Murata Software

Femtet

Computer Aided Engineering System
Murata Software Co., Ltd.

Femtet Ver.2023.0 What's New

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Murata Software

Functionality	What's New(released in Femtet2022.1 Japanese Version)
Solver	

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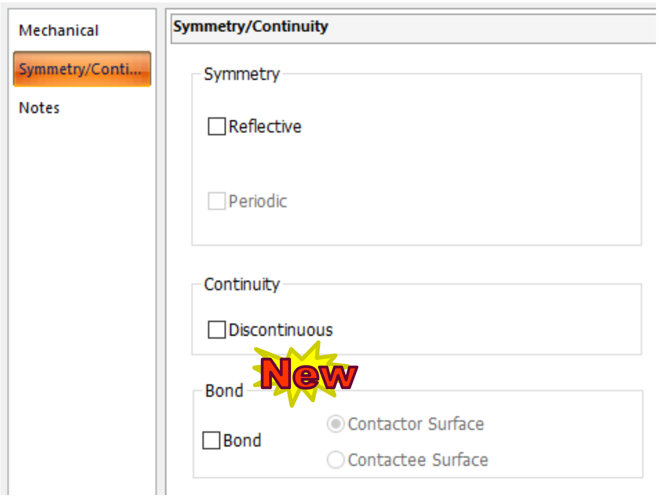
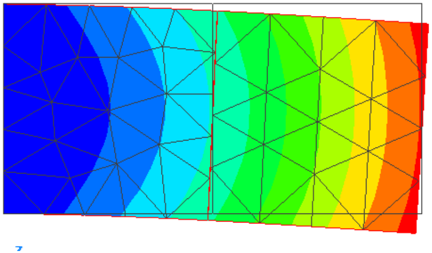
Murata Software

Bond as a Boundary Condition

Allows you to connect the separate meshes discontinuously.



Example of Stress Analysis



Separate meshes are connected discontinuously

- Discontinuously connecting separate meshes can improve meshing success rate and quality.
- Bond boundary condition is applicable in the stress and thermal analyses.
- Other solvers are going to support the bond boundary condition.

Higher Analysis Accuracy for 1st-order Hexahedral Elements

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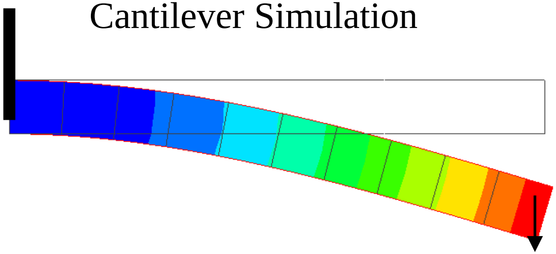
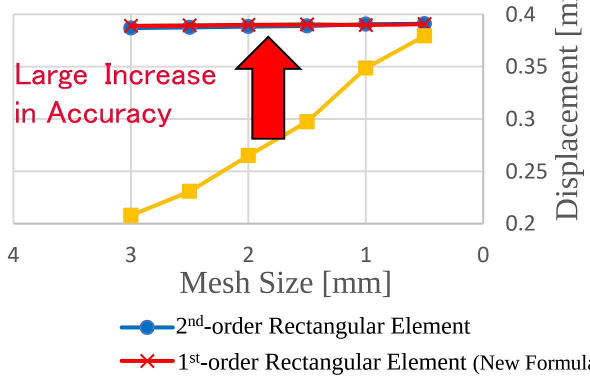
Improves analysis accuracy for 1st-order hexahedral elements in the stress analysis.

- We implemented the enhanced assumed strain method to improve the analysis accuracy for 1st-order elements. We had not supported hyperelastic and elasto-plastic materials yet.
- In the version 2023.0, hyperelastic and elasto-plastic materials have been applicable for the enhanced assumed strain method. The method also has improved the possibility of convergence for large displacement.

