
Femtet Seminar

Magnetic Analysis Exercise

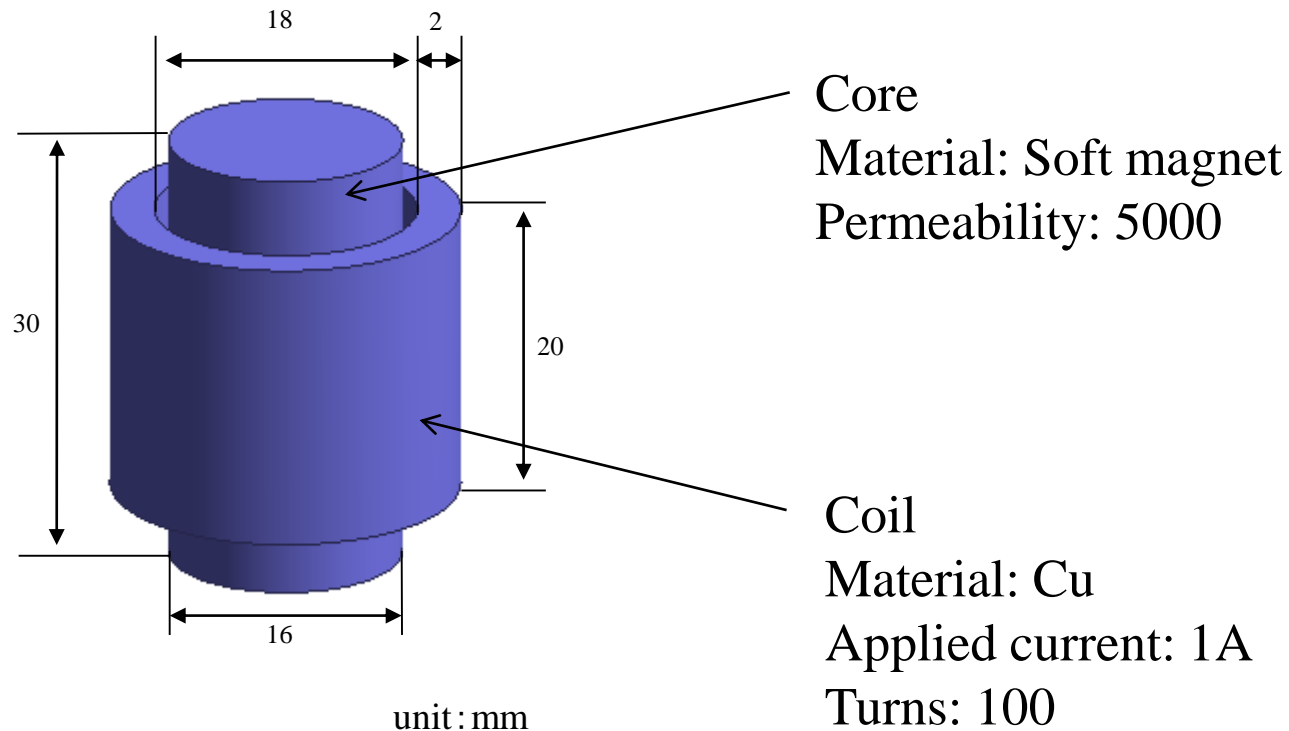
202009

Table of Contents

1. Make an analysis model of coil with core and solve inductance
2. (If time allows)
Make a quarter model and verify the results match those of the full model

Analysis Model

3D static analysis is performed on the model below.



Create Model

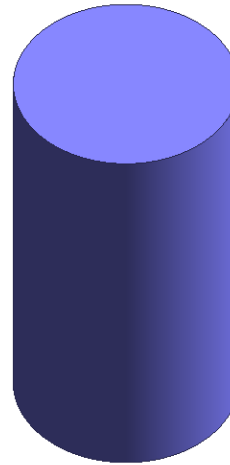
Create a core body.

Command: Primitive → Solid Body → Cylinder

Center (0, 0, 0)

Radius (8)

Height (30)



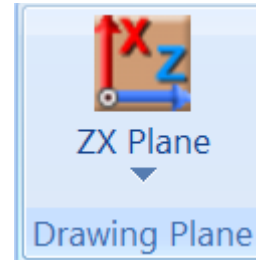

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Model's Maximum Dimension: 30 mm

Create Model

Create a cross-sectional body of the coil.

