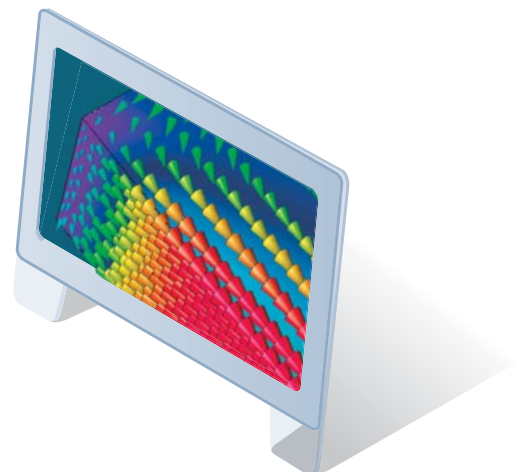


JMAG Newsletter

September, 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.



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Neturen Co. Ltd.

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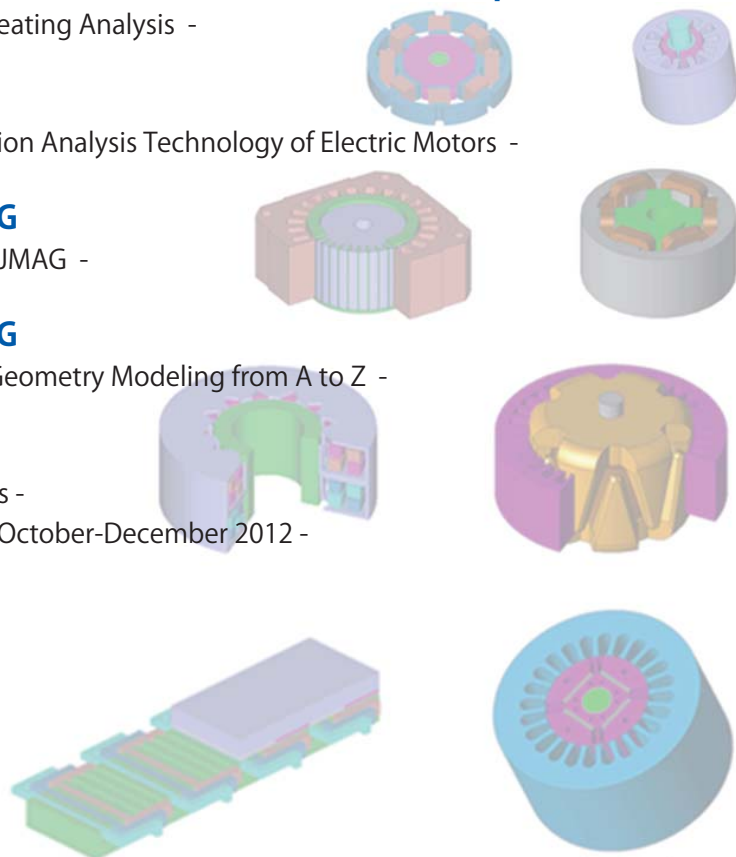
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JMAG Newsletter: Highlights of the September Issue

This FEA commentary is aimed at those designing or using induction heating apparatuses, we let you know the effects of utilizing simulations. Originally, inductance heating apparatus design was based on instinct or experience, but by using JMAG's induction heating analysis in initial studies, it is possible to reduce the number of times of creating prototypes and result in cost reduction. Also, it is possible to carry out a thorough investigation for the principles and phenomena such as whether there is room for improvements. By all means, please take a look.

In the paper introductions, we focus on introducing electromagnetic noise vibration analysis technology. Recently in the design of electrical equipment, reducing size and weight, increasing efficiency and reducing cost are required, so noise vibration reduction is also essential. It is necessary from the design stage to realize electrical design that makes vibration less likely and structural design that does not allow vibration to amplify. In this issue, through useful papers, we will introduce the difficulties of noise vibration simulation for electrical equipments and also how to address them. We think there are also other valuable papers. If you have any papers you would recommend, by all means please introduce them.

JMAG NewsLetter is intended for everybody, from those who are currently using JMAG to those who have not started yet and those who have started using it.

By all means, take this chance to introduce it to someone nearby.

We present you a content-rich issue as usual. Please enjoy to your heart's content.

JSOL Corporation
Electromagnetic Engineering Department, Engineering Technology Division

Implementing JMAG

Neturen Co. Ltd.

Pioneering Induction Heating Technology in Japan Using JMAG to Achieve Higher Accuracy and Quality in Induction Hardening

Neturen Co. Ltd. is the top domestic manufacturer when it comes to using induction heating (IH) technology to perform induction hardening on metal components. They have cutting-edge knowledge of the industry that can only be attained from continually developing new techniques and products based on IH technology. They apply JSOL Corporation's electromagnetic field analysis software JMAG to their development process. JMAG is making big contributions to shortening trial production time, improving thermal processing quality, and developing new IH technology in their induction hardening.

Induction Hardening for Steel Surfaces Using High Electromagnetic Frequency Fields

—Your company name literally means “high-frequency forge,” so I was wondering if you could explain what it means and introduce the business that you perform.

Mr. Horino We are pioneers that have succeeded in being the first to industrialize and commercialize induction heating (IH) technology in Japan. IH uses electricity, an environmentally friendly energy source, and is what we call a “W-Eco” technology because it is both ecological and economical.

Induction hardening is a surface hardening method that uses (high-frequency) electromagnetic induction phenomena as heat treatment for metal components in order to make them stronger and tougher. It is like the hardening and tempering used with a samurai sword: First a work piece is heated up to a temperature of around 1,000 deg C and alpha iron undergoes a phase transition to gamma

Takashi Horino
Manager
CAE Development Section
Technical Department
Technical Headquarters
NETUREN CO., LTD



iron, also called austenite. After that, very hard martensite is formed by rapidly cooling the austenite with water-cooling.

Induction hardening uses a heating coil. Running a high-frequency current through the heating coil causes AC magnetic flux to concentrate in the surface of the work piece. When this happens, the electromagnetic induction mechanisms induce eddy currents, which in turn heat the work piece. This is the same principle behind household IH cooking heaters. By selecting the frequency, power, heating time, retention time, and coil geometry according to the work piece's shape and material, we can give each work piece the heat treatment quality that it requires.

We manufacture and sell several things: heat treatment for steel wire products like prestressed concrete bars for civil engineering and construction, vehicular spring wires, as well as Induction heating

systems for automobiles and construction machine parts.

—When did Neturen start taking efforts to use simulation?

Mr. Horino We started making a serious effort to utilize commercial software in around 1990. The heat treatment process requires real craftsmanship, so it's a world of people with long years of experience and a sense for what they're doing. The techniques were also extremely dependent on a person's individual skills, and technical tradition used to be a big issue. When we utilized simulation technology we evaluated the heating time, frequency, and cooling time for optimal heat treatment quality, and were also able to verify new technology. The benefits of using simulation at our site are huge, even if it only gives us a general direction for our heat treatment.

Incredible User-Friendliness and Ample Support Collaborative Study Results

—Why did you adopt JMAG?

Mr. Horino We implemented JMAG in 2007. We felt that the software that we had been using until then wasn't as good from the standpoint of its functions. For example, in a heating coil the current tends to generate more in areas closer to the work piece instead of flowing evenly through its entire cross-section. This needs to be simulated correctly in order to obtain a correct temperature distribution, but the software that we used to use could not account for it. JMAG couples the simulation with an electric circuit and is able to calculate the current distribution in a cross-section automatically, even for parts like heating coils that have complex geometry. This makes it possible to perform a more correct and detailed analysis, which contributes greatly to shortening the lead time of development

and design. JMAG's customer support is also faster and more satisfactory than with other software, so we have been able to plan collaborative studies and get specific help from them.

—“Computer Analysis of Dual Frequency Induction Hardening,” which you used JMAG for, was one of those collaborative studies, wasn't it?

Mr. Horino Yes, that's right. At the 2007 JMAG Users Conference we gave a presentation titled, “Computer Analysis of Dual Frequency Induction Heating.”

When the specifications of a work piece's configuration or heat treatment quality change, the suitable frequency changes as well. In the past, we needed to prepare high-frequency power supply facilities for each necessary frequency. However, using dual frequency heating technology lets you output frequencies of your choosing from a single high frequency power supply, making it possible to perform hardening at the optimum frequencies (Figures 1 and 2). At our company we have prepared two kinds of systems: The hot switching system and the overlap system. We can analyze these in JMAG, enabling us to obtain the optimum power balance and heating time.

—Can you think of any specific case examples?

Mr. Horino Let's take a case where we perform induction hardening along the surface of the teeth of a spur gear. At a low frequency only the base of the tooth (the concave part) is heated, and at a high frequency only the tooth tip (the end of the convex part) is heated. By using low and high frequencies at the same time however, it becomes possible to perform uniform hardening along the teeth geometry (Fig. 2).

—Looking at it from another standpoint, you could say that JMAG simulations give you important ideas

about coil design and power settings.

Mr. Horino Yes, you could. Until now we had been figuring things out with our sense and years of experience, but using JMAG to obtain an optimum heating coil shape and heat treatment conditions has let me get highly accurate guidelines. We have some case examples where the development time has been cut in half.

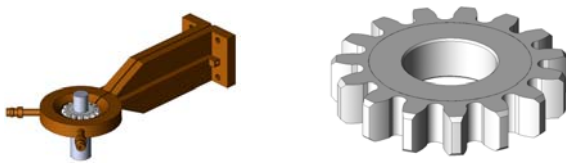


Fig. 1 A gear and heating coil

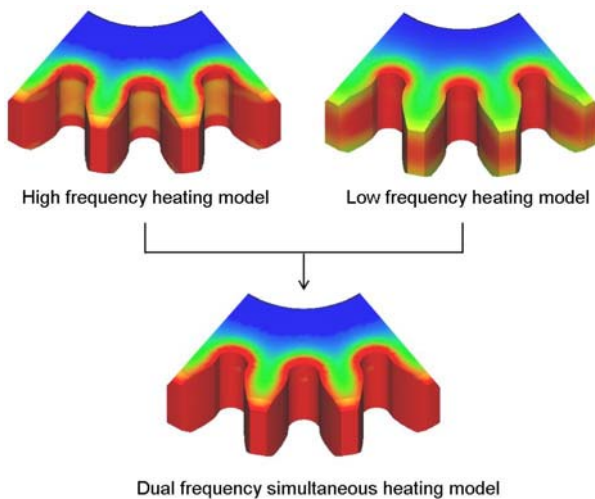


Fig. 2 The gear's temperature distribution after heating

Moving to the Realm of Even More Accurate Simulation With “Induction Heating Treatment Analysis

—There is a greater tendency toward thinner, lighter, and more complicated components while maintaining strength for equipment like automobiles. Has JMAG been able to meet these demands?

Mr. Horino Our expectations for JMAG get higher every year. Or, you could also say that our expectations for “induction heating treatment simulation” are getting higher.

Being more specific about it, there are four main

factors for wanting to apply simulation technology to perform studies. They are facility design, heating coil geometry, heat treatment conditions, and heat treatment quality. Of course we can analyze these separately, but at our company we have established a method where we couple heat treatment software with JMAG and simulate the entire induction hardening process. This lets us run highly accurate simulations (Fig. 3). We use a magnetic field analysis as the base, and link a thermal analysis, metallography analysis, and a stress/strain analysis with each other.

Looking at the transient results, we can discover solutions to problems like why the work piece deforms during heat treatment and why residual stress occurs. This is why we are able to apply it as a tool that can preserve low levels of deformation and optimum heat treatment quality, even considering thinner, lighter, and more complex vehicle components.

—Specifically, what kinds of cases is it being applied to?

