS, the precise motor and inverter models must be calculated very fast. dSPACE provides the customizable libraries for Simulink (ASM EC lib) and for FPGA (XSG EC Lib). This HILS demo simulates the closed-loop motor system in real time with the detailed motor model (spatial harmonic model) on FPGA imported from JMAG.
SCSK Corporation 	HP Z820 Workstation We are happy to present the HP Z820 Workstation, a high-end workstation that realizes the ultimate in performance. HP Z820 has a maximum 16 cores and 512GB memory with excellent performance and quiet water-cooling unit. We will also provide you with special information such as JMAG performance information, latest computer news and other items related to analysis work. Please keep an eye out for the latest updates.
TDK Corporation 	NEOREC Series (NdFeB magnet) FB Series (Ferrite magnet) We offer a wide variety of products to cover various motor products, applications, geometries and properties making use of powder control technology and our own unique processes. We quickly adopted an active response to resource problems and have cut our use of scarce elements. When it comes to rare earth sintered magnets, we have started mass production of the heavy rare-earth element-free NdFeB magnet, NEOREC47HF, and are developing the rare earth element-free ferrite magnet, FB-9RF.
Cybernet Systems Co., Ltd. つくる情熱を、変える情熱。 	Efficient Simulation by JMAG with Optimus Save your time! Try multidisciplinary optimization and robust design! We introduce several case studies to resolve your problems. Come and see the easy-to-use direct interface between Optimus and JMAG-Designer!
DSP Technology Co. Ltd. 	A controller that decreased torque ripple using a virtual motor Mounted with a virtual motor supporting JMAG-RT and with a controller capable of cutting torque ripple. By giving the virtual motor inside the controller torque command and current command to the actual motor with controlled results it's possible to significantly reduce torque ripple. This also enables sensorless current control.
Mentor Graphics Japan Co., Ltd. 	Comprehensive System Modeling Technique using Virtual Prototype The development of EV (Electric Vehicle) or HEV (Hybrid Electric Vehicle) today must support multiple domains - power electronics, software, controller, mechanical, etc. and the most important aspect is the verification of interaction between motor models and other components. We exhibit how Mentor Graphics multi-domain simulator, SystemVision® and JMAG-RT are collaborated to integrate various abstraction levels.
Motion System Tech Inc	1. Introducing for future SPEED with JMAG Get available Quick design and precise 2. Motion System Tech available Design developing and make prototype Motors Your design make available Quick deliver 2 month

<p>NEAT Co., LTD.</p>  <p>株式会社 <i>NEAT</i></p>	<p>Motor HILS RT-LAB with JMAG-RT RT-LAB is the real-time simulator, developed by OPAL-RT. We can use RT-LAB with JMAG-RT, to have more accurate results.</p>
<p>A&D Company, Limited</p> 	<p>Introduction of A&D's Motor Solutions A&D's motor HILS equipment provides a real-time simulator that improves motor control system development efficiency for hybrid cars (HV/PHV) and electric cars (EV). Motor models use parameter tables derived from JMAG analysis results to support PMSM models with spatial harmonics that recreate current harmonics. Take a look at the type of motor solutions only A&D is capable of producing.</p>

Refer to our website for latest news, information and preparations, which will remain on the site until the start of the JMAG Users Conference. We look forward to seeing you there. 

(Tomomi Igarashi)

Event Information

Exhibitions and Events for September through December, 2013

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 September through December, 2013.

Altair Technology Conference

Conference Outline

Host: Altair Engineering, Inc.

Date and Venue:

South Korea (Seoul) - Friday, September 6, 2013, Hotel Conrad Seoul

China(Beijing) - Monday September 9 to Wednesday September 11, 2013 Beijing International Exhibition Center

United Kingdom(Warwickshire) - Tuesday September 10, 2013 Heritage Motor Centre

Taiwan(Taipei) - Friday September 13, 2013 Hyatt Regency Orange County

United State(California) - Tuesday October 1 to Thursday October 3, 2013 Hyatt Regency Orange County

URL: <http://www.altairatc.com/Default.aspx>

Altair Engineering holds Altair Technology Conferences in countries around the world. We demonstrate JMAG in countries all over the world.