1. Select ZX plane for drawing

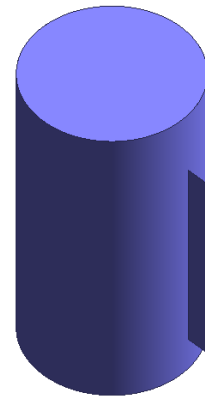


2. Command: Primitives → Sheet Body → Rectangle [Specify Length]

Startpoint (9, 0, 5)

Width (20)

Height (3)



Model's Maximum Dimension: 30 mm

Create Model

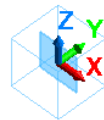
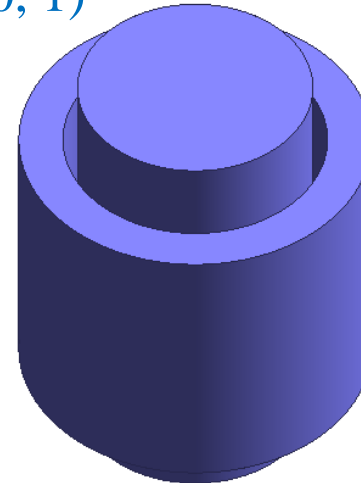
Modify the cross-sectional body to make a revolving body

Command: Modification Operation → Revolve

Points on the revolving axis (0, 0, 0)

Directional vector of the revolving axis (0, 0, 1)

Revolving angle (360)

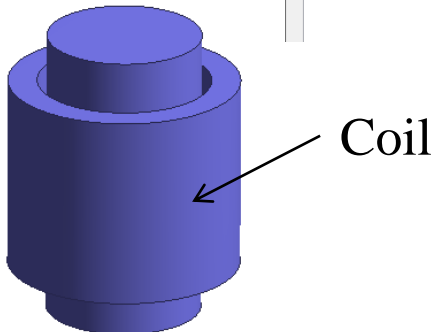


Model's Maximum Dimension: 30 mm

Create Model

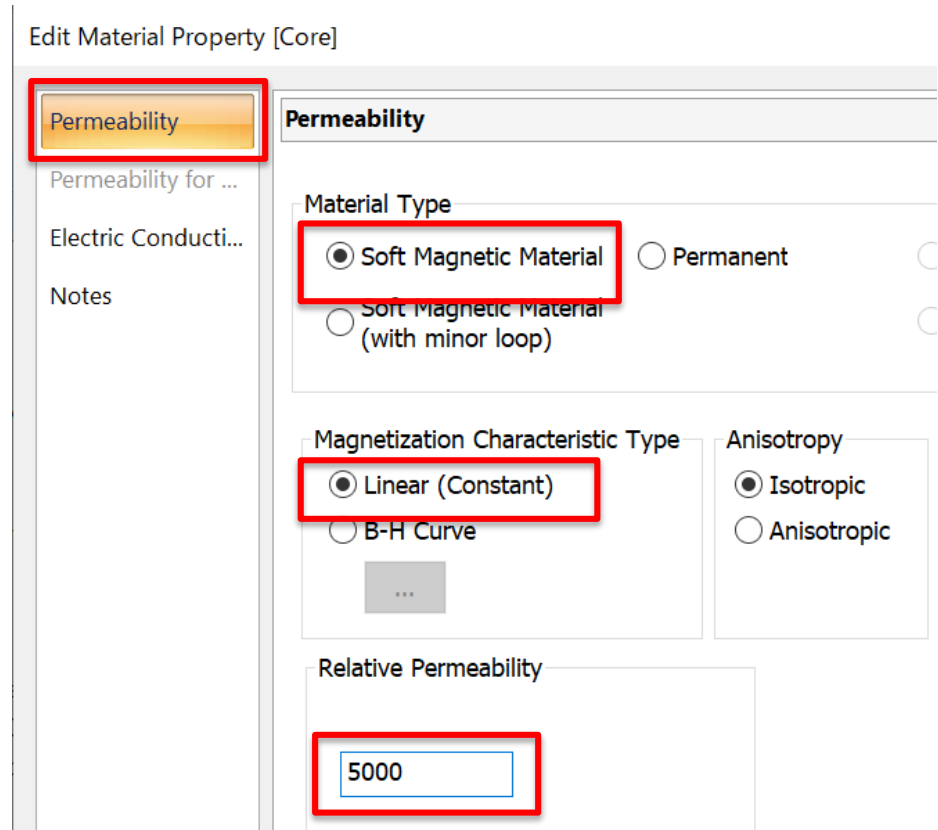
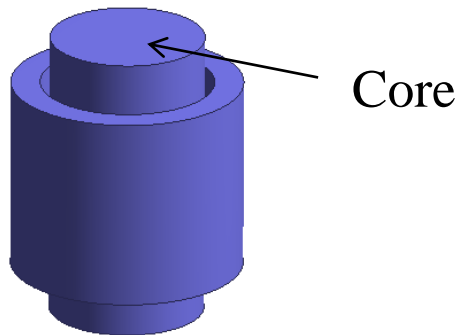
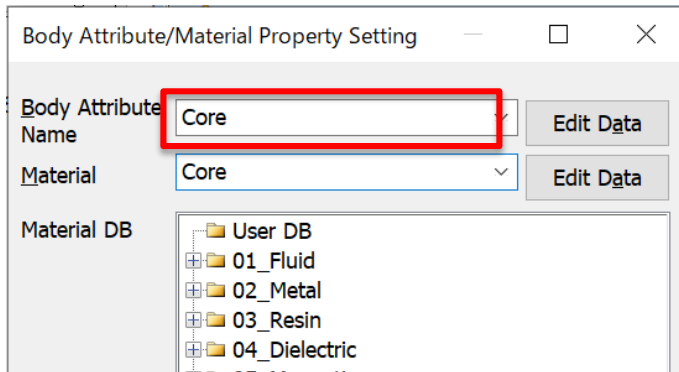
Setting body attribute and material property of Coil