Mr. Horino With JMAG, we can predict the heating range and temperature of a helical gear. When we coupled a structural analysis in JMAG, we were able to confirm that the twist angle of the teeth changes while the tips of the teeth spread up and down. We also performed simulations on the cooling process in addition to the heating process. These simulations made it possible to predict the hardening range, amount of distortion, and residual stress. This means that we can see the transitions in the work piece's conditions by looking at heat treatment as a single general phenomenon.

Putting it simply, we can predict in advance the elements and conditions to achieve the heat processing quality and functionality that we are aiming for. This allows us to eliminate unexpected occurrences that happen during heat treatment,

and it also gives us clues for developing high-quality components (Figures 4 and 5).

—In other words, it becomes a realistic and flexible countermeasure for when the component shape becomes complicated.

Mr. Horino That's right. Even with simulation software, if the work piece rotates and moves then we can perform precise calculations even when handling a complex geometry. If we can predict the heat treatment conditions of components that are complex, then the use of simulation will progress even further.

—Of course that ties in with your expectations of JMAG's functions.

Mr. Horino I want JMAG to enhance its three dimensional calculation features even more. When I want to handle more complex geometry, the model scale gets really big. I want shorter analysis time and faster operation for large analytical results.

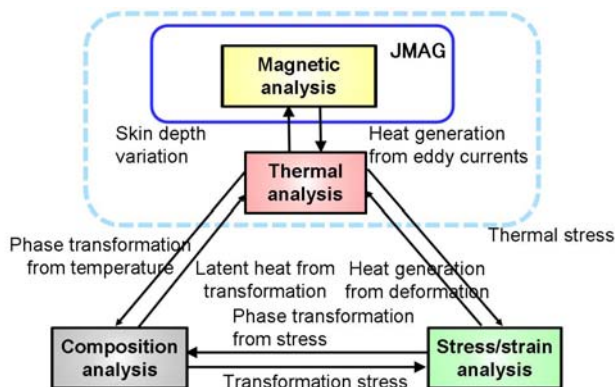


Fig. 3 "Induction Heating Treatment Analysis System"

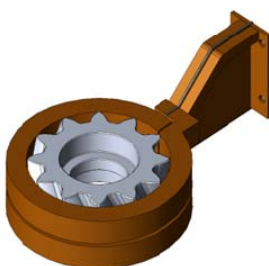


Fig. 4 A helical gear and heating coil

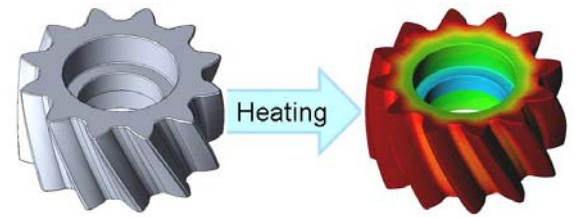


Fig. 5 Temperature distribution and deformation

JMAG's Applications in Production Sites are Limitless, and It Contributes Even More to Efficiency

—Tell us what you think about how JMAG will be applied in the future.

Mr. Horino In the CAE development section of the development department that I am responsible for, I respond to requests from all of the divisions in the company, and I am putting effort into research and development that will be passed on to the next generation.


CAE is also playing a bigger role in the company, so in 2012 we started training activity using JMAG for those working in on-site departments. In the future we will use JMAG near production sites, and make it a tool that improves heat treatment quality and development of new technology. In addition, we are thinking of a system that takes efforts toward more advanced research challenges.

—We at JMAG would be happy if we could contribute to raising the level of Neturen's technology.

Mr. Horino Induction hardening basically produces one work piece at a time, and it has the benefit of being able to handle large scale components. This is why JMAG will exhibit great ability in the field as a prediction tool.

CAE is also involved in part of the design and trial production process, so we have many benefits. For example, we can foresee problems in the production process, and verify new technologies as well. As a result, it allows high-satisfaction

responses to customer requests.

I would like to use these activities to appeal to the world that IH is a “W-Eco” technology that is kind to the global environment. 



Corporate name: NETUREN CO., LTD

Paid-in capital: ¥6,418 million

Number of employees: 1167 (consolidated)

Company listing: Tokyo Stock Exchange, first section

President: Tetsukazu Fukuhara

Business Overview

Neturen Co. Ltd. is a pioneer company in the industrialization of electromagnetic induction heating (hardening) in Japan. In 1946 they separated from Nippon Koshuha Heavy Industry and started to produce induction hardening equipment as well as provide surface heat treatment services of machine parts. At present, they have three divisions centered on induction heating technology. In the product division they manufacture and sell PC bars and materials like high strength shear reinforcing lines for construction, and high strength steel wires for coil springs. In the IH division, they manufacture and sell induction heating equipment in addition to doing commissioned processing of heat treatment.

<http://www.k-neturen.co.jp/eng/index.html>

The Goal of Induction Heating Analysis

The purpose of this session is to show the merit of using simulation for the design of induction heating apparatus. Please consider the merits of analysis when you try to improve your heating method.

Introduction

Induction heating is a kind of the electromagnetic induction phenomenon. When applying alternating magnetic field in a heating coil, eddy currents are produced in the surface of conductors. Its joule loss becomes the source of heat and the surface temperature rises. Induction heating apparatus span many fields, such as the induction hardening apparatus which improves the metallographic structure of the surface, the induction furnace which melts metal and is a meter in length. On the other side, there are medium-sized ones that warm up various liquids and solvents (Fig.1). The induction heating method has many merits, including local heating, rapid heating, high efficiency and direct heating by comparison with the combustion method.

It is difficult to get an optimized coil shape for various and complicated work pieces in a short time. Even though the geometry of a heating coil is defined, it is necessary to estimate the electrical power and frequencies for suitable depth of heating region from the surface. Spending a long time for heating, it results in heat conducting to the surrounding area and precise control of the heating process is not easy. In order to control increase in temperature while maintaining the objective heating range and depth, it is required to create many prototypes which change heating coils and power sources, or the intuition of experts would be another option.

The introduction of simulation causes a big

change for the design of heating coils. Not only attempting the more suitable geometry and electrical power of the heating coil and power control and performing a reproductive experiment but also analyzing the process to such result of heating conditions, it allows you to obtain further improvements theoretically. Then you can get better design logically. We will show the simulation effects indicating the example of linear motor's bearing.

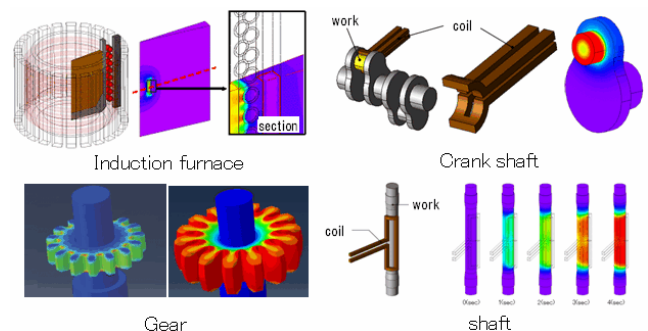


Fig.1 Various applications

The goal of induction heating analysis

About analytical model

This model is the long square rod of carbon steel which has concaves on both sides. We try to treat induction hardening of the surface of the concaves. The concaves are bearing parts. To prevent it from becoming worn, we treat the surface treatment of concaves and increase hardness. If the depth of high temperature is large, the toughness of rod is lost. So, the target depth range to heat is a few millimeters from the surface. The observed points

set three positions, the first one is the bottom of the concaves, the second is on the edge and the last one is the exterior surface (Fig.2). The alternating current was applied in heating coil, whose amplitude is 2000A, frequency is 30 kHz.

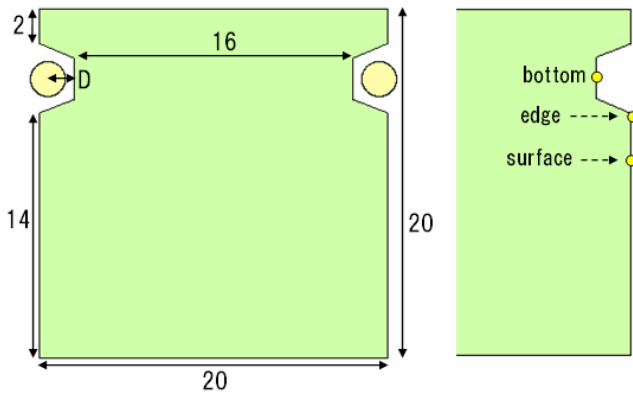


Fig.2 Analytical model and observed points

Whether heating condition is satisfied?

Just preparing the geometry, setting the material, and setting the current or voltage on the heating coil makes it possible to create an analytical model. After completing an analysis, we can know the final temperature distribution and the heating time easily. If the heating time is long to some extent, we can control the current amplitude or the frequency. This model, which set the heating coil at 1.5mm away from the bottom, confirmed that the temperature of the bottom reach and over Curie points (about 700 deg C) after about 10 seconds (Fig.3).

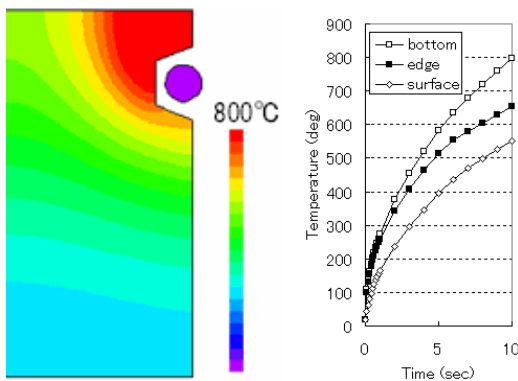


Fig.3 Temperature distribution after elapsing 10 seconds
(left) Temperature transition (right)

Changing the position of Coil

If the position of heating coil is changed, the magnetic circuit is changed and the heating position and efficiency is changed. In this model, the coil position of 1.5mm has enough heating, but the position of 7mm is in lack of a heat source and temperature does not increase enough (Fig.4).

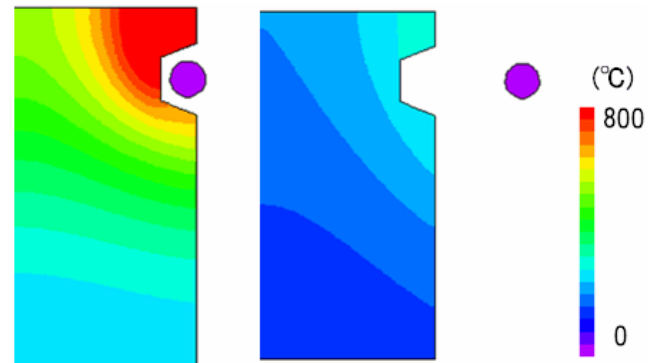


Fig.4 Temperature distribution after elapsing 10 seconds

(left : D=1.5mm, right : D=7mm)

Where do eddy currents flow?

Running an analysis makes it possible to indicate the locations where eddy currents flow in work pieces and the eddy current distribution offsets in the inner part of the heating coil as well. To raise the temperature of the surface, the eddy current must be generated in the target area. The distribution of eddy currents can investigate the validity of the position and shape of the heating coil and examine the next design. If D is 1.5mm, the large eddy currents are produced on the surface of the concaves (Fig.5 left). In order to heat only the surface of the concaves, it is better to place the heating coil closer so the amount of heat concentrated. On the other hand, when D is 7mm, the temperature rises on the outside surface as well (Fig.5 right). If we want to heat both inside of concaves and the outside, moving the heating coil further away is better. However, when setting it apart from the bottom, the heat generation amount

is reduced. To make the surface treatment shallower, rapid heating is necessary and much more power source is required.

