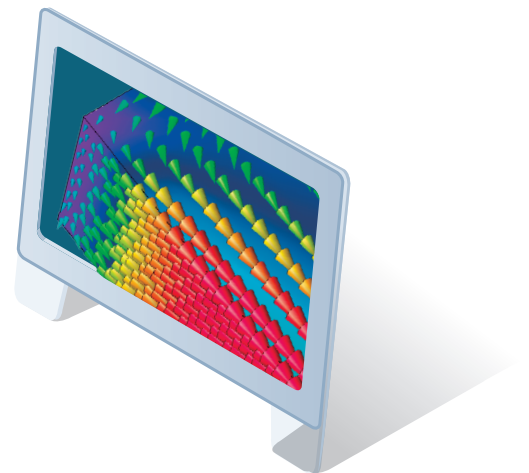


JMAG Newsletter

May, 2012

It is now simple to be precise

JMAG is a comprehensive software suite for
electromechanical equipment design and development.
Powerful simulation and analysis technologies provide a new standard in
performance and quality for product design.
Capture complex phenomena and gain valuable insights.



Contents

[1] FEA Commentary: What Advantages Does FEA Bring to Development?

- Applying JMAG to Power Transformer Designs
- Preventing Insulation Breakdowns Ahead of Time -

[2] How far has model based development spread? CAE edition

- Issue 1 Asking an LMS engineer
- Applying Model Based Development to Vibration and Sound Problems in Electrical Equipment -

[3] Fully Mastering JMAG

- Common Questions for JMAG -

[4] Fully Mastering JMAG

- Issue 4 Understanding Meshes from A to Z -

[5] Event Information

- Exhibitions and Events for May and June, 2012 -
- Event Report -



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JMAG Newsletter: Highlights of the May Issue

It is our pleasure to present the first JMAG Newsletter of the 2012 fiscal year.

In the series of explanations that we ran last year, we laid out the logic behind model based development. This year, we will take the next step and begin a series of reports about actual sites where model based development is being performed. We will introduce what engineers think about in their daily control and mechanical development operations, and what they expect of us, electrical engineers.

We also explain the value of introducing finite element analysis (FEA) to development sites by looking at its methods of application in the "FEA Commentary" section.

The JMAG Newsletter is valuable for everyone, including those currently using JMAG, those just starting to use it, and those who have not started yet.

Please don't hesitate to introduce the JMAG Newsletter to those around you who are just starting to use JMAG.

This issue is packed with even more information than ever before. We hope you enjoy it.

JSOL Corporation
Electromagnetic Engineering Department, Engineering Technology Division

FEA Commentary: What Advantages Does FEA Bring to Development?

Applying JMAG to Power Transformer Designs -Preventing Insulation Breakdowns Ahead of Time-

I would like to clarify how much value there is in introducing finite element analysis (FEA) to the electrical equipment design field. In this issue, I will examine the ways in which FEA can be applied to transformers, and to large scale power transformers in particular. In general, FEA allows you to visualize physical quantities that cannot be seen by the naked eye and streamline your design process. This article is a must-read for those who have given up on FEA because they think that it takes too much time.

Bringing Fast and Accurate FEA to Transformer Design

Transformers have a long history, dating back to the 1880's. Designs for large-scale power transformers in particular have many years of technical knowledge built into their designs, and there are many veteran designers who think that they can get by just fine without FEA.

This would be true if we continued to deal with traditional designs. Present day designers, however, must deal with current energy problems that require equipment to have even greater energy efficiency. They have to study ways of increasing efficiency in equipment as much as possible, even by a mere percentage point or two in some cases.

Using FEA allows designers to visualize phenomena that are not visible to the naked eye, enabling them to find the necessary means to improve efficiency. For example, FEA makes it possible to estimate the distribution amounts of iron losses produced in a transformer's core, or losses produced by leakage flux in its casing (Figures 1 and 2). Mastering the latest FEA technology enables a designer to run highly accurate simulations in a short period of time.

The following section shows two examples of JMAG analysis. The first one simulates surge

voltage during a disconnection, and the second one contains a dielectric strength evaluation of a lightning resistant transformer. These are both challenges when designing a power transformer.

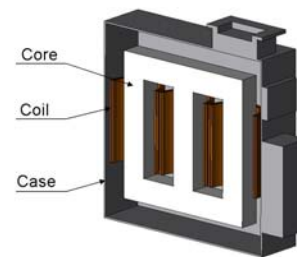


Fig. 1 A power transformer

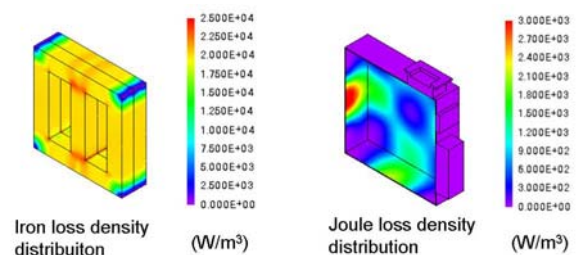


Fig. 2 Iron loss density distribution in the core and joule loss in the case

JMAG Application in Power Transformer Design

Surge countermeasures are often mentioned as one of the most important study items in power transformer design. It is especially important to estimate the effects on peripheral equipment from coil disconnection caused by a lightning strike or

aging deterioration. Lightning resistant transformers themselves can withstand the high pressure from lightning, so their coils and insulating materials need to be studied to make sure that they have the correct arrangement.

In this section, we will first use JMAG to perform a surge voltage evaluation when a coil has disconnected in a three phase power transformer. After that, we will confirm whether the insulation between the coils in a lightning resistant transformer has been maintained during a lightning strike.

Evaluation of Surge Voltage from a Coil Disconnection

We can estimate the abnormal voltage that occurs when the W-phase coil ruptures in a three phase power transformer during steady operation by using the switch to cut off current flowing to the coil. This, in turn, makes it possible to simulate the rupture (Fig. 3).

Let's use FEA to look at the voltage history that we have obtained for the coil (Fig. 4). We are using a 400 V sinusoidal wave as a power supply, but it is apparent from the voltage value at the moment of rupture that we need a pressure resistance of around 1240 V, including the equipment that connects to the surroundings.

JMAG needs a mere four minutes to obtain these results. Compared with a design based on traditional experience using a calculator, this makes it possible to obtain more accurate results faster.

Dielectric Strength Evaluation of a Lightning Resistant Transformer

The lightning resistance of a transformer's main unit is as important to study as its surge voltage, and designs for lightning resistant transformers in particular have to be able to withstand high voltages.

In this simulation, we assume that high voltage from lightning has been loaded to a transformer placed in insulating oil (Fig. 5, Table 1). Using FEA makes it possible to see the electric field distribution in the transformer, which will allow us to evaluate the arrangement of the coil and insulating materials, and examine whether or not the dielectric strength of each part is sufficient.

In this analysis, a voltage of 150 kV is loaded to the primary coil. Let's take a look at the interior electric field distribution (Fig. 6). When we zoom in on the corner of the primary coil, we see that a maximum electric field of 9.05 kV/mm has occurred in the area. This is a local value that is hard to evaluate quantitatively in a design relying on traditional experience, but using FEA brings it to light. As a result, we find that the assumed dielectric strength of this analysis is less than 10 kV/mm.