The image displays two software dialog boxes for configuring a coil model. The left dialog, 'Body Attribute/Material Property Setting', has 'Coil' selected in the 'Body Attribute Name' dropdown and '008_Cu' in the 'Material' dropdown. The 'Material DB' list shows various materials, with '008_Cu' highlighted. The right dialog, 'Edit Body Attribute [Coil]', has 'Current' selected in the 'Thickness/Width' dropdown. Under the 'Current' section, 'DC' is selected as the waveform. The 'Value' section shows 'Current' set to 1 [A] and 'Turns' set to 100 [Turn]. Under the 'Direction' section, 'Loop Coil/Magnetic Field' is selected. The 'Magnetic Field Vector' section shows X: 0.0, Y: 0.0, and Z: 1.0. An 'Options' section at the bottom has a checkbox for 'Distribute the current uniformly' which is unchecked.



Create Model

Setting body attribute and material property of Core



Create Model

Set the general mesh size of 2mm in the analysis condition setting

Analysis Condition Setting

Solver

Magnetic Analysis

Mesh

External Magneti...

Open Boundary

Harmonic Analysis

Transient Analysis

Torque Calculation

Rotating Machin...

Fast Stabilizer

Calculation of M...

Motor Characteri...

High-Level Setting

Result Import

Notes

Mesh

Meshing Setup

Use Mesher G2

Execute G1 when failed

Set the general mesh size automatically

General Mesh Size [mm]

Element Type

1st-Order Element (Time Prioritized)

2nd-Order Element (Accuracy Prioritized)