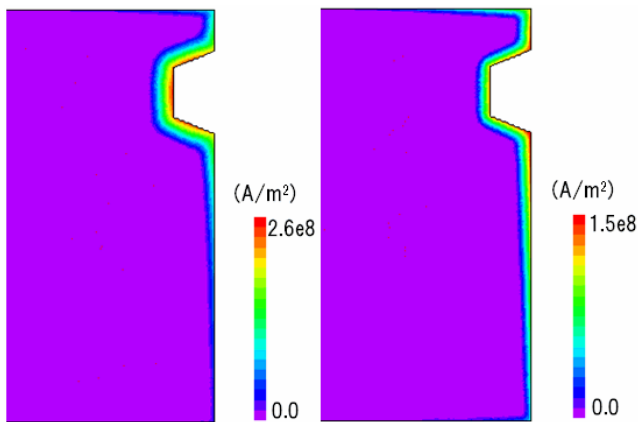


Fig.5 Current density distribution at room temperature
(left : D=1.5mm, right : D=7mm)

Checking the magnetic circuits

JMAG can indicate magnetic flux lines in 2D analysis and magnetic vector in 2D and 3D analyses. The eddy current flows to shield magnetic flux. Confirming the magnetic circuits is important to understand the induction heating process and the improvement of design. Please check where magnetic flux flows in test pieces. If D is 1.5mm, the magnetic flux flows from the heating coils to the surface of the concaves (Fig.6 left). This has the effect of concentrating the heat source on the bottom of the concaves. If D is 7mm, the magnetic flux flows from the heating coils to the outside surface (Fig.6 right). The eddy currents flow spreads widely and also enters from the bottom of the concaves and the exterior surface. The temperatures of the bottom rise simultaneously. If D is 7mm, the power is too little. The results of the case, whose amplitude of current is set at 3500A, are shown in figures 7 and 8. After heating for 10 seconds if we look at the temperature distribution shows, we can confirm that comparing with the position of D 1.5mm, the temperature rises both at

the bottom and the outside (Fig.7). The temperature of the position of D 1.5mm rises rapidly on the bottom and the difference between the bottom and the surface is bigger, on the other hand, in the case the temperature of the position of D 7mm the difference between the surface of the concaves and the surface is smaller (Fig.8).

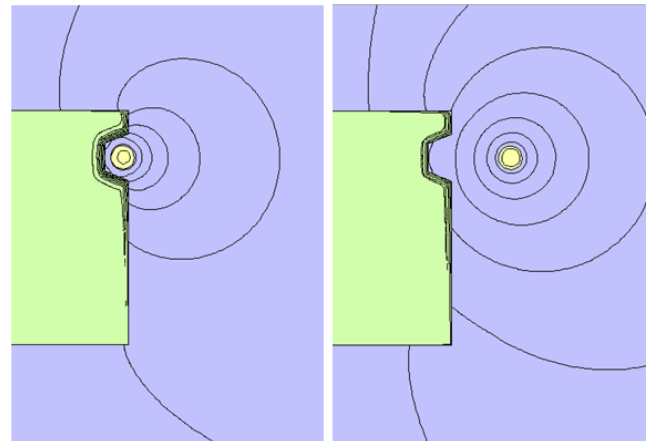
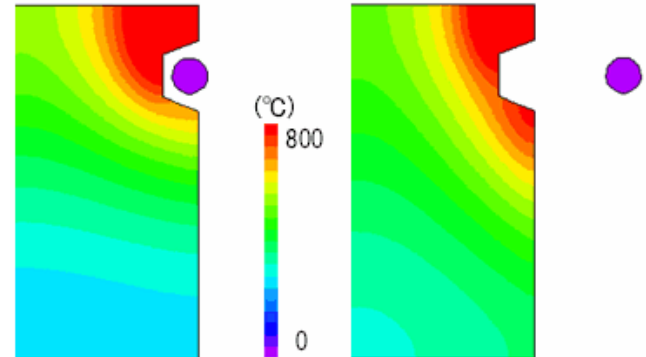
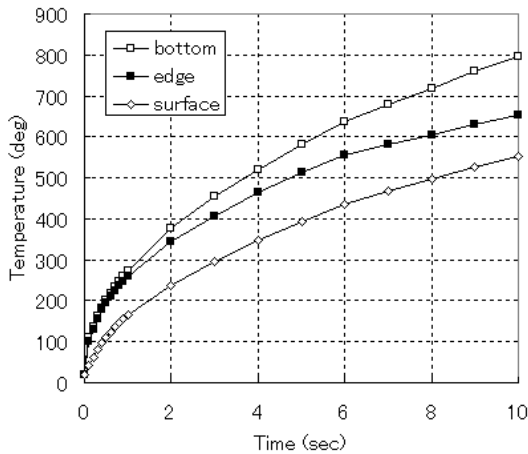


Fig.6 Magnetic flux (left : D=1.5mm, right : D=7mm)

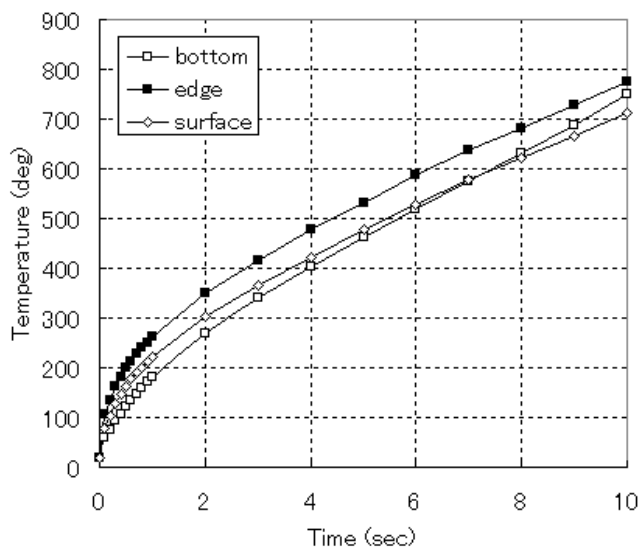


(a) D=1.5mm, current 2000A (b) D=7mm, current 3500A

Fig.7 Temperature distribution after elapsing 10 seconds



(a) D=1.5mm, current 2000A



(b) D=7mm, current 3500A

Fig.8 Temperature transition of observed points

Conclusion

The introduction of simulation can estimate the validity of design and can test a new idea easily. The distribution of each physical value inside work pieces shows new knowledge about the reason why this heating coil is better, then we can discuss logically about if there are more suitable designs. This text shows two dimensional section models, but JMAG supports complicated three dimensional models, off course. Please consider about induction heating analysis for your design.

(Hiroshi Hashimoto)

Paper Introduction

Issue 2 Noise and Vibration Analysis Technology of Electric Motors

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 eleven pieces (refer to [1] through [11] in Reference) of literature that discuss Noise and Vibration analysis technology for electric motors.

In addition, you can search from the Web page of the paper introduced in this corner so please have a look.
(http://www.jmag-international.com/cgi-bin/list_search.cgi)

Background

Recently, devices in the world have been switching to electrical operation in order to achieve make improvements in efficiency and functionality. It is normal to see hybrid automobiles and electric vehicles driving around our cities, inside the cars there is also in abundance of electrical appliances and because of this, we understand that our comfortable lives have been attained through motors and solenoids. Because automobiles and home appliances are used close to us, it is easy for us to notice their noise vibration and in order to raise the added value of products, it is necessary to reduce noise vibration.

On the other hand, there is also strong demand for electrical equipment to be reduced in size and weight, improved in efficiency and reduced in cost. Other factors arising from continued reductions in size and weight include reduced device performance, and the difficulty of vibration control, which has the effect of making noise vibration occur more easily.

In order to combine these contradictions, we need to realize from the design stage electrical design that makes vibration less likely to occur and structural design that does not amplify vibration, so simulation tools exert huge power in considering this tradeoff.

The Difficulty of Noise Vibration Simulation

Noise vibration simulation evaluates electromagnetic phenomena with electromagnetic field analysis, and the electromagnetic force obtained there is used to validate vibration phenomena through structural analysis. Compared with electromagnetic field analysis, structural analysis has a longer history and is used in various fields but actually in the validation of electrical equipment, it is possible to say that in compared with electromagnetic field analysis, structural analysis is more difficult in terms of the analysis.

The reason for this is that because electrical equipment is made up several combinations of parts, including laminated core, coils and frames, the contact points cannot be modeled at a small scale. A good example of this is the laminated core. One silicon steel sheet is a 0.35 t or 0.5 t steel plate, but the laminated core punches through this. Just piling it up causes it to move out of alignment so caulking or welding is used to adhere it in place, but vibrational characteristics vary according to how much caulking is used on which parts of the laminated core. Having said that, it is actually impossible to model each single silicon steel sheet if over one hundred have been laminated together so we must use some method to homogenize them.

As we can see in the homogenization method, if the analysis target is changed to an equivalent method, the

existing theory alone makes the information insufficient, and there are cases in which it is difficult to model. In such cases, what can be used as a solution is adjusting the analysis model's material properties and constraint method based on the experiment results, and bringing the vibrational characteristics (natural frequencies, mode shapes) closer to the actual measurement. The big drawbacks with this method that can be raised are that because the actual measurement's vibration data is the base point, you cannot run a simulation unless you have the actual measurement results and that if you change the structure a great deal, you will need to take actual measurements again. However, if you accumulate experiments, because you will be able to confirm the relationship between structure and behavior, there are many cases in which this method is used.

One method we can think of to improve the situation by which you cannot run a simulation without experiment results is to gather results from each institute where testing took place and use them for a paper. By checking papers, it is possible to obtain all kinds of information. The papers we introduce this time are one we checked when running the noise vibration simulation. I hope they will also be of use to those of you when you run noise vibration simulations.

Approaches to These Problems

The papers we will introduce can be divided into four broad themes. Allow us to introduce a paper for each of the themes.

- Modeling laminated core frequently used in electrical equipment
- Handling coils unique to electrical equipment
- The combined relationship of the laminated core and the frame that supports it
- Themes that are not included in the three mentioned already, including ways of thinking about the structure mode of the electromagnetic

force mode.

Laminated Steel Core Modeling



Fig. 1 Laminated core (stator)

When dealing with structural analysis of electric motors, the first thing we worry about is modeling the laminated core. We cannot carry out the impossible task of modeling every single structure of the single laminated core, so generally the method to use would be to impart anisotropy in the in-plane direction and direction of the lamination in order to model it. Compared to the entries in the in-plane direction in the laminated core ideally whether or not there are laminations should not have any affect so we can use the Young's modulus as it is in the catalog but as noted already, we need to pay attention to the lamination direction.

With regard to handling the lamination direction, we would think that the compression direction could be as it is in the catalog, but it is actually hard to say that each silicon steel sheet is attached because at the time of punching there was distortion. It is easy for us to get the image that the pulling direction can be connected by caulking and welding, consider that the compression direction has also been connected by caulking and welding, and there are many cases when it is modeled as linear material. In whichever case, there are many reports of the Young's modulus being much lower than the catalog value.

In 1, we prepared a number of samples that were shrinkage fitted with the cylindrical laminated core as the axis and ran a real eigenmode analysis and from the theoretical equations we extracted a Young's modulus equivalent to the experiment value. Because the sample's outer radius was 100 mm but it had the long axis length of 1 m, the equivalent Young's modulus was reported as 7.34 GPa. The properties of the original materials were that both the axis and core were 206 GPa, so a result is shown that is stops at 3-4%. In 2, a Young's modulus of 22 GPa is used in the lamination direction for the finite element method (FEM) analysis results, and 10% of 22 GPa in the in-plane direction. In 3 and 5, we adopted a lamination direction of 21 GPa and an in-plane direction of 210 GPa. In 4, we report the results of the experiments we ran, the lamination direction is 70.5 GPa and the in-plane direction is 225 GPa.

We infer that the differences in the lamination direction Young's modulus arise from the relationship between the outer diameter of the laminated core, which can be thought that have changed due to structure, as the smaller the diameter and the smaller the stack length the closer they get to solid geometry, so there is a reduction in the Young's modulus.