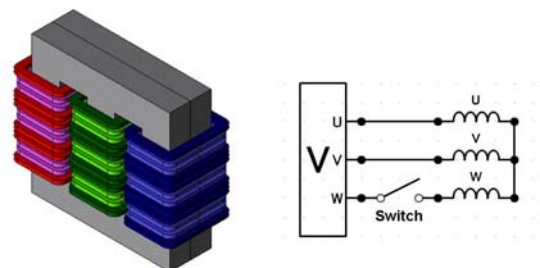


Fig. 3 A 3 phase power transformer model and its circuit

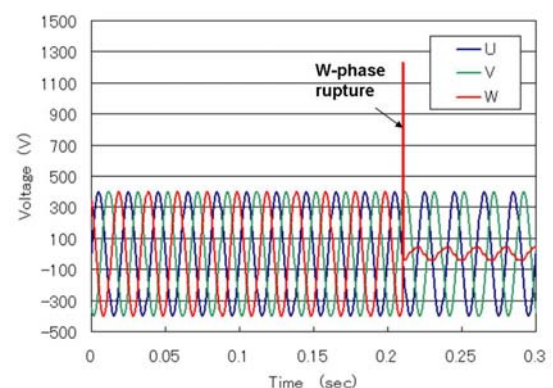


Fig. 4 The coil's voltage history

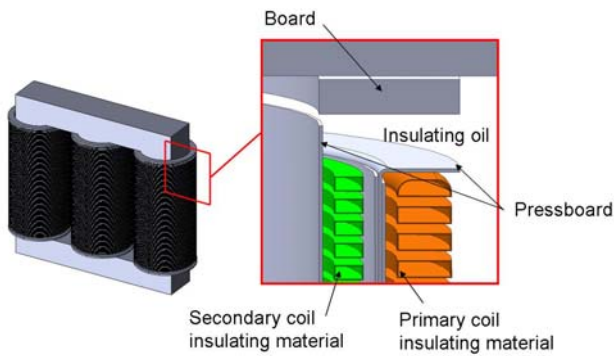


Fig. 5 Lightning resistant transformer

Table 1 Assumed dielectric strength in each part

Part	Dielectric strength kV/mm
Coil insulating material	10
Pressboard	
Board	
Insulating oil	12

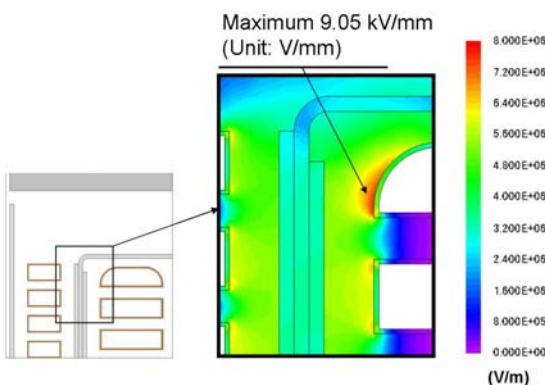


Fig. 6 Electric field distribution in the transformer

JMAG: Pursuing a Faster Transformer Analysis

Up to this point I have introduced the fact that, in addition to current and voltage, a transformer analysis allows you to visualize loss distribution and electric field distribution, which cannot be seen in actual measurements. At JMAG, we are developing technologies that allow you to obtain these results

quickly.

I would like to introduce a few more details about the Time Period Explicit Error Correction method, which was used in the preceding section titled, "Evaluation of Surge Voltage from a Coil Disconnection." In an analysis like this, when we skip the starting-up phenomena because the coil ruptures in a steady state, we want to shorten the transient phase to save analysis time. With JMAG, it is possible to eliminate this transient phase early on by using the Time Period Explicit Error Correction method (TP-EEC method). Using the TP-EEC method allows us to set the coil's rupture time to 0.21 s (Fig. 7). This kind of cutting-edge technology makes it possible to reduce the analysis time to half of that required by traditional FEA. In the loss analysis that I mentioned in the introduction, the analysis time was shortened remarkably by using two features: The improved version of the A-phi method (A-phi Method 2), which can run a high speed analysis for eddy currents, and the SMP parallel computing function, which utilizes a multi-core machine effectively to improve analysis speed. JMAG also has technology that converges nonlinear iterations quickly.

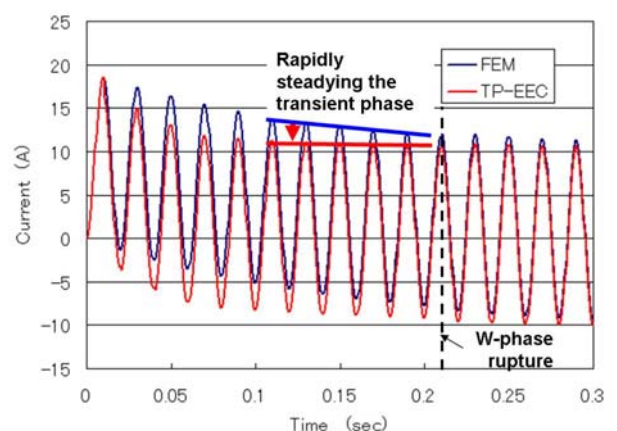


Fig. 7 Current history of the U-phase coil


In Closing

We used JMAG to examine a power transformer design and perform an abnormal voltage evaluation during a coil rupture, which is a vital study item. We also shortened the analysis time by using the TP-EEC method to eliminate the transient phenomena that occurred in the analysis's early stages. This allowed us to estimate the voltage increase during a coil rupture.

Additionally, we went through a dielectric strength evaluation of a lightning strike in a lightning resistant transformer. As a result, we found that the design proposal shown here can withstand a lightning strike of 150 kV. We were also able to confirm the electric field distribution in the transformer, which made it possible to study arrangements of a coil and insulating material that would have been difficult to examine using traditional methods.

I took the opportunity to introduce high-speed technology in JMAG that can be used in a transformer analysis, as well. Implementing the latest technology makes it possible to obtain analysis results in a shorter time than it would take with traditional FEA.

Visualizing phenomena in FEA gives veteran designers the ability to transfer their valuable techniques and knowledge to other designers and to the next generation.

JMAG's cutting-edge technology allows you to estimate a product's characteristics more easily and quickly than if you were using a traditional trial production. By all means, take this opportunity to begin using JMAG in your transformer design site. 

(Kazuki Semba)

How far has model based development spread? CAE edition

Issue 1 Asking an LMS engineer

Applying Model Based Development to Vibration and Sound Problems in Electrical Equipment

I laid out the logic behind model based development in the series that I wrote last year, so this year I would like to report on how it is actually being used in the field. I plan on interviewing vendors who work alongside JMAG to support model based development in order to clarify what engineers in control and mechanism development think about this development method, and what they expect from us, the electrical engineers. These interviews should give me and my coworkers a chance to learn what steps to take moving forward.

Last year, we at JSOL began running vibration noise analyses on permanent magnet motors with Shibaura Institute of Technology and LMS Japan. We gave a progress report during a seminar at the JMAG Users Conference last year, and I was surprised at how many people came to attend. It made me realize that there are a great many people concerned about these problems. In this issue, we hear from Mr. Asano and Mr. Ito of LMS Japan, one of our co-researchers. They talk about various themes, including how professional vibration and sound control engineers look at model based development application in electrical equipment.

The Importance of Reducing Noise Vibration

The story behind the increasing importance of noise vibration reduction

NV (noise vibration) is becoming more and more important as a development challenge for electrical equipment, because miniaturization and higher density in equipment have made it easier for motors and actuators themselves to vibrate. This problem is compounded by the fact that sound insulation can only be used to a limited degree, making NV impossible to ignore. At the same time, sound reduction requirements have been getting stricter because equipment is being used in quiet environments like rooms. This is why engineers who design electrical equipment like motors now have to meet NV requirements, in addition to fulfilling traditional basic characteristics like output and efficiency. However, those in the electrical equipment world are not the only ones who demand NV reduction, as it has almost gotten to the point

Featured interview



LMS Japan K.K.
Pre-sales Simulation 3D Supervisors
Shunji Asano
Hiroto Ito

where no appliance can be allowed to have noise vibration anymore.

In this issue, we asked engineers from LMS Japan, who are specialists in measuring and analyzing NV, what kinds of approaches NV engineers take toward solving problems with noise and vibration. Their responses should provide a good reference for how to proceed with solutions to NV problems, which electrical equipment engineers will most likely have to start dealing with in the next few years.

The Difficulty of Noise Vibration Simulation

Vibration analysis focuses on resonance

(JSOL) I understand resonance and damping in electric circuits, but I've never really had the chance

to properly think about physical vibration and noise even though they occur in everyday life, so I can't really get a picture of how they occur or how to solve them. Tell us about which parts of a noise vibration simulation can be difficult.