IEEE Energy Conversion Congress and Exposition 2013 (ECCE 2013)

Conference Outline

Host: IEEE

Dates: Sunday September 15 - Thursday September 19, 2013

Venue: Colorado Convention Center (Colorado, U.S.)

URL: <http://www.ecce2013.org/>

We will open a booth at ECCE 2013, a conference held by IEEE. The booth will provide case studies and information about JMAG's latest features as well as demonstrations of JMAG-Express and JMAG-RT Viewer.

Coil Winding Chicago

Conference Outline

Host: CWIEME Ltd.

Dates: Tuesday October 8 - Thursday October 10, 2013

Venue: Donald E. Stephens Convention Center (Chicago, U.S.)

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

Coil Winding Chicago, among the world's largest coil and winding exhibitions, gathers technicians from across the United

States and is filled with booths related to large transformers or wind generators. At the JMAG booth, we will be performing demonstrations centering on motor and transformer analysis case studies. The booth presentation is not to be missed!

Saber Product Seminar

Conference Outline

Host: Nihon Synopsys G.K.

Date: Thursday October 17, 2013

Venue: Midtown Square Conference Room (Nagoya, Japan)

Nihon Synopsys holds seminars informing about case studies involving the links between Synopsis's Saber and JMAG-RT.

MATLAB EXPO 2013

Conference Outline

Host: MathWorks Japan

Date: Tuesday October 29, 2013

Venue: Grand Pacific Le Daiba (Tokyo)

URL: <http://www.matlabexpo.com/jp/> (Only Japanese)

MATLAB EXPO is a conference held by MathWorks. JMAG's booth will offer a chance to try using JMAG-RT, which can be combined with MATLAB/Simulink (from MathWorks). Come and see how useful coupled analysis can be.

LMS European Vehicle Conference

Conference Outline

Host: LMS International

Dates: Tuesday October 29 - Wednesday October 30, 2012

Venue: Kempinski Hotel Airport Munich (Munich, Germany)

URL: <http://www.lmsintl.com/2013-european-vehicle-conference>

The LMS Vehicle Conference will also be held in Germany. JMAG's booth will give a case study of a sound and vibration coupled analysis with JMAG and LMS Virtual.Lab. Those looking to solve issues involving vibration analysis of electronic equipment should drop by the JMAG booth.

SMMA 2013 Fall Technical Conference

Conference Outline

Host: SMMA

Dates: Tuesday November 5 - Thursday November 7, 2013

Venue: Marriott Tampa Airport Hotel (Florida, U.S.)

URL: <http://www.smma.org/>

SMMA is a motor- and motion control-related consortium with members from 120 companies or colleges. JMAG's booth will provide a case study of motor design using JMAG-Express. Get hands-on experience at the site with JMAG, which can

calculate a motor's basic functions in about 1 second.

Solution Seminars (Held in conjunction with the JMAG Users Conference)

Conference Outline

Host: JSOL Corporation

Dates: Wednesday December 4 - Thursday December 5, 2013

Venue: Tokyo Conference Center - Shinagawa (Shinagawa, Tokyo)


Target audience: Clients considering installation of magnetic field analysis software or clients who have started trials using the same

In conjunction with this year's JMAG Users Conference, we will also hold the Solution Seminars open to non-JMAG users as well. Participants can take part in associated presentations, workshops or seminars.

Themes

- Motor Design 1 (PMSM)
- Motor Design 2 (PMSM)
- Induction Heating Design
- Large Transformer Design
- We are also planning the simultaneous hosting of a hands-on seminar for JMAG-Designer.

We will start accepting applications from early October and would definitely like to see you attend.

Autumn involves activities mainly in Japan, Germany and the United States. We are also planning to exhibit or hold seminars in countries all over the world. Check out our website for more information. We look forward to seeing you there. 

(Tomomi Igarashi)

Event Information

Event Report

Attendees report on events held from July to August, 2013. We hope you will attend our next event.