Coil Modeling

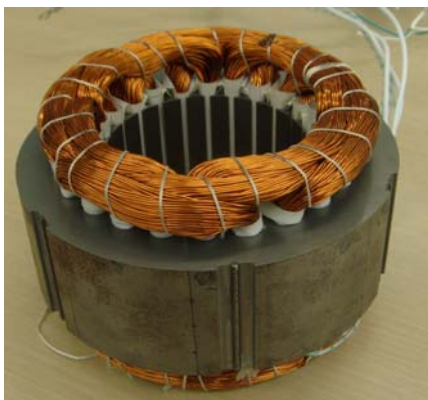


Fig. 2 Status of the coil being set in the stator core

The next thing we worry about in modeling structural analysis of electric motors is the coil. The widely used low-capacity distributed winding coils have magnetic wire (copper wire) in the vicinity of 1 mm that can ensure a cross-sectional area, there is also more wire that might be required and is stored in a bundled state in the slot, and in the end it is processed with an insulating varnish. As a result of this, the lamination factor for copper wire in the slot is usually no more than 50%, with the remaining 50% made up of the insulating paper and insulating varnish. As well as the coil end having being arranged, after being fixed, it is processed with insulating varnish so its status is also complex. In this case of both inside the slot and the coil end, the copper is in a completely different state but modeling each strand of copper wire is an even more impossible task than modeling each single laminated steel plate so material properties are allocated that are equivalent to the laminated core.

In 7, we carried out a trial production of a stator with a different lamination factor and ran a hammering test, and by comparing it to FEM results, we were able to extract the relation nature between the coil lamination factors for in the slot and at its ends and the equivalent longitudinal elastic modulus.

In 9, the coil ends that have toroidal properties are modeled as an oscillating system, showing an idea that treats the iron core and coil ends as double-degree-of-freedom system.

Combined Structural Modeling

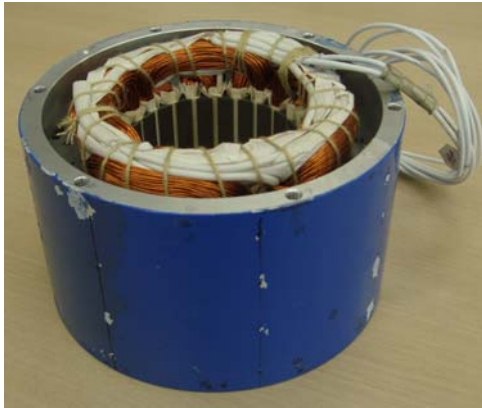


Fig. 3 Status of the stator core being set in the frame

As a rule of thumb, electric motors are made up of four parts which are the laminated core (stator, rotor), coil, frame and rotor axis. In comparison with the fixed side, the natural frequency of the rotation side is high, and because the fixed side can become a cause of noise vibration, there are many cases in which care is taken over the fixed side performing an analysis. As mentioned earlier in this section, there are difficult aspects to modeling each of the parts, and there are also challenges to combined modeling of the laminated core and frame, and the laminated core and coil, and if they share nodes, modeling with a spring has also been reported.

In 6, press fitting type segment core modeling is introduced, and by reviewing the material properties after considering the nodes of the contact points, the authors report that it is possible to generate a detailed model that will be useful in design validation.

In 8, in order to model the fitting of the stator and frame, we prepare a two-layer toroidal with a different clearance and run a modal analysis, we extract the relation nature between the eigen frequency changes and the fit pressure.

In 9, with regard to combining a pocket geometry frame with a core, because frame deformation has made the contact points discontinuous, we suggest that the

modeling should be run with the springs in the theta-direction and r-direction. With regard to what spring constant should be used in structural analysis, this has also been modeled based on experiment results.

Analytical Concept


Until this point, we have introduced papers on the theme of why we should raise the accuracy of structural analysis models but at the end we will introduce papers specializing in vibration noise analysis. To begin with, let's look at the relationship between excitation force and the electromagnetic force mode shape that is the excitation force and the vibration mode shape. Put simply, even if the natural frequencies are the same, if the mode shape of the electromagnetic force and of the vibration are different, they will not lead to large resonance.

In 11, after considering abstractly the relationship between the vibration response coming from the electromagnetic force mode that is the cause of electromagnetic noise and the structural eigen frequency, we ran a modal analysis and report the usefulness of this logic. Also, we tried two methods to apply electromagnetic force, Multipoint Excitation and Distributed Excitation, and we also conducted experiments on the different relationship nature of the resonating coupled mode for each one, and the points considered make an interesting report.

However, it is merely that the sensitivity of the geometries of the electromagnetic force mode and the eigen frequency mode differ from each other, not that is easy for resonance to occur. In 4, we verified that membrane oscillation at the bottom of a motor case is a source of noise vibration, but that an electromagnetic force mode that matches the membrane oscillation mode does not exist. However, because of toroidal electromagnetic force modes such as triangles, cases in which there is a structural connection, the membrane oscillation of case bottoms does not exist, so rather than worrying about whether modes match, there are in cases in which it is better to consider that some resonance will

remain.

In Closing

How were the papers we introduced? I think the information will be useful in electric engine vibration analysis. We may not know, but there are lots of other valuable papers. If we have time, we would like to introduce them, if there are any papers you think "should be read", we would be happy if you would introduce them to us. 

(Yoshiyuki Sakashita)

Reference

[1]Yoshio IWATA, Hidenori SATO and Yawara MORIOKA

"Natural Frequency of Rotor with Rotor Core"

Transaction of The Japan Society of Mechanical Engineers Series C vol57 No.544 (1991-12)

[2]Kenzo Tonoki, Shinichi Noda, Makoto Matsushita

"Finite Element Method for Natural Frequency Analysis of Stator Core in Induction Motor (K-Model)"

The National Convention of IEEJ 2005 (5-126)

[3]Investigating R&D Committee on analysis technology for electromagnetic vibration and acoustic noise of induction machines

"Analysis Technology for Electromagnetic Vibration and Acoustic Noise of Induction Machines"

IEEJ Technical Report No.1048

[4]Sakashita Yoshiyuki, Tetsuya Hattori, Takashi Yamada, Hiroto Ido, Ryohei Ota, Eri Zeze, Kan Akatsu

"Comparison of Electromagnetic/Vibration Co-Simulation and experimental result for Permanent magnet motor. (The 2nd report)"

IEEJ Technical Meeting of Rotating Machine Technical Committees on Series D (RM-12-126)

[5]Koki Shiohata, Kanako Nemoto, Yasumasa Nagawa, Shigeru Sakamoto, Takashi Kobayashi, Motoya Ito, Haruo Koharagi

"A Method for analyzing Electromagnetic-Force-Induced Vibration and Noise Analysis"

IEEJ Transaction on Industry Applications vol.118 (1998) No.11

[6]Ryo KAWASAKI, Kazuyuki YAMAMOTO, Koji MASUMOTO, and Masaharu NISHIMURA

"Noise and Vibration Analysis of Compressor for Air-Conditioning Machine Equipped with a Concentrated Winding Motor with a Press-Fitted Segment Core"

Transaction of The Japan Society of Mechanical Engineers Series C vol77 No.777 (2011-5)

[7]Kazunobu ITIMI, Shinichi NODA, Isao SUZUKI, Fuminori ISHIBASHI and Hisashi YAMAWAKI

"Young's Modulus of Finite Element Method for Natural Frequencies of Stator Core in Induction Motor"

Transaction of The Japan Society of Mechanical Engineers Series C vol68 No.669 (2002-5)

[8]Shinichi NODA, Kazunobu ITIMI, Fuminori ISHIBASHI and Katuki IDE

"Contact Pressure and Natural Frequencies on Dual Ring (Experimental Study for Natural Frequencies Stator Core in Induction Motor)"

Transaction of The Japan Society of Mechanical Engineers Series C vol65 No.629 (1999-1)

[9]Kazunobu ITIMI, Shinichi NODA, Isao SUZUKI and Fuminori ISHIBASHI

"Analysis for Natural Frequencies of Stator Core in Induction Motor"

Transaction of The Japan Society of Mechanical Engineers Series C vol64 No.624 (1998-8)

[10]Shinichi NODA, Isao SUZUKI, Kazunobu ITIMI,
Fuminori ISHIBASHI, Sadaaki MORI and Youich IKEDA

“Natural Frequencies of Stator Core with Frame in
Induction Motor”

Transaction of The Japan Society of Mechanical
Engineers Series C vol61 No.591 (1995-11)

[11]Shinichi NODA, Fuminori ISHIBASHI and Katuki
IDE

“Vibration Response Analysis of Induction Motor
Stator Core (Vibration Response of Distributed Excitation
and Multipoint Excitation)”

Transaction of The Japan Society of Mechanical
Engineers Series C vol59 No.562 (1993-6)

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 it to take part in electromagnetic designs that do not fall within this area, such as mechanical designers. There are probably quite a few among those who have made the transition to this unfamiliar analysis tool who worry about how they should use it to perform better analyses.

This section of the Newsletter introduces questions that we receive most often in order to help people who are having similar kinds of problems, and to make JMAG more user-friendly software.

The questions here cover a wide range of topics, such as "Operation Methods", "Analysis Techniques", "Result Evaluation", and "Troubleshooting". So start reading from the topic that interests you most!

OPERATION METHODS

Q1 . How can I display the results of Multiple cases of one study in a single graph?

A1 . Please use "Graph Manager" tool in JMAG-Designer for post-processing.

Analysis results are saved and managed as "Data Set" in JMAG-Designer, which are listed in "Graph Manager" (Fig.1). In "Graph Manager", both the results of multiple studies and the results of multiple cases of the same study can be displayed in a single graph, and new analysis results can also be added to an existing graph.

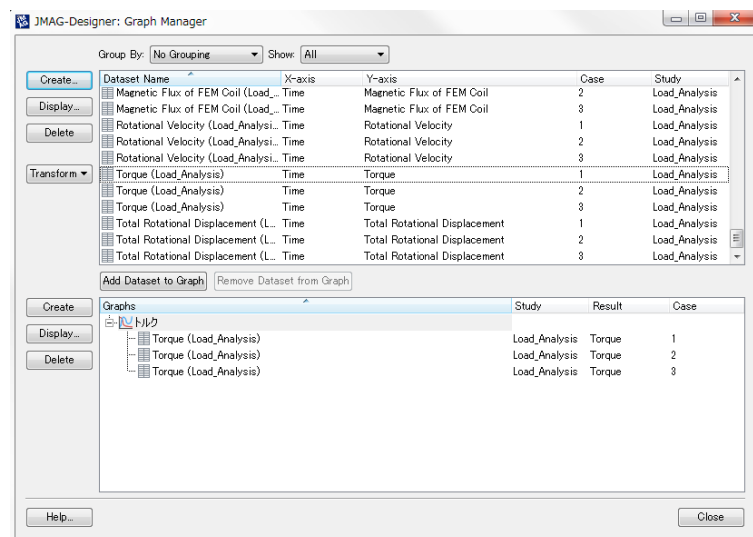


Fig.1 Graph Manager

Multiple analysis results can be displayed in a single graph by following the operation procedures below,

- 1). Select [Tools] > [Graph Manager] from the menu bar.
- 2). Select multiple datasets to be displayed in a graph from the dataset lists.
- 3). Click the [Create] button on the left side of [Graphs].

4). Select the graph that you want to display from the graph list and click the [Display] button, then the selected graphs appears in the [Graph] dialogue box.

Analysis results can be compared with each other easily by showing multiple case results in a single graph (Fig.2).