(LMS) Simulating NV is different from (structural) static analysis, which evaluates physical quantities like stress, deformation, and distortion. A dynamic analysis that handles vibration and noise needs to simultaneously evaluate several indicators that change with evaluation location, frequency, and time. This is why we need a unique approach toward countermeasures and design changes. A static analysis uses quantity size as its guideline, but the distinction with a dynamic analysis is that it focuses on resonance.

We need an analysis approach that lets us get to the root of the phenomenon without getting confused about changes in superficial indicators. We need to be able to clarify which things are predominant and which things we, the engineers, can control. In order to proceed accurately and efficiently with an analysis, correct knowledge and experience are necessary when it comes to finding a way to capture invisible boundary conditions and load conditions in a mathematical model.

(JSOL) What difficulties do you face in measuring vibration?

(LMS) In experimental analysis, one needs to innovate ways of bringing out the essential quantities instead of just measuring the phenomenon as it is. Complete noise removal, thinking of ways to measure places where you can't attach sensors, processing waveform signals based on correct knowledge... All of these require expertise supported by experience and knowledge gained in the field.

We need both the theoretical and experimental

sides to obtain universal solutions and knowledge from a measurement model (Figures 1 and 2).

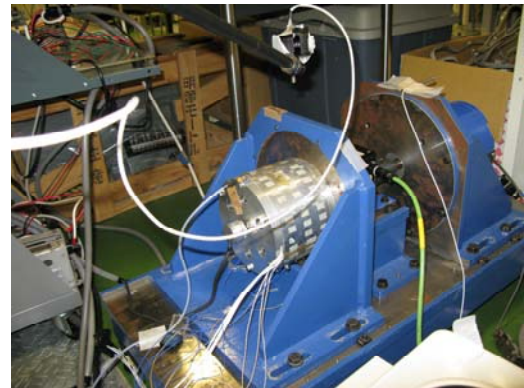


Fig. 1 Real operation NV test of Harumi Model 1

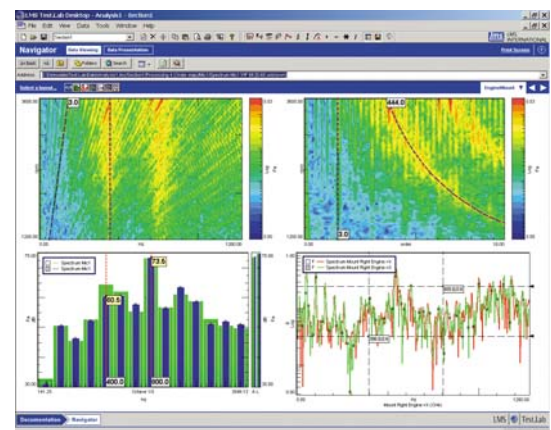


Fig. 2 LMS Test.Lab screenshot

Forecasting vibration

(JSOL) Motor designers who have accumulated a certain amount of experience can look at a magnetic circuit, picture the magnetic flux flow, and judge the design's good and bad points. Can a vibration engineer look at a structure and tell which parts will probably produce vibration and noise? Is it the kind of thing where you can tap a piece of equipment like a doctor palpates a patient's chest and determine where noise will be produced?

(LMS) There are times when, if I have the real piece of equipment, I can get a sense of its weight (by holding it) and its rigidity (by listening to the sound it makes when I tap it) and tell what the check points

of its model would be. Someone with a lot of experience can probably judge the dominant frequency range and mode shape, too. This ability to sense things is also important for a person creating simulation models.

Focusing on natural frequencies and mode shapes

(JSOL) Which places in measurement and analysis values do NV engineers pay attention to?

(LMS) Basically, the thing that becomes a problem with noise and vibration is resonance. The key to eliminating harmful vibration is avoiding resonance. Vibration is determined by the excitation force generated in the structure and how easy it is for the parts themselves to vibrate, so when it comes to the structure we have to give careful thought to both its resonant frequency and its mode shape, and check how they are vibrating.

On the other hand, though, we don't really focus on the amplitude of the vibration. Mathematically speaking, in the neighborhood of resonant frequency even a deviation of 1 Hz can change the resonance response level several dozen or even several hundred fold. Modal damping also contributes to the amplitude, but it cannot adhere too much to the vibration because the damping itself is not the root of the vibration.

What it all boils down to is the fact that vibration is an exchange of energy that follows an equation of motion between rigidity and inertia. This makes it vital to obtain the natural frequency and mode shape, which are vibration modes of the structure, regardless of whether one is dealing with an experiment or a simulation. These are what the designer takes countermeasures against.

LMS and NV Solutions

The history of LMS

(JSOL) Give us a brief introduction to LMS.

(LMS) We were established in Leuven, Belgium, in 1979. We started developing and selling experiment measurement and data analysis systems aimed at experimental system engineering related to noise and vibration phenomena. We are currently providing total solutions, including the development and sales of simulation tools, that cover experimental analysis systems. Our products include experimental analysis systems (hardware, software, and various measurement equipment), 3D simulation software (Virtual.Lab/Samtec), and 1D multi-domain system simulation software (Imagine.Lab AMESim).

LMS Japan is our Japanese branch, which carries out everything from consulting to support for our Japanese clients. We currently have a total of 50 engineers.

LMS Test.Lab and Virtual.Lab

(JSOL) Which fields is Virtual.Lab being used in?

(LMS) LMS's products are being used at home and abroad in all machine design fields (machines, electric appliances, vehicles, aeronautics, astronautics, military, device development, etc.). It is also being used in the sound, vibration, and structure R&D field. Test.Lab is an analysis tool based on experimental data from prototype measurement and analysis, and Virtual.Lab is a virtual 3D simulation tool.

(JSOL) What are Virtual.Lab's key characteristics? What is the difference with a normal structural analysis software?

(LMS) This software seamlessly achieves mechanism analysis, NV analysis, acoustic analysis, fatigue life prediction, correlated analysis, and optimization functions on a single platform.

It identifies loads generated from an object's motion, calculates the structural vibration response

that they cause, and predicts the sound that these vibrations produce. It makes this design process achievable with a single platform. Another of its attractive points is that it can run a direct analysis from CAD (CATIA V5) geometry. (It is also possible to use each analysis tool independently.)

LMS itself is also a company that has grown as an experiment consultant in the engineering field, so our strong point is the ability to provide hybrid solutions that unite experiments with CAE simulation.

(JSOL) Tell us about Virtual.Lab's makeup and the environment that it can be used in.

(LMS) Challenges like high-speed and high-accuracy mechanical operations as well as "noise and vibration" from resource saving and miniaturization will always exist in the mechanical design field. In the more than three decades since its establishment, LMS has accumulated results in the NV field, and has been developing and selling the experimental hardware and 3D CAE software necessary for it. You could say that we have become a de facto standard in the NV analysis field. Virtual.Lab Acoustics, which is an acoustic simulation module, has a quarter century (including its predecessor SYSNOISE) of achievements in development, and is being used in leading companies all over the world.

Compositions of selected modules differ according to objective and analysis grade, so it is not possible to make a comprehensive introduction. However, for specialized acoustic analysis, it is possible to put together a fundamental module starting at around four to five million yen (Fig.3).

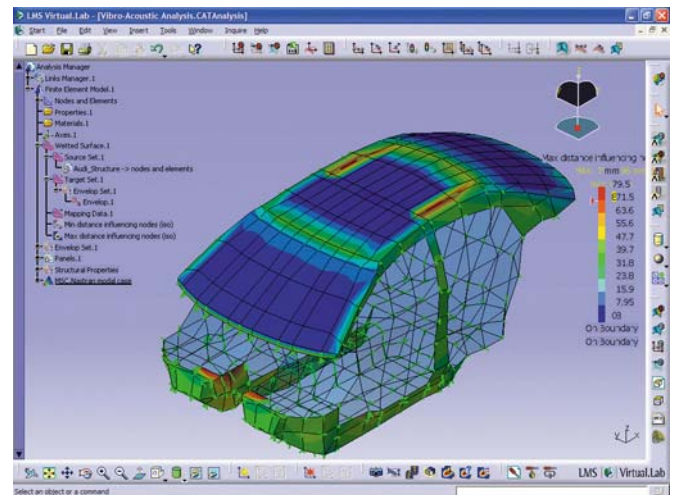


Fig. 3 LMSVirtual.Lab screenshot

Model Based Development for NV Solutions

Solving all of the physical phenomena simultaneously is unrealistic

(JSOL) The logic behind model based development is being applied to improving noise vibration, but how exactly is it being carried out?