Cantilever Simulation



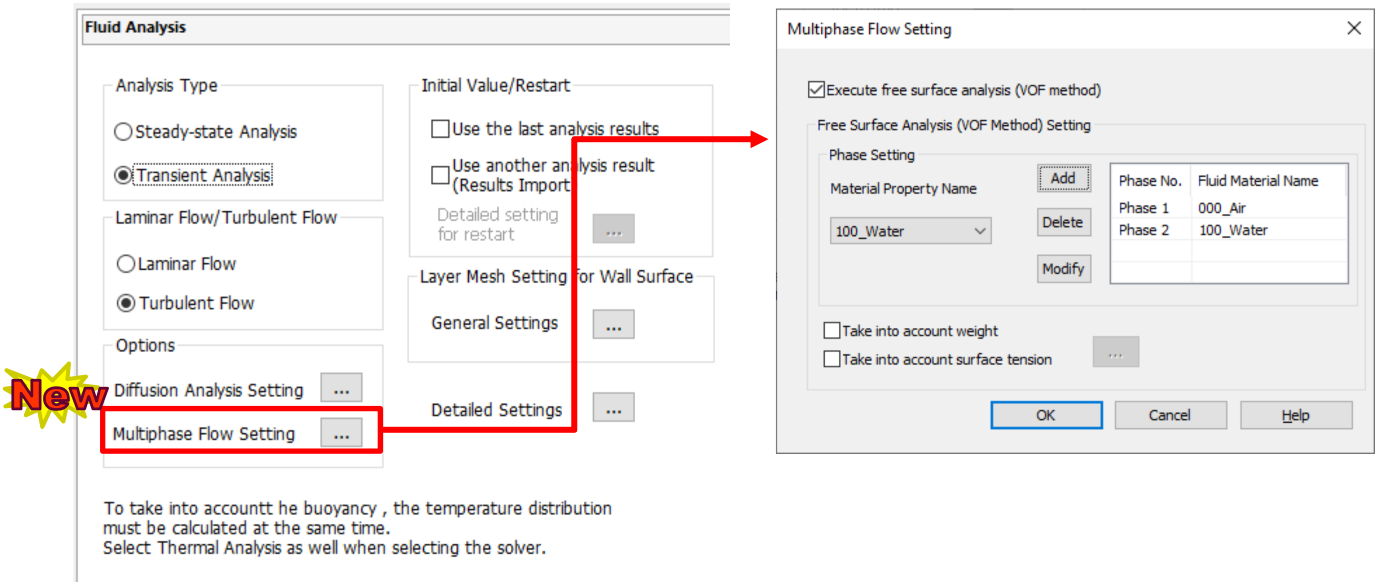
Analysis Result of Displacement



Solver: Fluid & Fluid-Thermal
Free Surface Analysis (VOF Method)

Murata Software

Available for fluid & fluid-thermal solvers



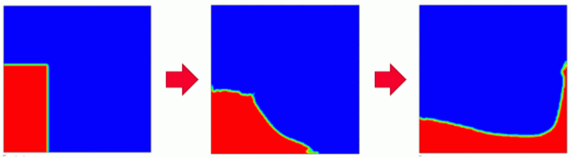
- Multiphase flow including multiple fluids, gas or liquid, can be analyzed.
- The movement of boundaries between gas and liquid caused by gravity, surface tension, and wetting (contact angle) can be calculated.
- Only available in the transient analysis.

Solver: Fluid & Fluid-Thermal
Free Surface Analysis (VOF Method)

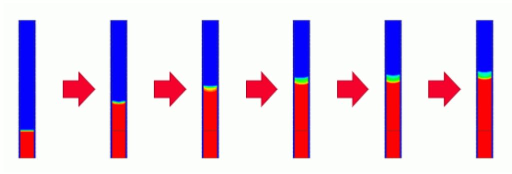
Murata Software

Available for fluid & fluid-thermal solvers

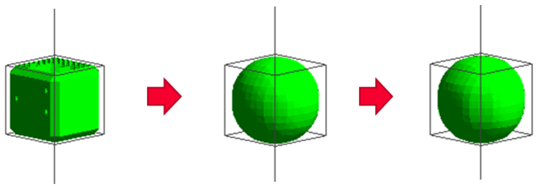
Example 14: Dam Break Analysis



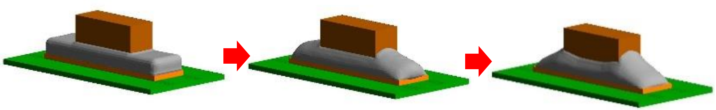
Example 16: Capillary Action Analysis



Example 15: Droplet Formation Analysis



Example 17: Solder Wicking Analysis



Note:

- Calculating the movement of a boundary requires a small timestep.
- Meshes as small and as regular as possible are required to reproduce the boundary shape precisely. Sweep meshes are recommended.

Moving Wall as a Boundary Condition

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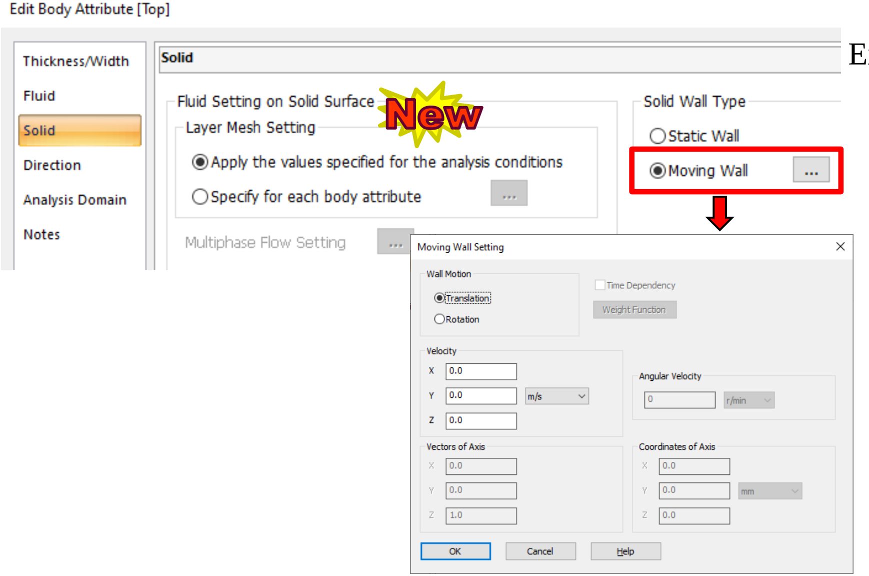
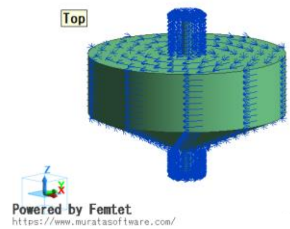
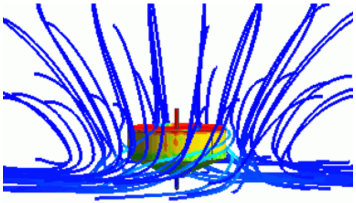
Available for fluid & fluid-thermal solvers



Example 18: Flow Around Spinning Top





- Translation velocity and rotational angular velocity can be specified to the wall face.
- The velocity component in the direction parallel to the wall face is taken into account and the velocity component in the normal direction is ignored.
- The rotational condition is applicable for a rotational symmetric body such as a top.
- The moving wall can be selected on the [Edit Boundary Condition] or [Edit Body Attribute] dialog box.