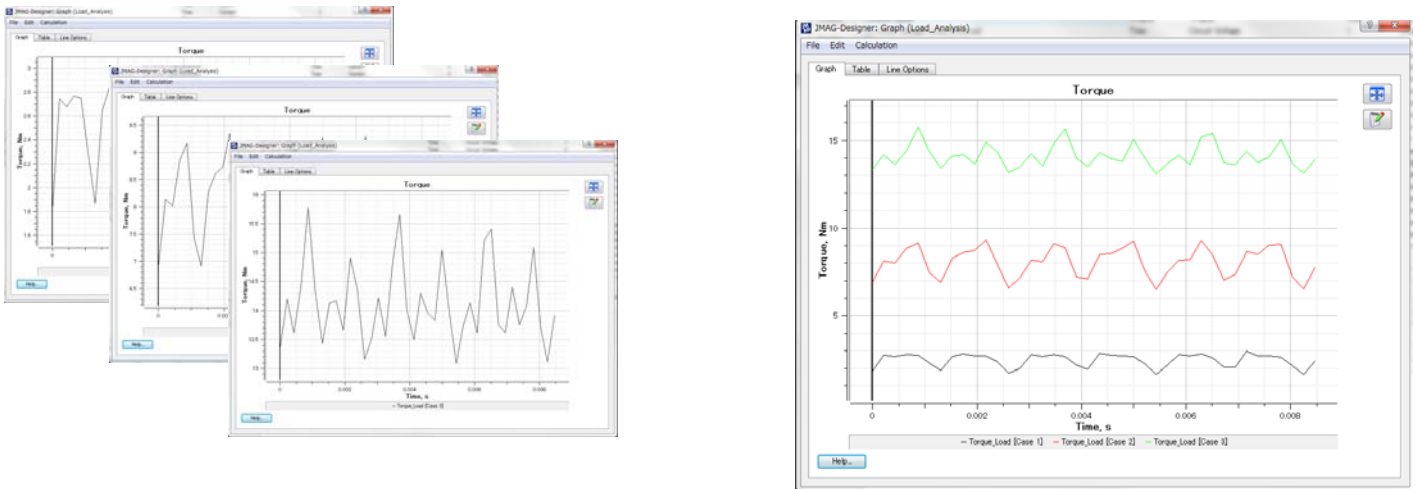


Fig.2 An analysis result's example showing how to display one study which involves multiple cases' results in a single graph

【Other documents】

Besides showing multiple results in a single graph, "Graph Manager" can also compare newly-created datasets with some existing graphs. If you need more information about Graph Manager, refer to Help as follows,

[JMAG-Designer Help > Result Display > Graph Manager > Managing Graphs](#)

OPERATION METHODS

Q2. How can I make even mesh divisions when the common edge belongs to both adjacent regions when generating a mesh manually?

A2. Please check on [Connection] to the common edge in "Geometry Editor".

The meshes in adjacent regions are sometimes inconsistent with each other when creating meshes manually in "Geometry Editor". In these cases, please apply [Connection] feature to the common edge which belongs to both adjacent regions (Fig.3).

"Connection" feature can be set to an edge by following the operation procedures below:

- 1). Right-click the region to be edit from [Model Manager] > [2D Sketch] > [Feature], and then click [Edit].
- 2). Set [Type] > [Specify Type] to [Divisions] in [Create Region Mesh] dialogue box.
- 3). Check on the [Connection] checkbox of the common edge.

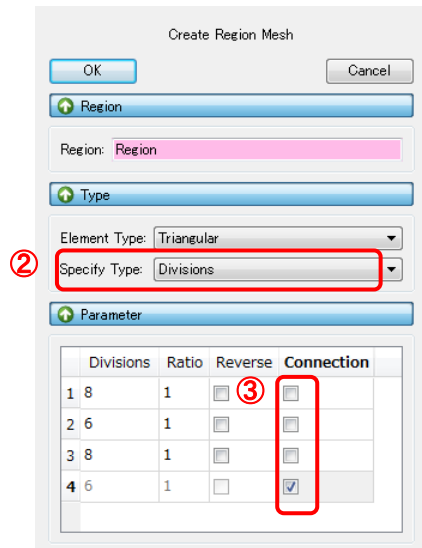


Fig.3 Setting steps of "Connection"

Note: [Connection] feature is not available when [Specify Type] is set to [Element Size].

The manually generating mesh feature has been enhanced in JMAG-Designer Ver.11.1. It is possible to edit and also to operate the manually generated meshes. We hope you can experience the quality that this new feature provides.

RESULT EVALUATION

Q3. Is it possible to convert the results of frequency response analysis into the results expressed as a function of time?

A3. It is possible to convert it into sinusoidal wave function with respect to time.

The analysis results obtained from frequency response analysis are complex vectors. Complex vectors can be converted into a sinusoidal wave function of time (Fig.4). The operation procedures are mentioned as below.

Note: I_{Re} is the real part, and I_{Im} is the imaginary part in the case of representing current value in complex form.

1). A (Amplitude) and θ_0 (phase) which can be calculated from the results of frequency response analysis are given as,

$$I_{amp} = \sqrt{I_{Re}^2 + I_{Im}^2}$$

$$\theta_0 = \tan^{-1}\left(\frac{I_{Re}}{-I_{Im}}\right)$$

2). Substitute the results obtained from 1) for the following formula, the result which is expressed as a function of time is given as,

$$I(I_{Re}, I_{Im}) = I_{amp} \sin(2\pi ft + \theta_0)$$

Note: f represents the value of frequency specified in the frequency response analysis.

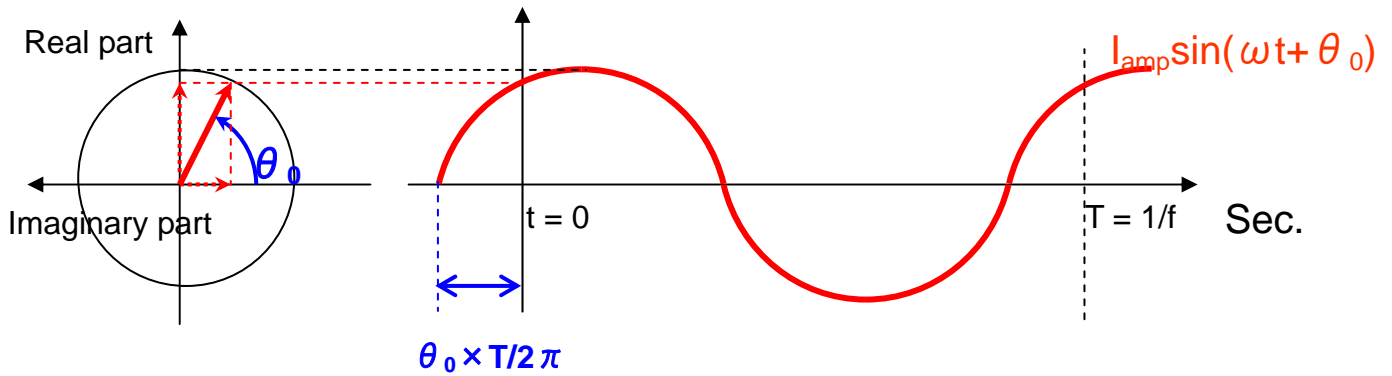


Fig. 4 The concept of complex vector

【Other reference materials】

There are detailed explanations in the seminar materials for fundamental concepts about how to use JMAG, as well, so refer to them for more information.

<http://www.jmag-international.com/support/documentation/index.html#2005> (User verification required)

“JMAG Users Week 2005”, JMAG Practical Sessions B-1 Efficient Use of JMAG

ANALYSIS TECHNIQUES

Q4. Abnormally large iron losses have generated over high frequency range.

A4. Please check the magnetic flux density variations of the high frequency range where results are abnormal.

Iron losses can be calculated using the derivative of magnetic flux density with respect to time. Therefore, it is necessary to calculate both the spatial distribution of magnetic flux density and the derivative of that with respect to time accurately. Here are the countermeasures against such problems.

- 1). If the high frequency range with the problem is within the frequency range to be calculated,
 (Countermeasure 1) Use a smaller time interval for the magnetic field analysis.
 (Countermeasure 2) Decrease the nonlinear tolerance.
- 2). If the high frequency range with the problem is out of the calculation frequency range,
 (Countermeasure 3) The calculation errors may be caused by the coarseness of the time interval resolution, or by a slight change in the magnetic flux, which can result in larger calculation errors. If the unnecessarily high frequency components are also included in the calculation target, please consider removing them from the calculation target.

【Other reference materials】

Besides iron loss analysis, the problem such as the analysis results and experimental results do not match with each other is another common worry. If you also have the same kind of problem, please have a look at the seminar materials as below,

http://www.jmag-international.com/support/en/seminar/seminar_uw2010.html (User verification required)

"JMAG Users Conference 2010" JMAG Seminars Logic and Strategies When Analysis and Measured Results Don't Match

TROUBLESHOOTING

Q5 After updating to JMAG-Designer Ver.11, JMAG-Designer exits abnormally during operation at times.

A5. Please check the graphics driver on your computer.

Since JMAG-Designer Ver.11, it is necessary to install DirectX End-User Runtime in order to use graphics driver Direct3D.

If it is not installed yet, we recommend downloading the installer from the website below and installing it.

<http://www.microsoft.com/download/en/details.aspx?id=8109>

Note: Graphics drive can be checked by following the operation procedures below,


- 1). Select [Tool] > [Preferences] from the menu bar of JMAG-Designer.
- 2.) Select [Rendering] > [Graphics Driver].

If there are still problems even after following the above instructions, please feel free to contact JMAG Technical Support.

Technical FAQ on the WEB

The technical FAQs are available on our website as well, so you can refer to them for further information

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

The technical FAQs are a collection of questions and points that are unclear points from actual customers, so looking through them may allow you to make new discoveries about how to use JMAG. We will update the FAQs on our homepage regularly, so please browse them and streamline your analysis operations. If you have questions or concerns while using JMAG, do not hesitate to use Technical Support. Let's fully master JMAG-Designer. 

(Ming Gao)

Issue 6 Understanding Geometry Modeling 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 aim at making 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

For a simulation which involves an electromagnetic field analysis, it is necessary to create data that represents the geometry of the target model. JMAG can load external CAD file, and can create geometry data for simulations using JMAG-Designer.

This report focuses on "Geometry Creation" and introduces the functions to create geometry data using the Geometry Editor bundled in JMAG-Designer.

Creating 2-D geometry using Geometry Editor

The flow to create 2-D geometry

The flow to create 2-D geometry data using the Geometry Editor in JMAG-Designer (hereinafter referred to as "Geometry Editor") is as follows:

- Create a sketch
- Create a basic geometry
- Adjust the basic geometry (Break at Intersection /Trim)
- Add constraints
- Create regions
- Add region feature

In this section, we will describe about the functions and operations that are used in the above mentioned

each step.

Creating a Sketch

The tree that is displayed in model manager is the data structure of the model (Fig.1). The assembly is the top of the hierarchy of the data structure. When creating a 2-D geometry using Geometry Editor, you need to add a sketch to the assembly. A 2-D sketch is inserted by clicking [Edit Sketch] on the tool bar. And the 2-D sketch has a hierarchic structure that includes basic geometries, constraints, regions, and features under it.

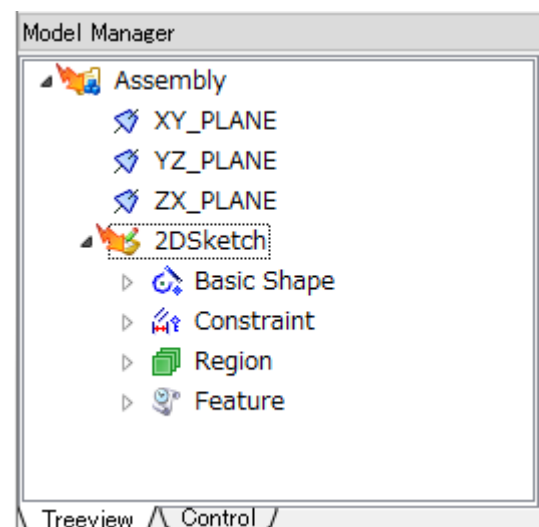


Fig.1 2-D geometry data displayed in the model manager.