(LMS) It is unrealistic to model the physical phenomena in all of the parts related to vibration and solve them at once. This is why the physical phenomena need to be divided in some way into a form that makes it possible to solve them. For motors familiar to JMAG users, we think about vibration as being caused by either structural deformation or torque. When it comes to structural deformation, the distribution of forces that act on the entire structure is important, so the electromagnetic force distribution needs to be obtained with FEM. In the case of axial torsion vibration caused by torque and the noise of gears meshing, torque versus time variations are important, but the electromagnetic force distribution itself does not make any contribution. Therefore, simulations can be run by using the torque versus time variations alone.

(JSOL) In other words, you split up the motor into a

model with structural deformations and a model with axial vibration, making it easier to connect with other models.

(LMS) For axial vibration, there is both torque variation generated by the motor and the inertia moment of the motor itself, so going from that to loading requires using gears or dampers. A mechanism analysis tool is suitable for considering these movements, so the axial torsion rigidity and the contact situation of the gears are transferred in a format that is easy for the mechanism analysis tool to receive. We re-import the vibration obtained from this process to a structural model and evaluate the noise and vibration.

We use experimental data and analysis data in the same setting.

(JSOL) Can a simulation do the job without a prototype or a trial?

(LMS) Values for damping and sound absorption characteristics cannot be obtained abstractly, so an experimental trial to record the phenomena into a mathematical model would be required every time. Numeric value simulations based on macro models founded on continuum mechanics also have solutions that can only be verified under limited conditions.

Last year there were quite a few times when experimental trials were advantageous in terms of cost (time and money), so we focused on what kinds of added value analysis brings to the table instead of simply looking at it as a replacement for experiments.

Starting with Virtual.Lab, LMS's product and service policy is to perform experimental trials efficiently and aid with product development. LMS makes it possible to cover experimental data and analysis data in the same setting. Instead of thinking about which is better, we feel that it is

necessary to handle them on equal footing and make use of them in analysis.

More and more people find that they need to solve problems with noise and vibration in electrical equipment.

(JSOL) I think that interest in NV solutions in electrical equipment is growing, but has LMS been seeing more of those needs from its clients?

(LMS) More and more customers are considering our tools for solving noise and vibration in motors. At last year's LMS User Conference, there was a presentation about raising design efficiency by using analysis tools to solve noise and vibration in electrical equipment. The speaker used JMAG for his magnetic field analysis.

Expectations for JMAG

(JSOL) What are the benefits of coupling with JMAG? Do you use any other electromagnetic field analysis software?

(LMS) The fact that JMAG has the top market share in Japan, and has the best track record. Also, the fact that the level of applications (analysis case examples) in Japan is high even when compared on a global scale.

JMAG can be introduced and used with users overseas, too. The effort that JSOL puts into developing its software, exceptional customer support, etc. ... Are all reasons that we chose it.

I think that another big factor is that JMAG is aggressive in its efforts to couple with other software. LMS's head office in Belgium and JSOL are developing a direct interface, so there are points that we have in common when it comes to our positive stance toward developing things that are beneficial for our clients. I think that if we work with JMAG, we will be able to provide better technical service to our users all over the world.


(JSOL) We (JSOL and LMS) are carrying out collaborative research along with the Shibaura Institute of Technology to improve analysis technology for noise vibration in motors. I think that the friendly relations that bring about this kind of cooperation will be reflected in our products and services, so we treasure this opportunity. In closing, tell use some expectations that you have for JMAG.

(LMS) I think that we are entering an age where electromagnetic field design itself will influence the acoustic quality of a product. I expect that there will be some countermeasure approaches that cannot be dealt with in traditional mechanical design companies. I think that it would be great if mechanical and electrical engineers would combine their knowledge to be able to solve their efforts toward making products silent or sound good.

Accurately obtaining electromagnetic force, which is an excitation force in electrical equipment, will become such a basic part of the process that I always have expectations for JMAG. In addition to that, I also believe that information sharing through model based design will continue to make progress if users, including us, can transfer it in a format that is easy to use. If you can deliver an accurate electromagnetic force to us, we can take it from there.

(JSOL) Thank you for having such a productive discussion with me today.

In Closing

In this issue we heard from members of LMS, which specializes in noise vibration, and got a perspective unique to a noise vibration engineer. I found it very inspiring as an electrical engineer, and was able to use this conversation to convey my opinions. When they talked about the ability to guess the condition of an electrical appliance from its sound and vibration, I came to the realization that I hadn't properly thought about how these phenomena are created, even though they are inescapable in my daily life. I get the feeling that this talk made me better able to see the effects of sound and vibration in the world around me. I will use this experience to improve JMAG's function development and technical service in order to be able to contribute further to the research and development of all of our users. 

(Yoshiyuki Sakashita)

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Common Questions for JMAG

While the majority of JMAG users consist of electrical engineering specialists, a lot of mechanical designers have begun using our products recently, and quite a few of them are probably wondering what they should do to perform better calculations. In this corner, we tackle some problems that many of our users seem to be encountering. In each issue we give examples of questions that we receive the most often to try and help readers who are having similar troubles.

This time around we will show responses to three frequently asked questions. The first one deals with the analytical accuracy of cogging torque, an issue that many JMAG users have lost sleep over. There have been recent improvements in meshing features, so it has become a standard method to import CAD data and easily create a model with an automatic meshing function. Depending on the case, however, there are times when obtaining cogging torque accurately requires that the CAD model be remade into an analysis-specific model. This used to be an extremely troublesome operation to perform, but with JMAG-Designer it has become possible to generate a mesh accurately and easily without having to recreate it. Let's take a look at how to solve this problem.

Q 1: I am trying to obtain the cogging torque of an 8 pole 9 slot SPM motor. I split it up into pretty small divisions, with 32 divisions for each period of cogging torque (a mechanical angle of 5 degrees), but there is still an offset. What do you think I should do?

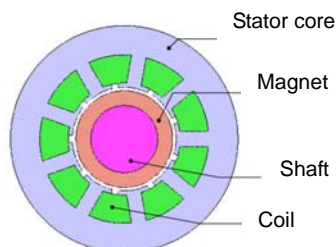


Fig. 1 Motor geometry

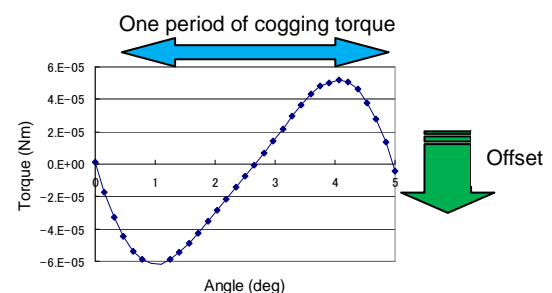


Fig. 2 Results of the problem cogging torque

A 1: Try using the Rotation Periodic Mesh.

Cogging torque is a type of torque that is generated from the magnetic adherence of the electromagnetic force in the circumferential direction, and it tends to be fairly small. That is why the analysis needs to be highly accurate, so that it is strongly affected by the mesh. JMAG-Designer's "Rotation Periodic Mesh" function lets you obtain accurate cogging torque that vibrates centered on the zero position. And, of course, there is no need to go out of your way to create a new geometry specifically for the analysis. Fig. 3 shows a comparison of the results.

You can see the procedures for the Rotation Periodic Mesh by opening Help in JMAG-Designer and going to [Contents] > [Analysis] > [Generating Mesh (Automatic)] > [Rotation Periodic Mesh].