Thermotec 2013

Conference Outline

Host: Japan Industrial Furnace Manufacturers Association

Dates: Wednesday July 3 - Friday July 5, 2013

Venue: Tokyo Big Sight (Tokyo, Japan)

URL: <http://thermotec-expo.com/> (Only Japanese)



Thermotec is an industrial furnace and heat treatment exhibition held once every four years.

We have been focusing attention in recent years on proposals for JMAG's induction heating analysis. This was the first time we exhibited. We saw that many other exhibitors were manufacturers of carburizing, induction or electrical furnaces, or companies associated with temperature measurement, which have the technologies supporting thermal application.

Most of the people who visited the JMAG booth had an interest in induction heating coil design but had little awareness of analysis, which meant we dealt with a lot of inquiries about coil design. We arranged gear induction heating analysis case studies within the booth and introduced a case study of coil design when heat is applied evenly to a sheet.

We displayed a comparatively large number of JMAG analysis case studies, centering on Neturen and Denki Kogyo, at the exhibition venue and during the exhibitors' presentations. The exhibition presented us with an opportunity to realize what we need to do to meet customers' expectations and made me think again about the importance of improving the analysis environment in this field.

(Hiroshi Hashimoto)

JMAAB Open Conference 2013

Conference Outline

Host: MathWorks Japan

Date: Thursday July 4, 2013

Venue: Tokyo Conference Center - Shinagawa (Tokyo, Japan)

URL: <http://www.mathworks.co.jp/company/events/conferences/jmaab-open-conference> (Only Japanese)

JMAAB, hosted every second year, was held for the sixth time this year, the lively event attracting upward of 350 people from a variety of manufacturing sectors, with participants coming from industries outside of the automaking business as well. JMAAB is backed by activities from such bodies as working groups comprised of cross-corporate members. This year, though, saw a speech that provided insight into JMAAB's activities and achievements up until now.

Among the booth exhibitors at JMAAB was Fujitsu Ten, a HILS vendor whose display of JMAG-RT resulted in a synergetic effect for the JMAG booth, resulting in the wonderful situation of having all our promotional pamphlets being

collected by booth visitors by the time we had finished our lunch break. Our booth gave a JMAG-RT Viewer demonstration of motor characteristics and presentation using JMAG-RT to show construction of a supply chain linking an automaker and supplier.

(Takayuki Nishio)

Basics of Magnetic Fields for Motor Design and Magnetic Field Analysis Training -Including PC Practice-

Conference Outline

Host: J-TECHNO INC

Date: Friday July 5, 2013

Venue: J-TECHNO Seminar Room (Tokyo, Japan)

URL: <http://www.j-techno.co.jp/infos> (Only Japanese)

JSOL's Mr. Sakashita once again lectured at a seminar this year on implementing a magnetic field analysis using JMAG and starting from the basics of electromagnetics for an audience comprised of those involved in motor design to others thinking about electromagnetic analysis.

When it came to the fundamentals of electromagnetism, he endeavored to provide direct and concise information about electromagnetism, electromagnetic induction and handling of materials. Implementation involved going through each step of a motor analysis, which provided participants with hands-on experience. He was able to convey the interesting aspects of electromagnetic field analysis and the appeal of JMAG in a simple manner easily understood even by beginners.

(Tomomi Igarashi)

MATLAB EXPO in Hamamatsu

Conference Outline

Host: MathWorks Japan

Date: Wednesday July 10, 2013

Venue: Act City Hamamatsu Congress Center (Shizuoka, Japan)

URL: <http://www.mathworks.co.jp/company/events/seminars/seminar77612.html> (Only Japanese)

We exhibited in MATLAB EXPO in Hamamatsu, held by MathWorks Japan. The seminar mainly provided case studies of model-based development in the automobile industry or gave introductions of MathWorks production functions.

There was also a lecture from Mr. Kakisaki of Nissan Motor Co.'s Powertrain development headquarters, which made me feel that model-based development is definitely broadening. Many people visited the JMAG booth, looking at items such as coupling case examples.