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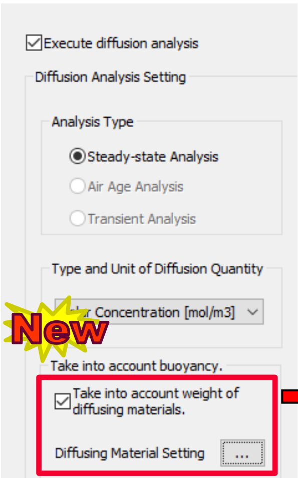
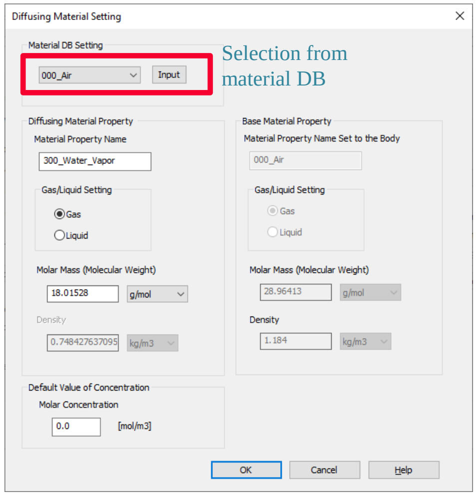
Allows the analysis with weight of diffusing materials taken into account.

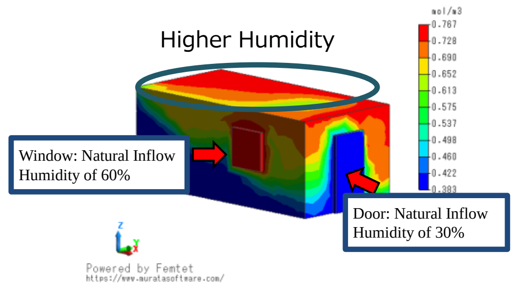
Diffusion Analysis Setting



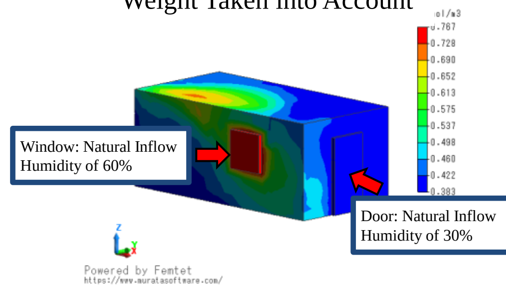
Diffusing Material Setting



Example 20: Room Ventilation (Air of Humidity)



Weight Taken into Account



Weight not Taken into Account

- Setting a diffusing material allows the analysis with weight of diffusing materials taken into account.
- You can calculate water vapor diffusion in the air as follows.

  As water vapor is lighter than dry air, buoyancy is generated in a humid area.

  Then water vapor tends to stay around the top due to buoyancy.

Solver: Fluid & Fluid-Thermal
Enhanced Boundary Condition for Diffusion Analysis

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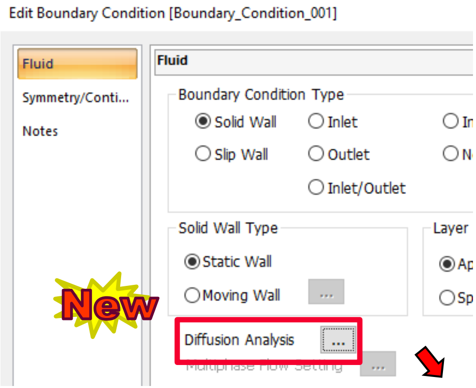
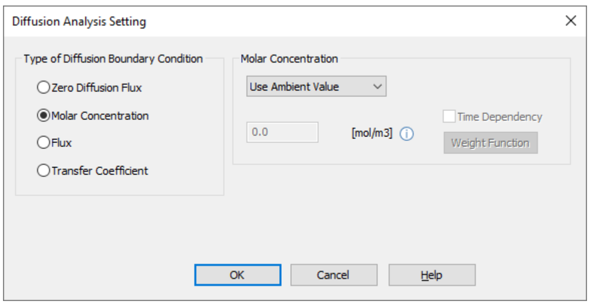
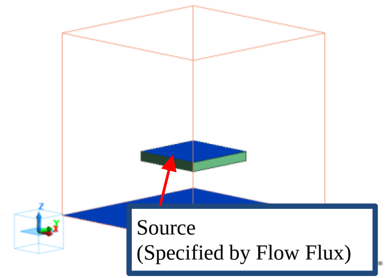
Allows you to set the movement of diffusing materials from a wall face.