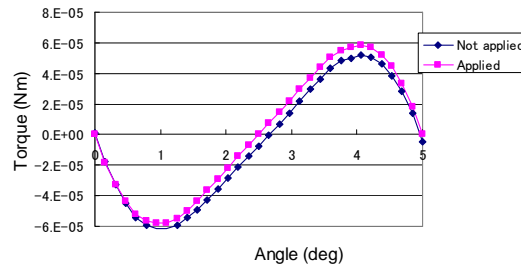


Fig. 3 A comparison of cogging torque results

This time we used an example of a 2D model, but you can save yourself a lot of time and effort by using the Rotation Periodic Mesh and the Extruded Mesh together to create a 3D model. See "Understanding Meshes from A to Z" for more information. This is just one of the ways that JMAG-Designer continues to evolve day by day, so be sure to check out the new functions, as well.

The second question is about coil modeling methods, which should be simple for those who have gotten used to them, but hard to understand for those who are just starting out. Each spring there are a lot of people who are using JMAG for the first time, so many of them are probably facing the same problems. Let's take a look at how to solve this issue.

Q 2: An error appeared that says "Cannot find flow-out face of FEM coil (or current condition)." Does this mean that I have to extend the coil region like in the SLS motor model?

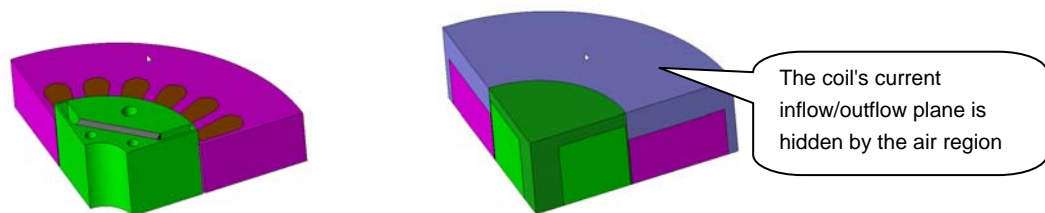


Fig. 4 The model in question (left: without the air mesh, right: with the air mesh)

A 2: The coil region needs to be extended, because the coil's inflow/outflow plane has to exist on the same face as the plane boundary.

If the coil is not ring-shaped, then either the symmetry boundary condition or periodic boundary condition needs to be set to the inflow/outflow plane, meaning that the current must enter and leave through the outermost face of the analysis model. The reason for this is that the model has to be created so that the current does not flow out into the analysis space or disappear. Try extending the coil as shown in Fig. 5.

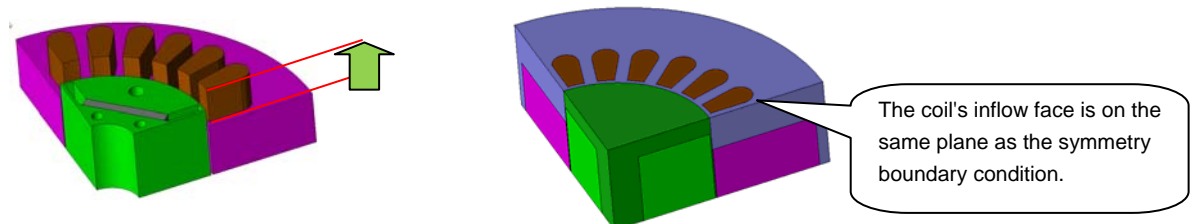


Fig. 5 Corrected model (left: without the air mesh, right: with the air mesh)

The coil is essentially made up of one wire that wraps around the core. While there is not a problem with modeling the coil ends precisely, this can greatly increase the calculation cost. Most of the time it is enough to correctly express the magnetic field generated in the core, so in cases like this it is better to use a method of modeling the coil so that its ends extend straight out. This concept may not be easy for some to understand, however.

The third and final question has to do with machine environments. These days, machines are generally used in a network environment, so people often read files by taking a machine on their network and using it as a drive on their local machine. There are times, however, when running an analysis this way is not possible depending on the person's usage method. Let's take a look at how to solve this problem.

Q 3: An error saying "The UNC path is not supported" has shown up, and I can't run the analysis. What is the problem?

A 3: Perform the network drive settings.

This error appears when your computer is trying to use data on the other end of the network to perform an analysis.

It is usually better to save the data locally on the machine performing the analysis and run everything from there. Try copying the analysis model to your local machine and running it again.

If you want to analyze the data saved on the other end of the network, set the destination to save the data to the network drive. An analysis takes more time when sending and receiving data through a network, however, and there is also the possibility of trouble occurring in the network itself, so we do not recommend this approach.


Refer to the following website for more information on how to adjust network drive settings with Windows XP.

URL: <http://support.microsoft.com/kb/308582/en>

Technical FAQ on the WEB

We have technical FAQ on our homepage, so come take a look if you have any questions:

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

The technical FAQ is a collection of actual questions from our clients, so you might discover some new ways to use JMAG if you browse through them. We also update the FAQ on our homepage regularly, so we hope that you can use them along with the Newsletter to help streamline your analysis operations. Please do not hesitate to use JMAG technical support if you have any questions when using JMAG. Let's fully master JMAG-Designer. 

(Tetsuya Hattori)

Fully Mastering JMAG

Issue 4 Understanding Meshes from A to Z

Have you mastered JMAG?

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, as well as some useful procedures that are not well known yet. Why don't we make operations more efficient by becoming familiar with new functions and operations 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 that you can try.

Overview

Most people probably feel that, out of all the operations necessary for a finite element analysis (FEA), mesh generation takes the most time and effort. People tend to worry about mesh generation because it has a big effect on calculation time and accuracy.

JMAG has developed and implemented a variety of mesh generation functions to help reduce the burden on our users. This issue introduces functions for meshes in JMAG that can help make operations more efficient. By all means, take this opportunity to try them out for yourself.

For information about the operating procedures for each function, open Help in JMAG-Designer and look at Home > Analysis > Generating Mesh (Automatic).

Running an Analysis that Accounts for Motion

In this section, I would like to introduce two functions that can be used when an analysis target like a rotating machine or actuator has a moving part. The first of these is the Slide Mesh function, which can account for motion. When using a model that cannot apply the Slide Mesh function, however, you can use the second of these features: Remesh Model at Each Step.

Slide Mesh

This function automatically generates a mesh that can

handle motion in moving parts, and can be used to generate a regular mesh that can obtain motion in the gap (Fig. 1). Calculations with a mesh generated by this function are fast and stable because there are no regenerations during the calculation itself. You can set the level of detail in the gap mesh, which is vital from a calculation accuracy standpoint, by using the number of slide mesh divisions.

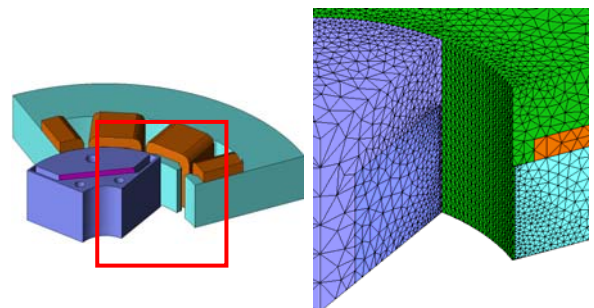


Fig. 1 A rotating machine mesh generated with the Slide Mesh function

Remesh Model at Each Step

Use this function to handle motion when Slide Mesh function cannot be used. It runs calculations while remeshing the model at each analysis step, and has a wide range of applications because there are no restrictions on the motion or model geometry that it can be used on. Be sure to select Semi Auto Mesh as the generation method when using this function, because it makes the meshes for the parts other than the

surrounding space the same for each analysis step. The Remesh Model at Each Step function has good calculation accuracy when running calculations that account for eddy currents in particular because the mesh for the conductor does not change.

Automatically Generating a Mesh Suitable for a Rotating Machine

I would like to introduce functions that automatically generate meshes for use in a rotating machine analysis. Using these functions to generate a mesh will allow you to run accurate calculations with a small number of elements. Try using both of the following functions when analyzing a rotating machine.