Meshing control

Adaptive Mesh/Multigrid

Use the adaptive mesh method

Use the multigrid method

Automatic Ambient Air Creation

Create ambient air automatically

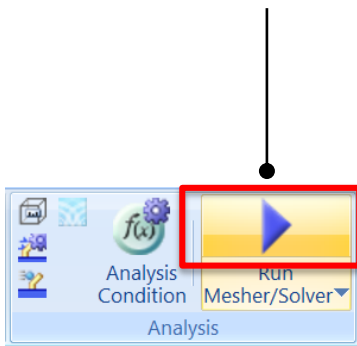
Ambient Air Scale Model Length x

Set mesh size automatically

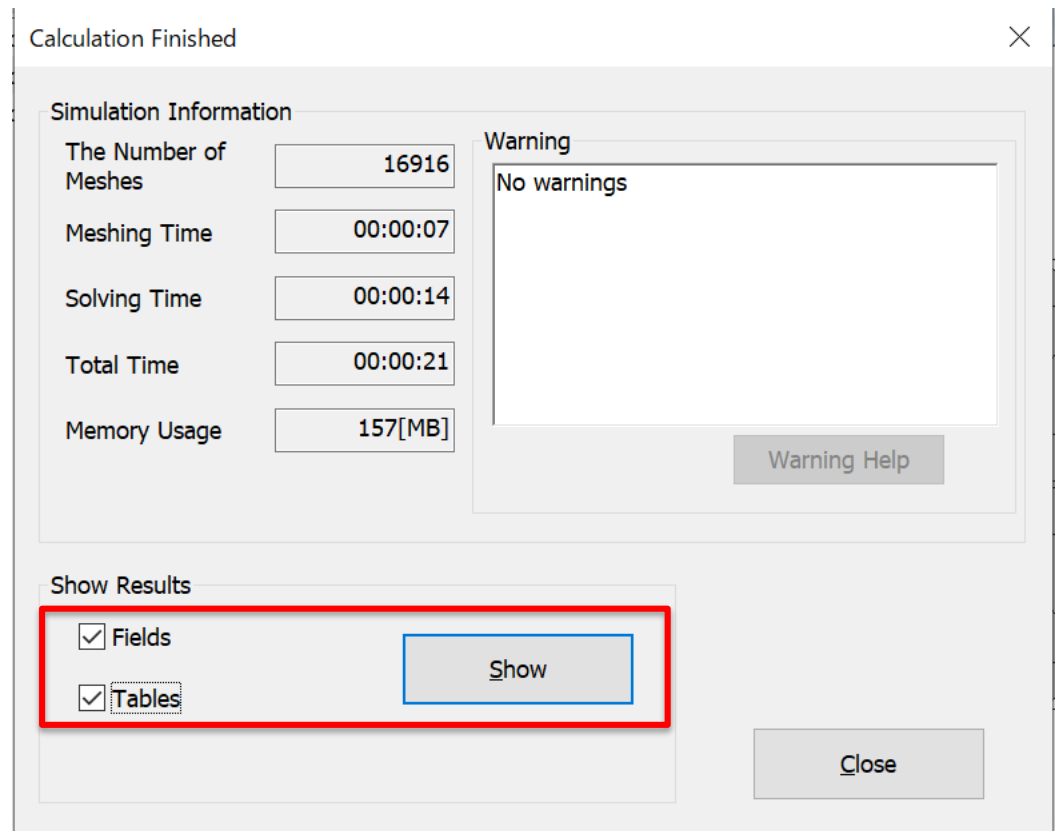
Mesh Size of Ambient Air [mm]