Creating Basic Geometries

In order to draft geometry of the model for an analysis, locate basic geometries on the inserted sketch. The “basic geometry” is fundamental elements (straight lines, arc lines, spline curves) to represent the shape of the geometry. Basic geometry is sometimes called an “entity” in other CAD system.

Adjusting Basic Geometries

1. Break at Intersection

In order to use the created shape for an analysis, you need to create a region enclosed by basic geometries. Basic geometry constructing a region cannot be intersected. If the basic geometries intersect each other, you need to divide these basic geometries using [Break at Intersection] to create vertices at the intersected points (Fig. 2).

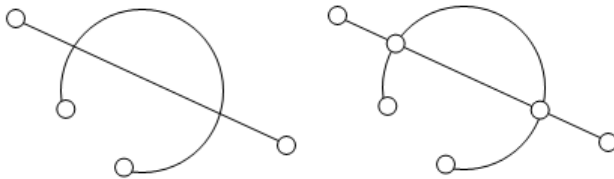


Fig. 2 Break at Intersection

2. Sketch Trim

When drafting a shape using basic geometries, a lot of overlapped basic geometry will be appeared. The “Trim” function can resolve this situation.

The operation to trim basic geometries is as follows:

- Click [Sketch Trim] on the tool bar
- Click any basic geometries (straight line, circle, arc, spline)

The basic geometry is cut at the closest intersection(s), and a vertex (vertices) is created at the intersected point (Fig. 3).

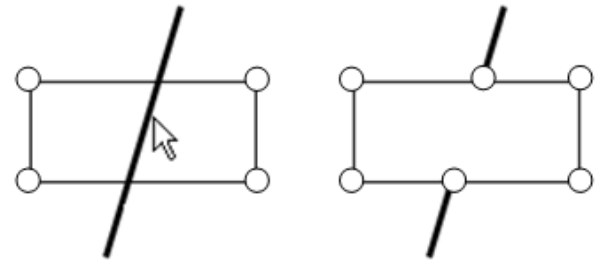


Fig. 3 Trim

Adding Constraints

In order to control dimensions of the shape you have created, “constraints” need to be added to the geometry. The “constraints” define a relationship between basic geometries. In other words, it is a material to represent the “intention” of the author of the drawing.

To understand the notion of constraints, consider the way of drafting by hand on a drawing board and corresponds the way of the constraints.

When drafting on the Geometry Editor, adding a “fixation” constraint is necessary. And for parallel lines with the base line, a “parallel” constraint and a “distance” constraint are added.

For the line angled with the base line, an “angle” constraint is added. When a distance constraint or an angle constraint is added, a dimension line will appear on the basic geometries (Fig. 4).

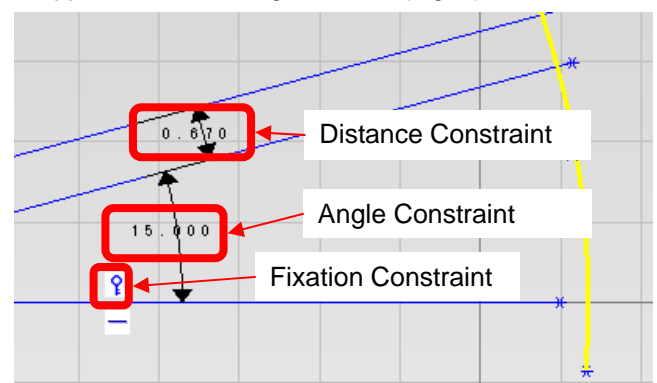


Fig. 4 Constraints

Creating a Region

Conditions for analysis can be set on regions, edges and vertices. The edges and vertices must

be contained in a region. So it is necessary to create regions to use the created geometry for analysis.

To create a region, it is necessary that basic geometries are not intersecting each other, and basic geometries are enclosed to construct the region (Fig.5). If there are intersected entities, use [Break at Intersection]. When DXF or IGES (2D entity) file is loaded into Geometry Editor, the loaded basic geometries might not be fulfill preconditions to construct regions. To resolve this problem, see “Create 2-D geometry by reading external files”.

The operation to create a region is as follows:

- Select target basic geometries.
- Select a menu [Insert]-[Basic Shape]-[Create Region]

When the selected basic geometries fulfill the precondition to create a region, the part enclosed by the selected basic geometry is highlighted in yellow. Click the [OK] button to determine the region. If the part enclosed by the selected basic geometries is not highlighted in yellow, the basic geometries do not fulfill the precondition to create a region. If so, check the basic geometry encloses the region correctly.

Also analysis cannot be run with duplicated regions. To resolve the duplicated regions, it is necessary to use [Break at Intersection] to divide the basic geometries which will be contained in a region in advance.

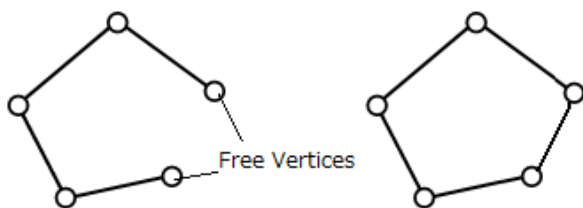


Fig.5 Region not closed (left) and region closed (right)

Adding a region feature

1. Copy

If all shapes are created with only basic geometries, it is hard to adjust the shape. Finding the regularity of the shape (symmetry or periodicity) and using the “copy” feature for source regions is recommended because modifications in the source regions are also made in the destination regions. It is helpful to reduce the work load of modifications and to avoid operation mistakes.

In order to utilize the symmetry of the shape, apply “mirror copy” feature (Fig.6).

In order to utilize the periodicity of the shape, apply “linear pattern” feature or “radial pattern” feature (Figures 7 and 8).

Added features appear under [2D Sketch]-[Feature] in the tree of the model manager. The setting can be changed by right-clicking the feature and selecting [Edit] on the tree item.

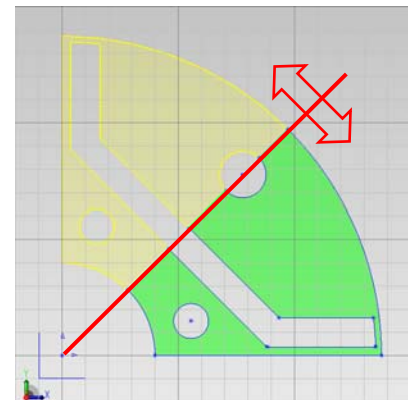


Fig.6 Region Mirror Pattern

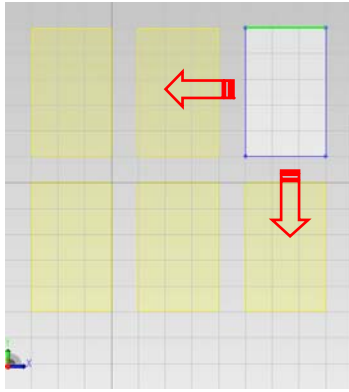


Fig. 7 Region Linear Pattern

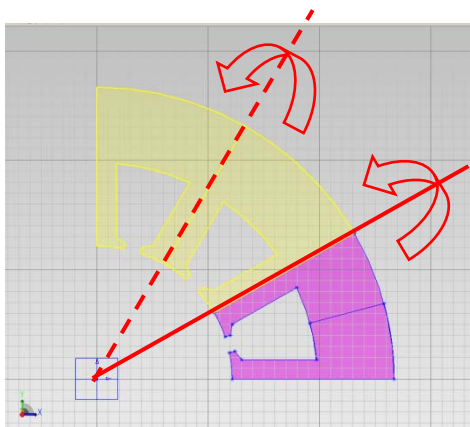


Fig.8 Region Radial Pattern

2. Fillet / Chamfer

Shapes like fillets and chamfers frequently appear in the shape of actual products. If you draft the fillet and chamfer shape directly using basic geometry on the sketch, it is hard to change and remove the fillet / chamfer shape.

Using the fillet / chamfer feature for a region, makes it possible to change the properties and remove it from the region easily.

But a fillet / chamfer shape which steps over different regions cannot be created by the region feature. In such case, it is necessary to create a fillet /chamfer shape directly as basic geometry using [Insert]-[Basic Shape]-[Create Fillet] (or [Create Chamfer]).

Creating a 2-D geometry by reading external files

The flow to read DXF-IGES 2D format files

When reading DXF-IGES (2D Entity) format file in the Geometry Editor, the read entities are treated as basic geometries. And it is necessary to create regions on these basic geometries using the Geometry Editor. When creating a region, all the edges of basic geometries must be connected at each vertex and form a closed loop.

If the geometry does not fulfill the precondition, it is possible to adjust the geometry on the Geometry Editor (described later). But setting sufficient constraints and congruencies on the original CAD system is helpful to decrease the work load to fix the geometry. And increasing the number of columns of significant figures when outputting DXF / IGES files sometimes make it easier to create a region.

The steps to read DXF / IGES (2D Entity) format and create regions using Geometry Editor is described as below:

- Open a file.
- Adjust the basic geometries.
 - Highlighting free vertexes
 - Deleting duplicate vertices
 - Connecting two basic geometries
- Create a region.

In this section, we will introduce the functions to highlight free vertices, delete duplicate vertices and connect two basic geometries. These functions are useful to adjust basic geometries.

Highlighting Free Vertices

A free vertex refers to a vertex that does not connect to two or more edges (Fig.9). Highlighting free vertices is useful to detect geometries which should be adjusted when loading CAD files like

IGES format.

The step to highlight free vertices is below:

- Select menu [View]-[Visibility]-[Highlight Free Vertex]

Lines and arcs which has free vertex cannot be loaded in JMAG-Designer because the lines and edges are not a part of regions.

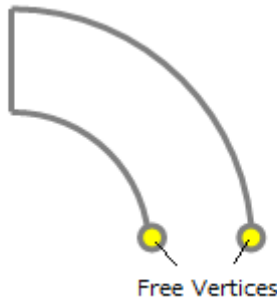


Fig.9 Free Vertices

Deleting Duplicate Vertices

When reading DXF files or IGES files, regions sometimes cannot be created despite nothing seems to be wrong with the geometry's appearance. The cause of this problem is the existence of duplicated nodes at the cross point between entities. In order to resolve the problem, use "Delete duplicate vertices", then vertices which can be treated as same vertex is merged to a single vertex (Fig.10).

Basic geometry may be deleted or modified after deleting duplications. Therefore, constraints that are no longer valid may be deleted after deleting duplications

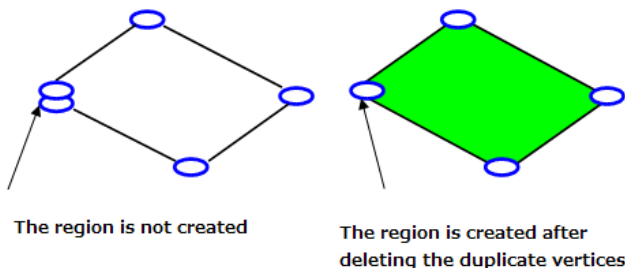


Fig.10 Deleting the duplicate vertices

Connect Two Basic Shapes

When reading DXF file or IGES files, entities which should be connected to each other might be disconnected by a small distance. To fix this kind of geometry, use [Connect Two Basic Shapes] function to connect basic geometries at some distance.

This function connects two basic geometries by extending one or both basic geometries. And also a new vertex is created using the break at intersection function at same time (Fig.11). The basic shapes that can be extended to connect with the other basic shapes are arcs and lines. This function can be used for arcs and splines, but cannot be extended or be contracted in the size of radius.

Regions with the two basic shapes are connected using this function after the regions are automatically deleted.

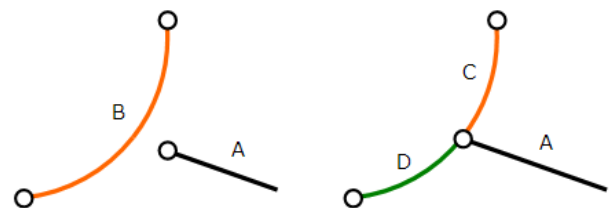


Fig.11 Connect two basic geometries

Creating a 3-D geometry using Geometry Editor

The flow to create a 3-D geometry

A tree displayed in model manager is a data structure of the model. An assembly is the top of the hierarchy of the data structure, and part is located under the assembly. A part has sketches, and the sketch does basic geometries, constraints, regions and features (Fig.12).