Rotation Periodic Mesh

Specifying the Rotation Periodic Mesh function to run an automatic mesh generation makes it possible to reduce the accidental errors that a mesh can sometimes cause. An example of cancelling the offset in cogging torque is shown below (Fig. 2). Meshes strongly affect cogging torque calculations in particular, making them difficult to perform accurately. The magnet orientation and stator geometry in the model used in this example have been modified, and the cogging torque produced has been calculated to be extremely small. The ordinary mesh generates an offset, but it disappears when the Rotation Periodic Mesh function is used. This makes it possible to calculate the cogging torque accurately.

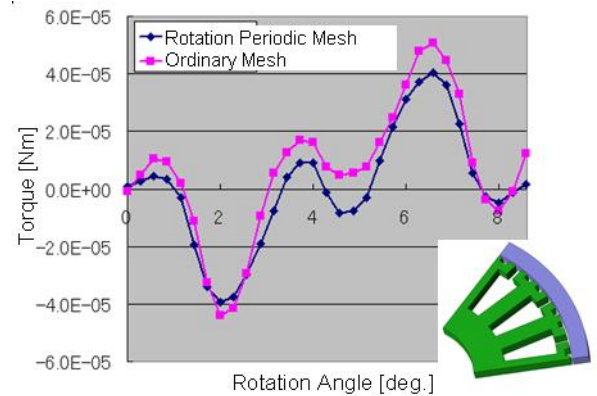
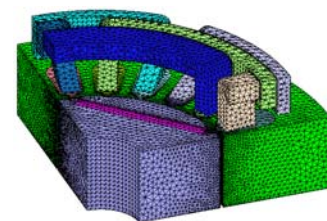


Fig. 2 A comparison of cogging torque analysis results

Extruded Mesh

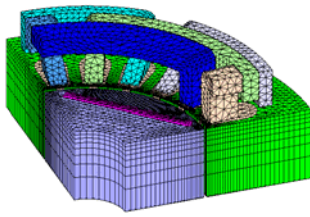
This is an automatic mesh generation function for 3D analysis. When generating a 3D mesh for a rotating machine, often times the best course of action is to have fine divisions in the in-plane direction and coarse divisions in the axial direction. The Semi Auto Mesh function used until now created fine mesh divisions in the axial direction, however, so it was often not possible to create the mesh that the user was hoping for (Fig. 3).

The Extruded Mesh function makes it possible to have coarse divisions in the axial direction for parts that have a uniform geometry. This means that you can have a low number of mesh elements without sacrificing any of the convenience that an automatic mesh provides (Fig. 4). The Extruded Mesh function produces a smaller number of elements than the Semi Auto Mesh, shortening calculation time considerably (Fig. 5).



Number of elements: 486,390

Fig. 3 A mesh generated using the Semi Auto Mesh function



Number of elements: 148,096

Fig. 4 A mesh generated using the Extruded Mesh function

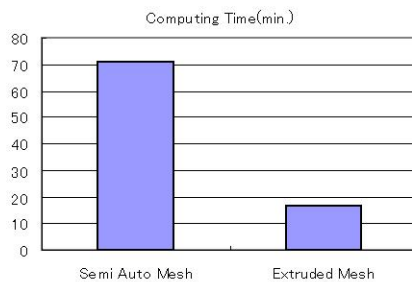
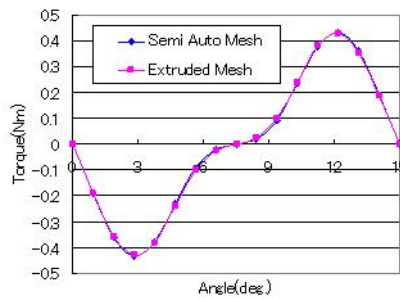


Fig. 5 A comparison of calculation time and results

Using Hexahedral Elements

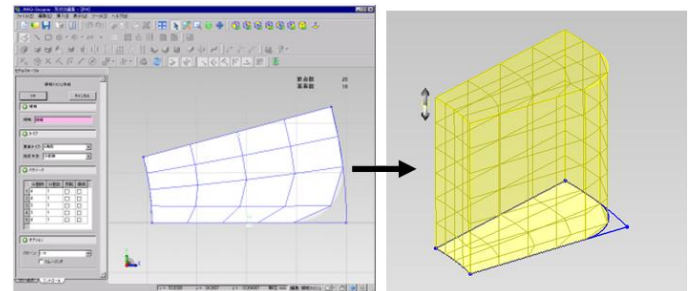
There are probably more than a few people out there who would like to run an analysis by using a hexahedral element mesh because it provides accurate calculations. However, it can be pretty tough to generate a hexahedral element mesh manually if you include the space around the analysis target.

With JMAG, it is possible to create a mesh model that uses hexahedral elements by making the mesh for the surrounding space after manually generating a mesh for the analysis target.

Generating the Analysis Target's Mesh Manually

Create a mesh by specifying its number of divisions manually with the Geometry Editor's manual mesh

function. This function makes it possible to generate a triangular or quadrilateral mesh for a 2D model, or to drag a 2D mesh model and create a 3D mesh. A hexahedral element mesh can be generated by creating a quadrilateral 2D mesh model and dragging it (Fig. 6).



Generate 2D mesh in the region

Generate 3D mesh by dragging the 2D mesh

Fig. 6 The mesh generation procedure for the manual mesh function

Generating a Mesh for the Surrounding Space

This function automatically creates a mesh to fill in the space surrounding an existing mesh without changing the existing mesh at all. Using this function will allow you to automatically generate the mesh for the surrounding space without changing a hexahedral element mesh that has already been created manually (Fig. 7). This makes it easy to generate a mesh using hexahedral elements.

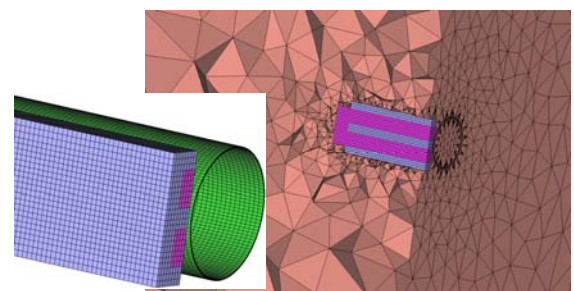


Fig. 7 Automatic generation of a mesh in a space region while maintaining hexahedral elements

Generating a Mesh That Meets Your Analysis Objective

The "optimal mesh" is different for each analysis

objective. For example, when the analysis target is a sheet of laminated steel, the analysis requires a mesh that is modeled precisely in order to show the effects of eddy currents. Or as another example, you need a mesh that can express the skin effect precisely to evaluate the losses and effects from eddy currents in a conductor. In this section, I would like to introduce mesh generation functions that are suitable for these kinds of analysis objectives.

Layered Mesh

In rotating machines, axial direction components of the magnetic flux are generated in the inside edge at the top of the stator (Fig. 8). For this reason, in the laminated steel at the top of the stator there are eddy currents that flow back in the in-plane direction, in addition to the ones that flow back in the lamination direction. When examining the effects of the eddy currents that flow inside of the laminated steel, it is necessary to model each layer in the laminated steel to account for eddy currents, instead of treating it like a single block. Using this function makes it possible to look at the effects of eddy currents in the laminated steel by automatically generating a mesh that is faithful to the real article (Fig. 9).

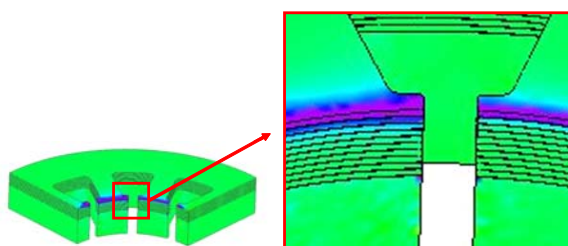


Fig. 8 Distribution of the magnetic flux density's axial direction component

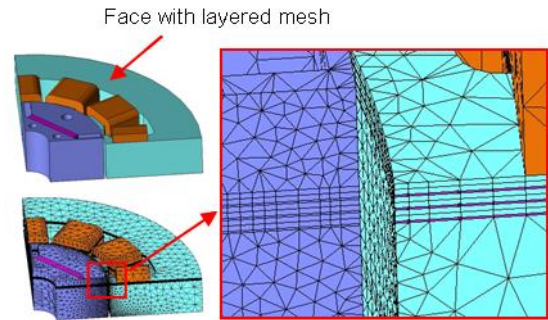


Fig. 9 Mesh generation with the Layered Mesh function

Skin Depth

Mesh divisions that can accurately express offsets in magnetic flux distribution from the skin effect are necessary to evaluate the effects from eddy currents that flow through a conductor. The Skin Depth function can be used to generate a layered mesh of a specified thickness on the surface (face) of a certain part. This makes it possible to do two things. First, you can accurately express offsets in magnetic flux distribution caused by the skin effect, and second, you can generate a mesh capable of evaluating the effects of eddy currents (Fig. 10).