Run Solver

Run Mesher/Solver



Show Results

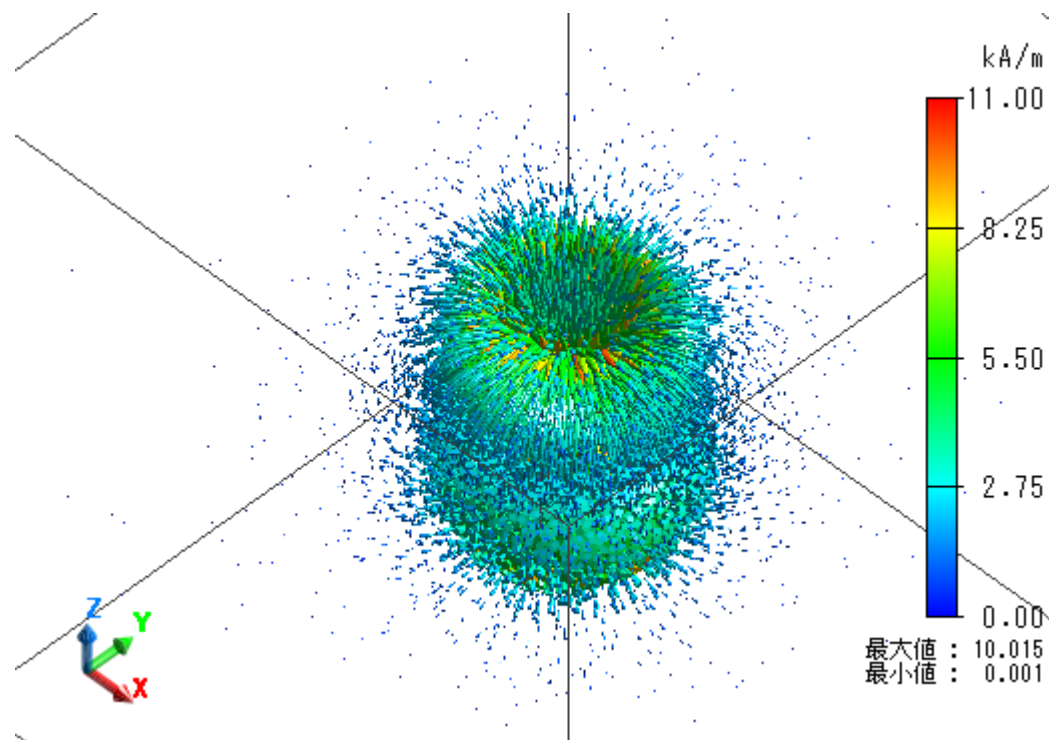


Inductance

Table

Magnetic energy [J]	Inductance [H]	Coupling	
	Value		
Coil 1	Coil	Coil_InAuto	Coil_OutAuto
L1			5.409e-4

Magnetic Field Vector



Create Quarter Model

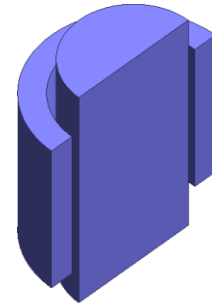
Select two bodies and cut to a quarter.

Command: Modification Operation → Cut

Point on the cutting plane: Origin (0, 0, 0)

Normal vector of the cutting plane: (-1, 0, 0)

Select [Keep bodies in the positive normal direction only]



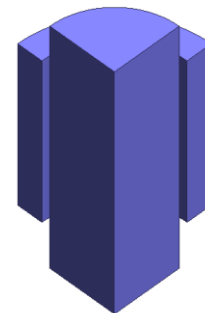

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Model's Maximum Dimension: 30 mm

Point on the cutting plane: Origin(0, 0, 0)

Normal vector of the cutting plane: (0, 1, 0)

Select [Keep bodies in the positive normal direction only]

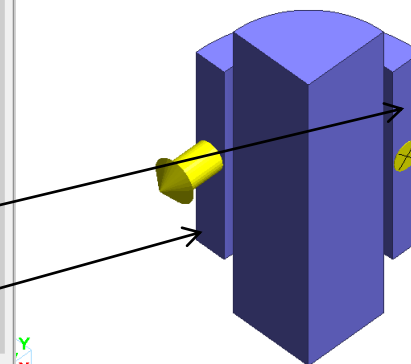
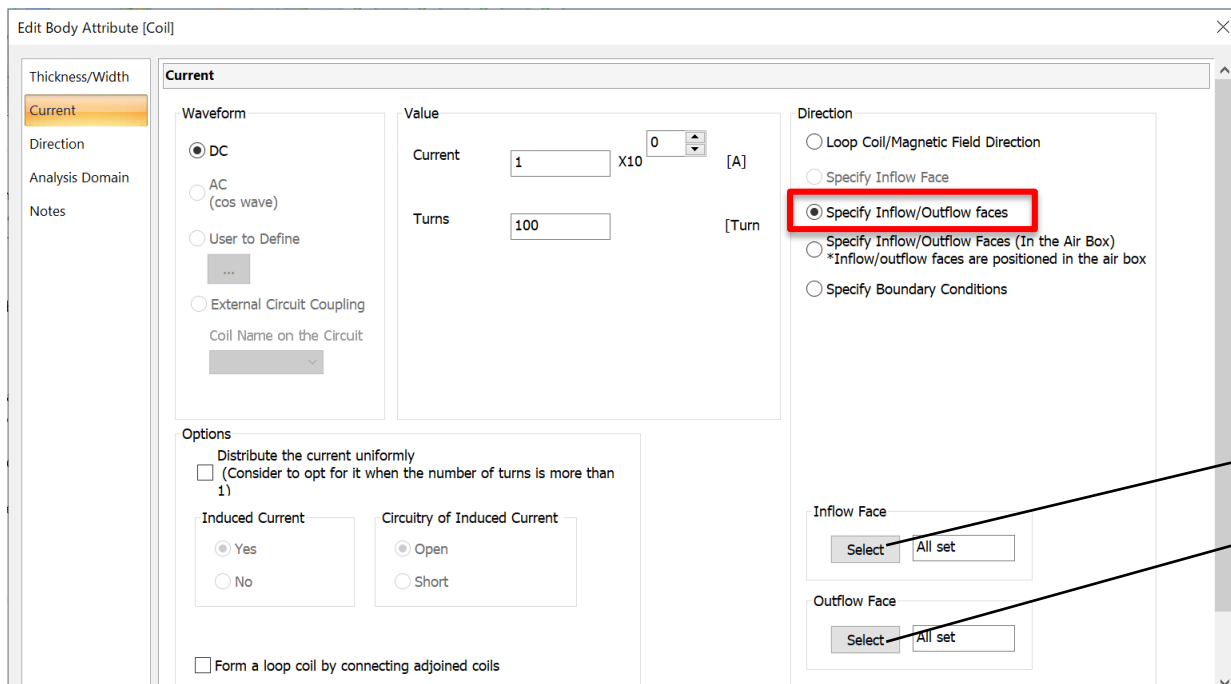