Also 2D-sketch can be copied to a part as a base of creating 3-D geometry.

The steps to create 3-D geometry using the Geometry Editor are mentioned as below:

- Create a 2-D shape on the sketch
- Add features to the sketch and created solid.
 - Extrude
 - Copy
 - Fillet / Chamfer

And also it is possible to project an outline of a solid face to sketch for a base of solid creation (convert sketch), or divide the contact area as a new face (imprint).

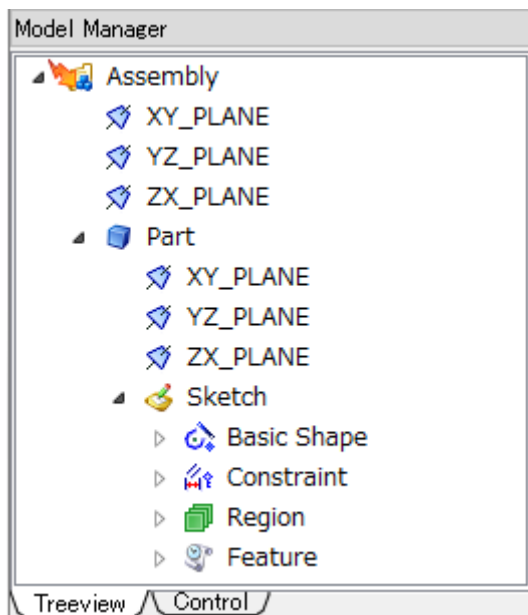


Fig.12 3-D geometry data displayed in the model manager

Creating a 2-D Geometry on the Sketch

In order to create a 3-D shape using the Geometry Editor, first add a part to the assembly. Select [Edit Part] on the tool bar, then the new part is added.

After that, add a new sketch to create a base shape. It is necessary to select a base plane from [XY Plane], [YZ Plane], [ZX Plane] under [Part]. Otherwise, it is also possible to select an arbitrary surface as a base plane. It is helpful for easiness of operation to select a plane which shows the characteristic of the shape (Fig.13).

When creating 3-D geometry, creating an over detailed shape on a sketch should be avoided

because it is hard to adjust such detailed shape ahead. So the recommended way is to use feature (described later) and divide into several sketches. This is helpful to handle the 3-D geometry easily.

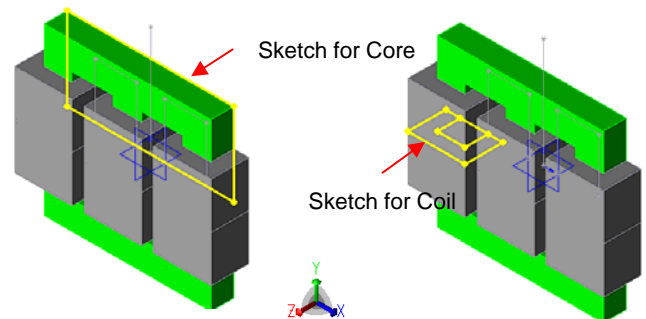


Fig.13 Select basic plane

Adding Features to Solid

1. Extrude

A region in a sketch can be extruded in the Z or -Z-axis with respect to the sketch face. Extruding is the most basic operation to create a solid.

And adding a skew to the solid is also possible.

2. Copy

Finding symmetry or periodicity properties and using copy make geometry creation easy.

In order to use symmetric property of a shape, use “mirror copy” feature. Clicking the “merge” check box enables you to merge a source solid and destination solids.

In order to use periodicity of shape, use “linear pattern” or “radial pattern”. Clicking the “merge” check box also enables you to merge a source solid and destination solids.

3. Fillet / Chamfer

Of course, it is possible to create a solid with a fillet / chamfer by extruding a sketch on which a fillet / chamfer shape represented by only basic geometries directly. But adding the fillet / chamfer feature makes it easy to change the dimension parameter or to suppress the feature.

The steps to create fillet/chamfer are as follows:

- Click [Edge Fillet] or [Edge Chamfer] on the tool bar.
- Select an edge or face in the work plane.
- A translucent preview of the edge or face to fillet / chamfer appears in the work plane based on the settings that are specified (Fig.14).
- Click [OK]

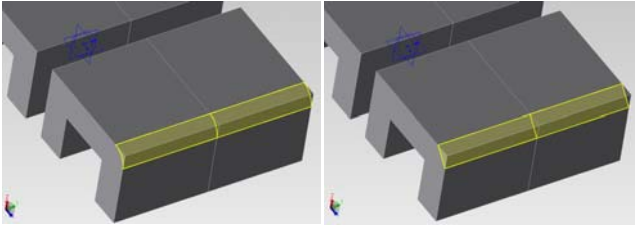


Fig.14 Fillet feature (left) • Chamfer feature (right)

Converting the Outline of the Solid to the Sketch

When a SAT file that contains a 3D CAD model created with another CAD system is imported to Geometry Editor, the geometry of the model cannot be edited because the dimensions of the model are not imported. Click [Convert Sketch] button to project the outline of the selected solid on the selected plane as a sketch. The original solid can be created by adding features to a sketch, such as extruding the surface.

Imprinting

If solids are adjacent or contacting to each other, you might want to get the surface divided by the projection of edges of contact or closed region. The

imprint feature is used to create a new solid face by projecting the area where parts have contact with or are adjacent to each other. For example, the contact area between Part A and Part B are imprinted as shown in the following figure. In this case, the shape of Part B is projected on the surface of Part A. The surface of Part A is divided by the projected shape, and two faces are created.

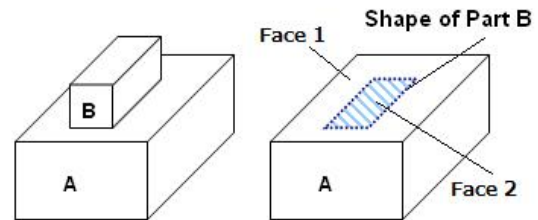


Fig.15 Before imprint Part A and B (Left) After imprint Part A(Right)

In Closing

This time, we introduced several functions related to geometry creation. Creating geometry data in a suitable way will save your time for analysis. Hopefully these functions are helpful for your job.

Next time we plan to introduce an A to Z for setting physical conditions of analysis. Be sure not to miss it. **J**

(Motohito Hirose)

Event Information

JMAG Users Conferences

We are holding this year's JMAG Users Conferences in various countries around the world. Here we'd like to introduce those to be held in America and Japan, as well as telling you about the one held in Germany in July.

JMAG Users Conferences have programs that emphasize communication between engineers. They are a good opportunity to gather information on how electromagnetic analysis is used, so please take part in one.

JMAG Users Conference 2012 in USA

Conference Outline

Host : Powersys Solutions

Date : October 16, 2012

Venue : WESTIN DETROIT METROPOLITAN AIRPORT HOTEL (America, Detroit)

URL : http://www.powersys-solutions.com/usersconference_jmag_usa_2012.php

At the Users Conference to be held in America, Hamid A. Toliyat of Texas A&M University has been invited to give the keynote presentation which will be on the topic of Magnetic Gears. In addition to this, beginning with General Motors, Toyota Motor Corporation, and Nidec Corporation, other JMAG users will also kindly make speeches.

After the speeches, we plan to host a cocktail party so the speakers, attendees and technical staff from our company can get to each other even better.

We plan to hold the training seminar of JMAG-Designer Ver.11 at the same venue on the previous day of the Users Conference.

This Users Conference will have an atmosphere different to those held in Japan. Beginning with those whose companies are based in America, we are looking forward to our American customers' participation.

JMAG Users Conference 2012 in Tokyo

Conference Outline

Host : JSOL Corporation

Date : December 12-13, 2012

Venue : Tokyo Conference Center (Japan: Shinagawa)

URL : <http://www.jmag-international.com/event/conference2012/index.html>

To finish the schedule of Users Conferences held around the world, the 19th JMAG Users Conference will be held. Last year over 430 customers kindly participated.

In order to make it an event in which JMAG veterans of course, and also JMAG beginners and those who have not been to a Users Conference before could also attend without being overwhelmed by scheduling speeches and seminars by JMAG users in active at the leading edge in various fields and also technical interchange sessions.

Presentations

We are planning to hold various kinds of sessions including on motor design, coupled analysis and JMAG user techniques. Not only local speakers, but speeches by overseas speakers can also be heard through a simultaneous interpreter.

Exhibitions

Various companies will exhibit, including those in materials manufacturing, measurement and HILS. In between talks, there will also be presentations so please gather in the foyer.

JMAG Users Conference 2012.



Presentations



Exhibits



Section meetings



Simulation Park and technical support meetings

Event Information

Exhibit Introduction for October–December 2012

JMAG is actively exhibiting at events both in Japan and overseas. Please see how JMAG is performing at the venues.

Here we introduce events between October and December 2012 at which we will exhibit.

NAFEMS European Conference: Multiphysics Simulation 2012(MpCCI) Conference Outline

Host : NAFEMS

Date : October 16 - 17, 2012

Venue : Holiday Inn Frankfurt Airport-North (Germany: Frankfurt)

URL : <http://www.nafems.org/events/nafeems/2012/mp2012/>

MpCCI is an interface that allows coupled analyses to be performed with external applications. From JMAG-Designer Ver.11, an MpCCI-compatible interface was implemented. At this conference, MpCCI -developer Fraunhofer Institut SCAI will also introduce JMAG in under the title "Simulation of Electric Arcs Using a Coupled STAR-CD4 - JMAG Approach".

Wireless Charging Technology Fundamentals and Electromagnetic Field Analysis Technology Case Studies Conference Outline

Host : J-TECHNO INC

Date : October 19, 2012

Venue : J-TECHNO INC (Japan: Nihombashi)

URL : <http://www.j-techno.co.jp/>

On request from J-TECHNO INC, JSOL engineer Sakashita will be the lecturer at this seminar. For those who don't yet know wireless charging technology, the seminar will cover everything from fundamental topics to pointers for running simulation analysis using JMAG.

In the first part a lecturer from another company will explain wireless charging from its background to recent developments so people will understand the overall picture and in the second part, Sakashita will pass on knowledge for applying simulation analysis.

Integrated Electrical Solutions Forum (IESF) China Automotive 2012

Conference Outline

Host : Mentor Graphics
Date : October 25, 2012: China
Venue : Sheraton Shanghai Hongkou Hotel (China: Shanghai)
URL : <http://mentorg.com.cn/aboutus/view.php?id=165>

We will exhibit at this event organized by Mentor Graphics Corporation and that is concerned with an integrated design environment for automobile electrical and electronic design. Also, on the JMAG booth there will be a demonstration of JMAG-RT which propels model based design and supports VHDL-AMS, the IEEE benchmark. And also we will give a presentation titled, "高档车辆的汽车发动机零件模型".

PSIM Users Conference 2012

Conference Outline

Host : Myway Plus Corporation
Date : October 26, 2012
Venue : Shinyokohama Grace Hotel (Japan: Yokohama)
URL : <http://www.myway.co.jp/products/psim/seminar/user/2012/index.html>

We will attend the PSIM Users Conference. We will also make a presentation introducing how to use JMAG for power electronics.

We will also introduce case studies of coupling JMAG-RT and PSIM. Please visit the booth.

MATLAB EXPO2012

Conference Outline

Host : MathWorks Japan
Date : October 30 (Tuesday), 2012
Venue : GRAND PACIFIC LE DAIBALE DAIBA(Japan: Daiba)
URL : <http://www.matlabexpo.com/jp/>

In JMAG-Designer Ver.11, the coupling with MATLAB/Simulink has become stronger. On the booth, you will be able to actually test the stronger linkage. Please check out coupled analysis at the venue.