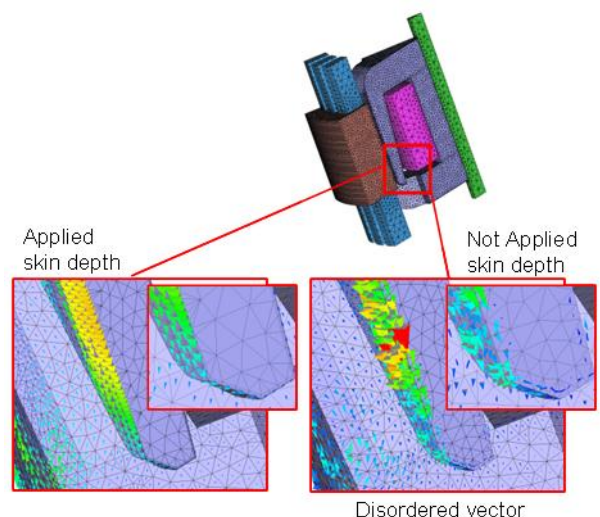


Fig. 10 Eddy current vector distribution on the surface of a claw pole

Reducing the Number of Elements and Streamlining Calculations

In order to run an accurate calculation while reducing the number of elements, it is most effective to choose a mesh generation method that is tailored to the geometry. This includes giving the mesh an appropriate density that changes where necessary and eliminating excessive detailed geometry features. In this section, I would like to introduce functions that achieve these results.

Setting the Element Size

Everyone has, at one time or another, wanted to reduce calculation time while maintaining accuracy. This requires giving the mesh an appropriate density and achieving a balance between accuracy and the time required for the calculation. JMAG has prepared an enhanced function that sets the element size to control mesh density. It can carry out the settings for edges and vertices as well, making it possible to carry out detailed density controls (Fig. 11).

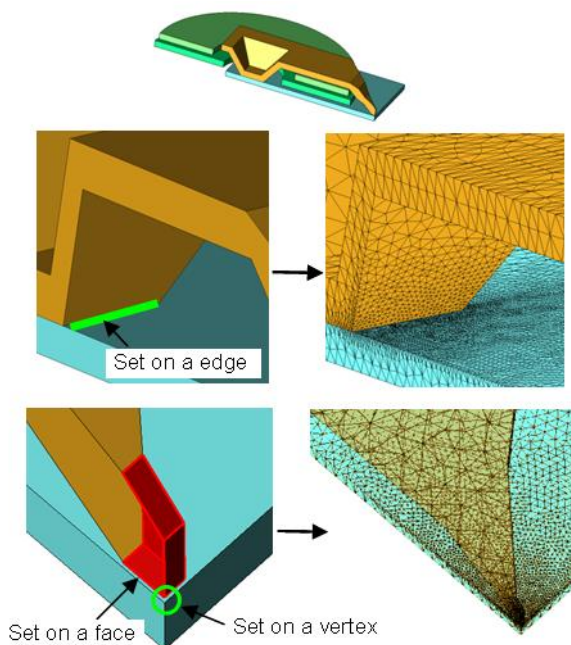


Fig. 11 Mesh density control via specified element sizes

Defeaturing

You can restrain the number of elements by eliminating excessive detailed geometry features. However, returning to a CAD software and carrying out geometry changes takes too much time and effort. To fix this problem, JMAG has a function that allows you to use its intuitive settings to eliminate detailed geometry features such as holes, fillets, and chamfers during mesh generation. Using this function to generate a mesh makes it possible to omit detailed geometry and reduce the number of mesh elements (Fig. 12).

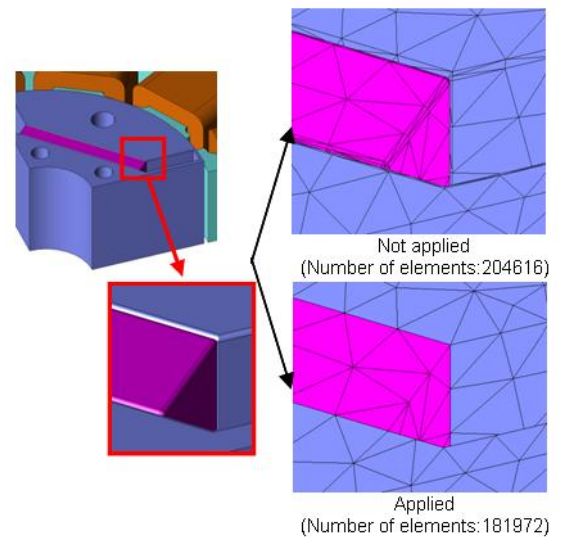


Fig. 12 Controlling corner R with the Defeaturing function

Thin Shell Mesh

When creating a mesh for a model whose geometry includes a thin sheet, you can use the Thin Shell Mesh function (under Generating Mesh (Automatic)) to prevent the number of elements from growing too large. This function creates the thin sheet with a shell that has no thickness. By performing the Thin Shell Mesh settings for the shell and running an automatic mesh generation, you can create a part with the specified thickness in the mesh (Fig. 13). This ensures that the mesh will have a smaller number of elements.

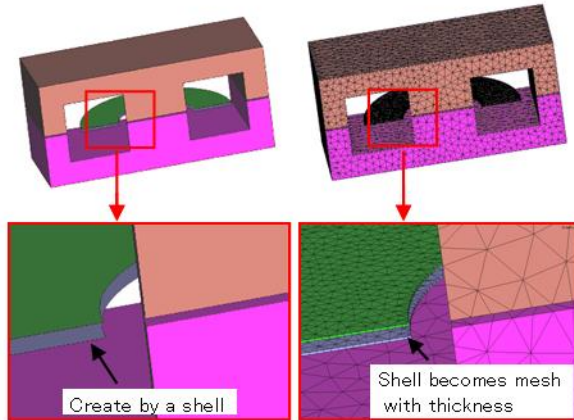


Fig. 13 Creating a sheet coil
with the Thin Shell Mesh function

Generating a Mesh Suitable for Geometry Optimization Studies

When most people hear "geometry optimization study," they probably imagine having to repeatedly change model geometry, generate meshes, and run calculations. However, if you use the automatic mesh generation function to remesh when changing geometry, the number of element divisions in the adjusted parts changes as well, greatly transforming the mesh's local division pattern. There are times when errors from the difference in mesh divisions get included in the evaluation values, making it impossible to perform an adequate evaluation.

In this section I would like to introduce the Morphing function, which can change the shape of an existing mesh.

Morphing

The Morphing function is effective when you want to evaluate the effects of a small change in geometry. It changes the model geometry by moving only the nodes of the existing mesh, so that the pattern of the geometry and number divisions in the mesh do not change. Morphing does not include the errors caused by differences in mesh divisions, so you can accurately evaluate the effects of geometry changes.

In this article there is an example of geometry that has been altered by using the Morphing function (Fig. 14). This example displays changes in the width of a tooth tip. The displacement specified in the Morphing function settings becomes a variable in the parametric analysis, making it possible to evaluate the effects of geometry changes.