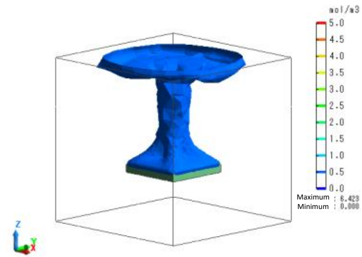




You can set a diffusion source on a wall face.

Example 19: Convection Caused by Generation of Impurity Substance

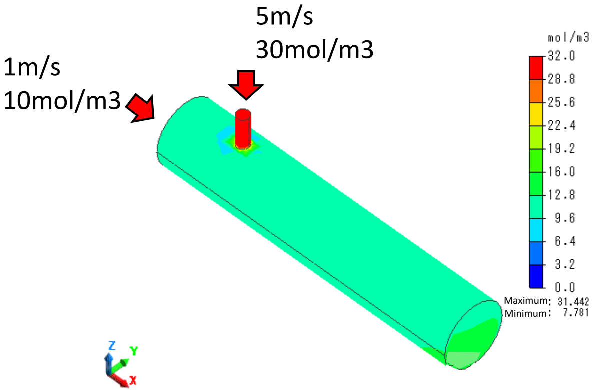




Concentration Distribution

Solver: Fluid & Fluid-Thermal
Enhanced Result Table for Diffusion Analysis

Allows outputs of the inflow rate, outflow rate, and an average, of diffusing materials on a boundary.



Mixed Flow Analysis of Diffusing Materials

FEM Info | Convergence status | Molar Concentration [mol/m3] | Molar Concentration Flow Rate [mol/s]

	Value
Inlet	10.000
Inlet_2	30.000
Outlet	13.100
Outer_Boundary_Con	11.334

Concentration of Diffusing Materials at Outlet

FEM Info | Convergence status | Molar Concentration [mol/m3] | Molar Concentration Flow Rate [mol/s]

	Value
Inlet	3.055e-3
Inlet_2	1.681e-3
Outlet	-4.736e-3
Outer_Boundary_Con	-7.247e-7

Flow Rate of Diffusing Materials at Inlet

Improved Setting of Fluid Boundary Condition

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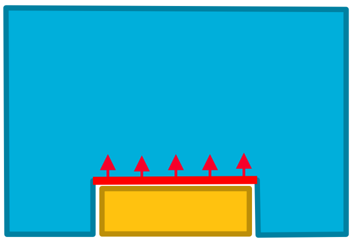
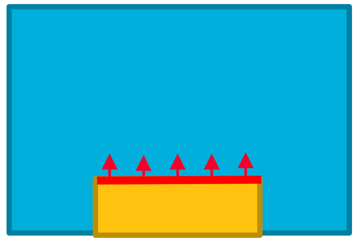
Allows easy fluid boundary condition setting to the boundary between solid and fluid.

Before



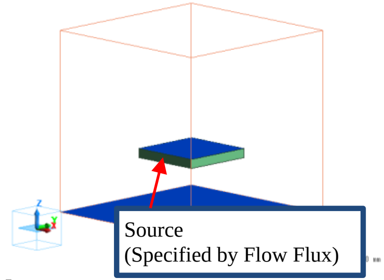
1. Apply Boolean operation (Subtract).
   ➡ Create a fluid domain
2. Set a boundary condition on the face of the fluid.
   *Only for wall boundaries,
   not available for inflow/outflow boundaries.

Ver.2023.0



1. Set a boundary condition on the face of the solid.
   (Without Boolean operation)
   *Also available for inflow/outflow boundaries

Example 19: Convection Caused by Generation of Impurity Substance



Application Examples

- An inlet located on a solid surface. (Air conditioner, Humidifier, etc.)
- A diffusion source located on a solid surface.