LMS Conference Japan 2012

Conference Outline

Host : LMS Japan K.K.

Date : November 1, 2012

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

URL : <http://www.lmsjapan.com/lmsconferences2012>

We will present a case study of coupled sound/vibration analysis of LMS Virtual.Lab and JMAG. You will actually be able to try out the case study announced at the booth so those attending the Conference, please visit the JMAG booth.

IDAJ CAE Solution Conference 2012-GT-SUITE Conference Day


Conference Outline

Host : IDAJ Co., LTD.

Date : November 16 (Friday)

Venue : Pan Pacific Yokohama Bay Hotel Tokyu (Japan: Yokohama)

The tools and environments that can coupled with JMAG-RT are increasing more and more.

Now it is possible to couple JMAG-RT with GT-SUITE, the entire-vehicle system simulation software package. At this conference, a case study of a motor in a cleaning system constructed using JMAG-RT will be presented. If you are interested, please take part. 

(Tomomi Igarashi)

Event Information

Event Report

The following are reports written by those who attended events between June and September, 2012. Please attend next time if you can.

CWIEME Berlin2012 Conference Outline


Host : CWIEME LTD

Date : June 26 - 28, 2012

Venue : Berlin Messe (Germany: Berlin)

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

We had a JMAG exhibit at the "CWIEME Berlin 2012" held in Berlin, Germany. "CWIEME Exhibitions" have on display coils, laminated steels, magnets, insulating papers, and various other constituent parts that make up electric devices such as motors and transformers and in this field, it is one of the biggest exhibitions in the world. On the JMAG booth, beginning with JMAG-SuperExpress, we introduced solutions for motor designers and also for large-scale transformers.

The JMAG booth received visits from many motor and transformer manufacturers from all over Europe. We received many inquiries about induction motors and direct-current machines and questions about dealing with heat in CAE, which was different to exhibits in Japan which are focused more on permanent magnet motors. We will continue exhibiting overseas in the future so that JMAG is utilized in all countries and applications. 

(Katsuyuki Narita)

JMAG Users Conference 2012 in Germany Conference Outline

Host : Powersys Solutions

Date : July 3, 2012


Venue : STEIGENBERGER AIRPORT HOTEL (Germany: Frankfurt)

URL : http://www.powersys-solutions.com/usersconference_jmag_2012.php

JMAG Users Conference in Germany 2012 was held and organized by Powersys Solutions, JMAG's European agent.

On the first day, a JMAG-Designer seminar was held and attended by 15 of JMAG's European users. Many of the users had mastered JMAG and we realized how widely JMAG has spread in Europe.

On the second day of the conference, not only participants from Europe but also from South Africa gave presentations and there was active debate and exchange of opinions on topics such as multiphysics and optimization. We received feedback from over 40 participants saying they found the presentations and poster sessions useful, so the event finished on a positive note.

On both days, not only was information transmitted that introduced functions and case studies, we were able to receive many opinions and requests about JMAG, including some who even brought their own personal computers to ask questions, which left us with a renewed sense of the high level of expectation JMAG has in Europe. 

(Yuya Yamashita)

Integrated Electrical Solutions Forum (IESF) JAPAN 2012

Conference Outline

Host : Mentor Graphics Japan Co.,Ltd.

Date : July 4 (Nagoya), July 6 (Tokyo)

Venue : TKP NAGOYA Ekimae Conference Center (Nagoya , Japan), Hotel Laforet Tokyo (Tokyo, Japan)

URL : <http://www.mentorg.co.jp/events/iesf2012/>

We exhibited at IEFS Japan 2012 which is organized by Mentor Graphics Japan. IEFS is an abbreviation of Integrated Electrical Solutions Forum, a world-wide event which offers solutions to design development challenges in the automotive industry, and is held in June in Detroit in the USA. In Japan, it is held in two locations, Nagoya and Tokyo. According to announcements from the organizers, 118 participants attended the Nagoya conference and 105 attended the Tokyo event so it was very successful. As expected, nearly all the people who participated were from automotive manufacturers and suppliers. In the JMAG partner corporate presentation slot, there was a presentation titled "Introduction of motor model JMAG-RT that drives model-based design forward" that introduced the importance of high accuracy motor models in control design: JMAG-RT motor models.

Also, we had an exhibition booth and had a chance to talk with designers in charge of vehicle's drive motor designs and the people who are going ahead with model-based developments. Everyone feels the necessity for high fidelity motor models that we proposed, and we realized the JMAG-RT solution's great potential.

(Koji Tani)

TECHNO-FRONTIER 2012

Conference Outline

Host : Japan Management Association

Date : July 11 – 13, 2012

Venue : Tokyo Big Sight (Tokyo: Ariake)

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



The TECHNO-FRONTIER 2012 event held at Tokyo Big Sight was favored with good weather and over 30,000 visitors gathered for the conference.


On the JMAG booth, there was the unveiling of JMAG-Designer Ver.11, JMAG-SuperExpress, JMAG-VTB which were released in June, and we introduced motor simulation technology, of which JSOL is the leader.

As you know, there is intense technical competition aimed at raising the motor performance. A finite element analysis (FEA) is the essential technique when handling or analyzing the physical phenomena that cannot be measured or evaluating the status that is difficult for measurement testing. Also, with the call for streamlining and higher accuracy, the

wave of model based design is approaching to the motor designs. We introduced the approach method unique to JMAG for addressing magnetic fields, heat, structure and control, respectively.

We held internal-booth presentations that have been extremely well received. Each session of 11 themes was given twice per day in this year, so we fortunately received comments saying that they were able to attend their target session at convenient times from most people. In addition, we stuck posters that corresponding to the presentations up, so we hopefully believe that helped the attendees understand the technical contents in more details.

In conclusion, concerning the presentation with narrated motion pictures as the first trial we received a lot of favorable reviews saying that that made it easy to understand the operation procedure, and it became a big success.

We will present JMAG with further upgraded contents to you, and look forward to your visiting the booth at the venue next year, too. 

(Tomomi Igarashi)

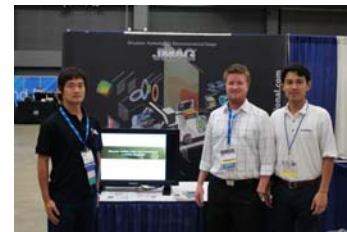
NIWeek2012 Conference Outline

Host : National Instruments Corporation

Date : August 6 – 9, 2012

Venue : Austin Convention Center (America: Austin)


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



National Instruments Corporation (NI) has its headquarters in Austin, Texas, in the USA and is a manufacturer of measurement equipment and controls. They can be applied to a wide range of areas in both hardware and software. For motor HILS, JMAG offers JMAG-RT as a high accuracy plant model.

NI Week is held once a year in Austin, Texas where NI is based and about 3600 engineers from around the world attend this event. In the keynote presentation, reference is made to the most recent functions and future vision, and we are always surprised at how polished the contents and presentation techniques are.

JMAG also took part from last year, and in addition to introducing products on the booth, we introduced and held a demonstration of JMAG-RT+NI VeriStand, together with Dr. Ben Black, an engineer at NI.

Seminars were also held, and about 40 people attended. There were many questions during the seminar but after it finished, about half of the participants stayed in the room. 

(Yusaku Suzuki)

2012 IEE-Japan Industry Applications Society Conference (JIASC)—Corporate Exhibits Conference Outline

Host : IEEJ Industry Applications Society


Date : August 21 – 23, 2012

Venue : Chiba Institute of Technology, Tsudanuma Campus (Japan: Chiba)

URL : http://www.gakkai-web.net/gakkai/jiasc/hp12_e/index.html

We took part in IEE-Japan Industry Applications Society Conference (JIASC). Since this is an academic society, we were visited by those in research and development, in addition to academics and students from universities.

This year there was also the chance to have presentations in the company exhibit area, and we introduced case studies showing JMAG's wide range of applications in electromechanical design.

HILS and SILS related companies put on exhibitions at the venue, and they introduced JMAG-RT. We were questioned on JMAG-RT, and felt higher interest in JMAG-RT. 

(Hiroyuki Sano)

ICEM 2012 Conference Outline

Host : ICEM 2012 Conference Secretariat

Date : September 2-5, 2012


Venue : Palais des Congrès et des Expositions de Marseille (France: Marseille)

URL : <http://www.icem.cc/2012/>

The International Conference on Electrical Machines (ICEM) is focused on technology advances in design, analysis, manufacturing and measurements for electrical machines and drives.

ICEM has established itself as an influential and recognized International event, being the only major international conference entirely devoted to electrical machines.

The 2012 edition gathered more than 500 attendees mainly from academics that came for papers and posters presentation.

POWERSYS, the distributor of JMAG in Europe, was there to present the JMAG Tool Chain for Motor Design: JMAG Designer, JMAG Express, JMAG Super-Express were introduced. This conference gave us the opportunity to discuss about the software strengths. Some posters on the booth also gave us a good opportunity to answer many technical questions. 

(POWERSYS)

ECCE2012

Conference Outline

Host : IEEE

Date : September 15 - 20, 2012

Venue : Raleigh Convention Center (America, North Carolina)

URL : <http://www.ecce2012.org>

JMAG's agent in America, Powersys Solutions, exhibited. We will report on this in detail next time. Please look forward to it.

SIMULIA Regional User Meeting

Conference Outline

Host : Dassault Systèmes

Date : September 17 -19, 2012

Venue : Radisson Blu Hotel (Germany: Hamburg)

URL : <http://www.3ds.com/company/events/germany-regional-user-meeting/overview/>

JMAG's agent in Europe, Powersys Solutions, exhibited. We will report on this in detail next time. Please look forward to it.

Try it now



Motor Designing Tool



JMAG-Express

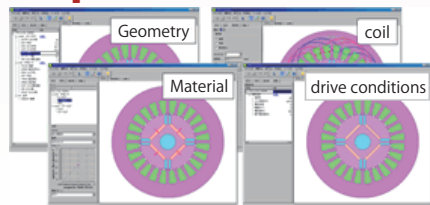
for Rotating Machines

Obtain Motor Characteristics **Instantly**

Special features of JMAG-Express

- Over 200 templates for geometries are available.
- The geometrical sizing feature recommends geometry and drive conditions for required outputs.
- You can create JMAG-RT models (1D simulation models) that account for motor characteristics.

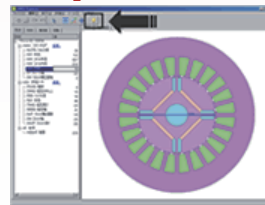
Step1



Enter the Specifications

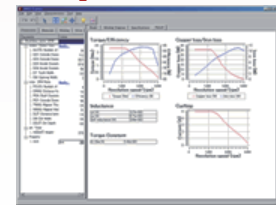
You can validate brushless motors (IPM/SPM) and induction motors!

Step2



Click

Step3



Output the Fundamental Characteristics

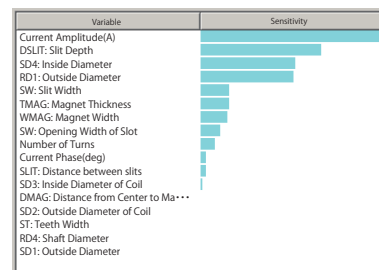
Torque, Efficiency, Copper loss, Iron loss, Inductance, Torque Constant

NEW!!

Sensitivity analysis function has been equipped in the new version

- Sensitivity analysis

By just setting the target function and its target value, you can obtain variables that affect the target value.



➤ Optimization function will be released soon

Information!!

If you want to perform more detailed validations, please use JMAG-SuperExpress (license needed).
JMAG-SuperExpress delivers highly accurate results with simple settings.

The module can be downloaded from here

www.jmag-international.com/express/
jmag-express@sci.jsol.co.jp