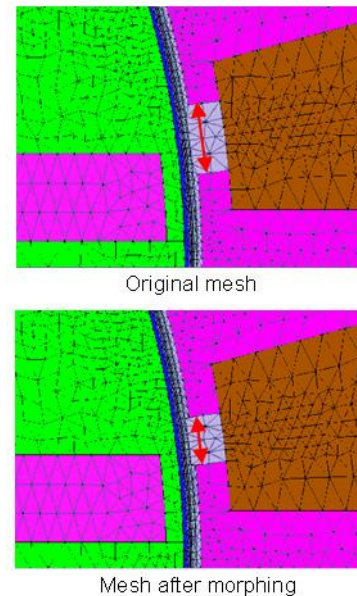


Fig. 14 A change in geometry using the Morphing function

In Closing

In this issue, I took the opportunity to introduce JMAG's various meshing functions. Were there some functions that you will be able to use in your own work operations? By all means, take this opportunity to use them and get the maximum benefit from their application.

Next time I plan to introduce an A to Z for materials, conditions, and circuits. Be sure not to miss it.

(Noriyo Mimura)

Event Information

Exhibitions and Events for May and June, 2012

JMAG is holding exhibitions both in Japan and overseas. Come take a look at JMAG's activity at an event near you.

I would like to take this opportunity to introduce events and exhibitions for May and June, 2012.

SMMA2012 Spring (Management Conference) Conference Outline

Host : SMMA - The Motor & Motion Association
 Dates : May 1 - 3, 2012
 Location : Florida (America)
 URL : <http://www.smma.org/>

SMMA is an association that is active in the motor industry, so many suppliers specializing in manufacturing technology attended this conference. JMAG attended the spring conference, and will have an exhibit at the fall conferences as well. We will take this opportunity to continue exchanging information with motor designers.

IEEE International Magnetics Conference 2012 (InterMag) Conference Outline

Host : IEEE
 Dates : May 7 - 11, 2012
 Location: Vancouver (Canada)
 URL: <http://intermagconference.com/2012/>

Intermag is an international conference on applied magnetics and information storage technologies. In recent years they have seen a rise in motor-related sessions, in particular. At the JMAG booth we held demonstrations of JMAG-SuperExpress, which is approaching release.

5th Conference Simulation and Testing for Automotive Electronics Conference Outline

Host : IAV Automotive Engineering
 Dates: May 10 - 11, 2012
 Location: Berlin (Germany)
 URL : <http://www.iav.com/en/events/iav-tagung/5th-conference-simulation-and-testing-automotive-electronics>

This is the first year that we held an exhibit at an IAV-held conference that specializes in vehicles. We introduced the latest version of JMAG, as well as JMAG-RT case examples. We hope that those who were able to attend had a chance to stop by the JMAG booth.

2012 SIMULIA Customer Conference

Conference Outline

Host : SIMULIA

Dates: May 14 - 17, 2012

Location : Rhode Island (America)

URL : <http://www.3ds.com/products/simulia/overview/>

JMAG-Designer Ver. 11.1 has enhanced abilities to link with Abaqus (SIMULIA), a structural analysis software. We introduced examples of its linked analysis functions, which are easier to use than ever. Many thanks to everyone who came and saw the intuitive operations.

MathWorks Automotive Conference2012

Conference Outline

Host : MathWorks Japan

Date: June 21, 2012

Venue: Tokyo Conference Center - Shinagawa

We will be presenting JMAG-RT.

JMAG-RT can model motor characteristics designed by motor designers without changing anything about them. It can also import them into MATLAB/Simulink (Mathworks). Come see the JMAG-RT technology, which can share models between system designs and plant designs.

CWIEME Berlin2012


Conference Outline

Host : CWIEME LTD

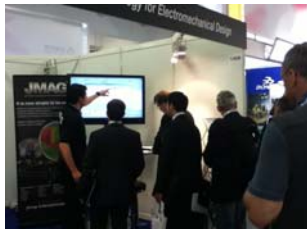
Dates : June 26 - 28, 2012

Location : Berlin (Germany)

URL : http://www.coilwindingexpo.com/BERLIN/berlin_home.htm

CWIEME Berlin 2012 is a large-scale conference that people come to attend from all parts of Europe. As expected of a conference of this scale, there are always a lot of large transformer and wind generated power exhibits. At the JMAG booth, we will be doing demonstrations of motor and transformer design case examples. 

(Tomomi Igarashi)



The 2011 conference

Event Information

Event Report - 1

We held the opening ceremony for POWERSYS Inc.'s new office in Madison on March 22. The following is a report on how it went.

Opening Ceremony for the American Office


Conference Outline

Host : POWERSYS Inc, JSOL Corporation

Dates : March 22, 2012

Location : Madison (America)

Powersys Inc., JMAG's North American distributor, moved their office from Florida to Wisconsin. From now on they will carry out their North American sales and support services for JMAG from their head office in Madison.

50 people who have given us a great deal of support attended the ceremony, and all of our staff members felt the weight of the expectations and responsibility that we bear toward our users. Please take the chance to stop by if you are ever in the Madison area. 

(Toshie Furubayashi)



David Cottini of the Powersys sales department was the chairman.



Greetings from JSOL's Mr. Yamada. One of the few times that he has been nervous.



Congratulatory words from Wisconsin University's Prof. Lorenz (left) and Prof. Jahns (right).



The ceremony was held in two stages, the reception and the banquet.



Prof. Lipo (left) also congratulated us at the banquet.

Mr. Suzuki of JSOL (right) has been working in America for two years. He is doing technical support.



The poster is covered with messages from those who attended the ceremony. It has been given a place of honor in the entrance of the Madison office.

Middle: Powersys CEO Olivier Toury
Right: Powersys CTO Vincent Capron



A picture of the Powersys and JSOL staff with members of JMAG technical support.

We would like to thank all those who attended.

POWERSYS Inc.

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Email: jmagsales@powersys-solutions.com

Tel: +1 608 203 8808 /Fax: +1 608 203 8811

Event Information

Event Report - 2

POWERSYS, JMAG's North American distributor, held a hands-on training seminar on March 21 and 22. The following is a reflection of the seminar itself and my experience as a participant.

JMAG Training Seminar (North America)

Conference Outline


Host : POWERSYS Inc, JSOL Corporation
 Dates : March 21 - 22, 2012
 Location : Marriott Hotel Madison West (America)
 Attendees: 35



We held the first training seminar in North America. Regardless of the fact that it was the first time, we had 35 attendees from companies, universities, and JMAG partners.

The seminar started with an introduction of JMAG's latest version, JMAG-Designer Ver. 11, and those attending got a chance to experience a sequence of operating procedures, including geometry creation, condition settings, analysis execution, and results evaluation. JMAG partners contributed, as well. LMS International presented evaluation methods and functions for noise and vibration; National Instruments gave the latest information about HILS (Hardware in the Loop Simulation) using JMAG-RT, and demonstrated linking functions with JMAG.

In the JMAG introduction they explained the concepts behind JMAG-VTB and JMAG-SuperExpress, and were able to give those who attended a better understanding by showing the actual JMAG operations in a demonstration. When presenting a series of operations from geometry creation to result confirmation, they went deeper than just giving a superficial explanation and took the chance to explain what the warnings mean and what to do when an error occurs. When the seminar ended I felt that I was immediately better able to work with my own model. They also introduced the various linking functions from the standpoint of both JMAG and its partners, allowing everyone to get an even deeper understanding of them. Those attending had a lot of questions and quite a few of them stayed after the seminar ended to continue working. I felt that this seminar was a good chance for some of the attendees who were new to analysis to start electromagnetic field simulation, and to let each participant review how much he knew.

Some of the other attendees said that learning how to use scripts that couple with Excel made them want to apply it to their own analysis systems. This gave us a good start for holding a wide variety of seminars in North America in the future. 

(Yusaku Suzuki)

Day 1 Agenda	Day 2 Agenda
How to create and import geometry	Examine the results
CAD	Demonstrate JMAG tools
JMAG-Express template	Inductance
Geometry Editor	JMAG-RT
Setting the model conditions	Iron loss tool
Setting the material conditions	Motor design topics
Mesh creation	Advanced feature discussion
Solver conditions	Thermal and Structural modeling
	Co-simulation with different CAE tools