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Model's Maximum Dimension: 30 mm

Create Quarter Model

The model is not a loop coil.
Set the current direction in the body attribute setting

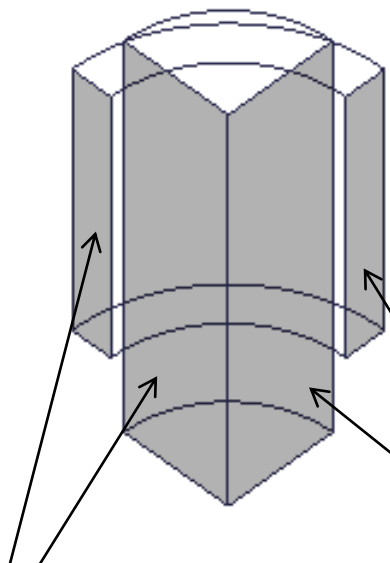


Created by Femtet
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Model's Maximum Dimension: 30 mm

Create Quarter Model

Set Reflective on the cutting plane



Edit Boundary Condition [symmetry_x]

Electric

Symmetry/Conti...

Notes

Symmetry/Continuity

Symmetry

Reflective

Periodic

Continuity

Discontinuous

Boundary Condition

Boundary Condition: symmetry_y

Edit Data

Add

Delete

OK Cancel

Boundary Condition

Boundary Condition: symmetry_x

Edit Data

Add

Delete

OK Cancel

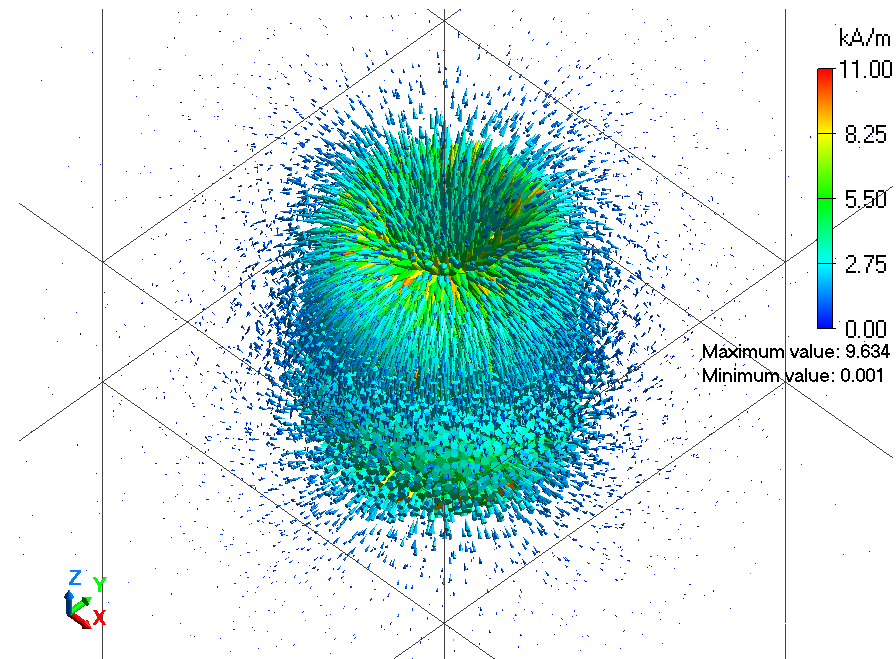
Inductance

Table

Magnetic energy [J]	Inductance [H]	Coupling coefficient	Electromagnetic Force [N]	FEM Info
	Value(4time...)			
Coil 1	0			
L1	5.48e-4			

Magnetic Anal | 0: Static Analysis | Display Options | Adjustment 4

Magnetic Field Vector



Type 4.0 as this is a quarter model.

The results mostly match those of the full model.