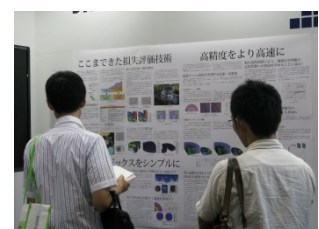
The next step for JMAG is to further increase precision of plant models like motors, get into databases and get JMAG contributing to model-based development.

(Yusaku Suzuki)

TECHNO-FRONTIER 2013

Conference Outline

Host: Japan Management Association



Dates: Wednesday July 17 - Friday July 19, 2013

Venue: Tokyo Big Sight (Tokyo, Japan)

URL: <http://www.jma.or.jp/TF/en/index.html>

Beautiful weather blessed TECHNO-FRONTIER 2013, drawing over 30,000 people on consecutive days to the Tokyo Big Sight.

JMAG's booth featured JMAG-Designer Ver. 12.1, which had been released in June, the JMAG-Express motor design tool and the motor simulation technologies of which JSOL is a leader. As you are well aware, there's currently a fierce technological competition going on to enhance the functionality of motors. FEA has become an indispensable technology for analyzing physical phenomena that can't be measured or evaluating situations that are difficult to actually test. Greater efficiency and precision are being sought while the wave of model-based development is also looming over motor design. We gave presentations on approaches possible with JMAG when dealing with items like magnetic fields, structures and control. Large numbers of people showed great interest in a wall display newspaper filled with articles about such JMAG initiatives as loss evaluation technologies and high-precision, high-acceleration measures. We are looking to give an even more powerful display of JMAG's wares next year and await you at the booth.

(Tomomi Igarashi)

5th Seminar on Advanced Computational Electromagnetics: Toward Putting High-Precision Loss Analysis into Practice

Conference Outline

Host: JSOL Corporation

Date: Tuesday July 23, 2012 13:30-20:00 (including reception)

Venue: TRUST CITY CONFERENCE MARUNOUCHI (Tokyo, Japan)

Enrollment Limit: 200

URL: http://www.jmag-international.com/seminar/op/new_mag.html



We invited leaders in fields associated with the loss analysis that JMAG deals with and asked them to provide lectures that expressed their demands regarding future loss analysis in motor development and talking about the latest likely loss analysis developments and evaluation methods.

Lecture topics included loss properties in materials under stress, the future of electromagnetic analysis technology including a detailed explanation of motor development speed and issues and problems arising from large-scale models. The lectures were filled with advantageous and worthwhile comments.

A party following the lectures gave the lecturers a chance to mix with attendees, each other, as well as our engineers. Discussion at the party was extremely lively, possibly because it has been so long since JMAG held something similar. Discussions at the party extended well beyond the seminar theme of loss analysis and went into providing feedback about the new features on the motor design tools JMAG-Express and JMAG-Designer. Thank you very much.

JMAG will continue focusing on loss analysis from now on. We look forward to seeing JMAG move ahead.

(Tomomi Igarashi)

NI Week 2013

Conference Outline

Host: National Instruments Inc.

Dates: Monday August 5 - Wednesday August 8, 2013

Venue: Austin Convention Center (Texas, U.S.)

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

National Instruments (NI) is a measurement and control equipment manufacturer with headquarters in Austin, Texas, in the United States. It hosts NI Week, a massive technology event, which draws in participants from a wide variety of technology fields who come from countries all over the world.

The exhibition starts with operational case studies and introductions of how latest technology trends are mixing in with development, and the site is packed with product displays and workshops, including a variety of lectures, with participants mixing and engaging in lively discussions.

JMAG gave a presentation with NI about high-precision HILS using JMAG-RT. There was an introduction of an application case study and case study demonstration of Inverter ECU. Furthermore, there was talk about progress on the development of a motor analysis toolkit. Altogether, the show provided an opportunity to gain an even deeper feeling for the high-precision HILS environment.

(Tetsuo Ogawa)

This issue has focused largely on reporting exhibitions and seminars held in Japan. JMAG will continue to strive to not only provide technological support, but also to play a part in our customers' global strategy.

Author: Tomomi Igarashi