Two-way Coupled Analysis in Electric-Fluid-Thermal Analysis

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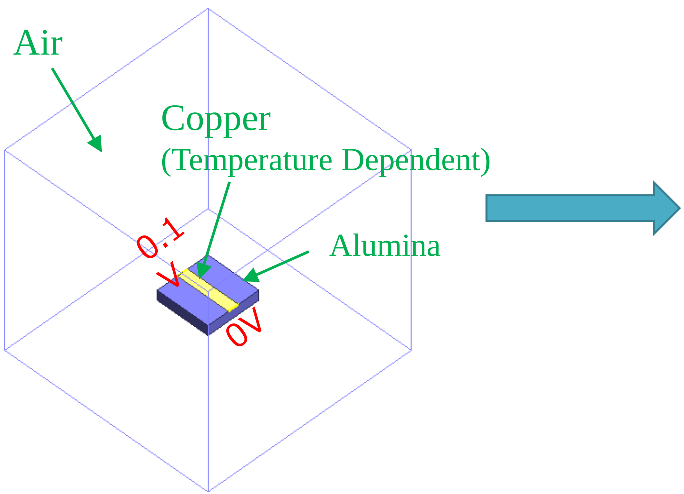
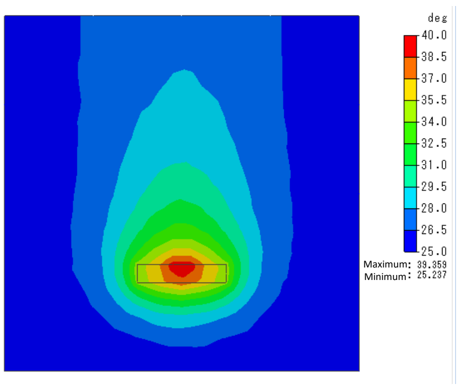
Allows two-way coupling between Electric Analysis and Fluid-Thermal Analysis

- Loss density is calculated in the electric analysis. Then using the loss density as a heat density, fluid-thermal analysis will be performed. This procedure allows the electric-fluid-thermal analysis.
- Allows the electric-fluid-thermal analysis with temperature dependency of conductivity taken into account.

Model



Temperature Distribution



Temperature Distribution of
Air around Heating Substrate

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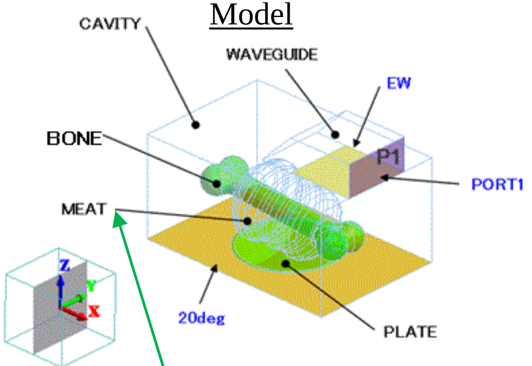
Allows two-way coupling between Electromagnetic-Harmonic Analysis and Thermal Analysis

- Allows the electromagnetic-harmonic analysis and the thermal analysis with temperature dependency of permittivity taken into account.
- Applicable for the thermal steady-state and thermal transient analyses.

Model

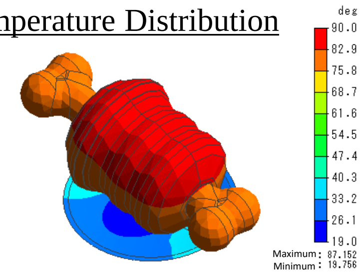


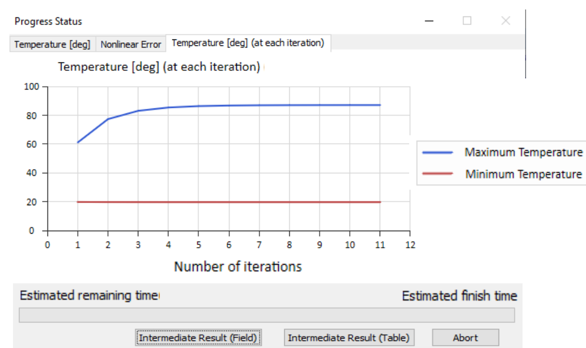
Temperature Dependency of Water Permittivity

[Temperature- Relative Permittivity] Graph

No.	Tempera...	Relative p...	tanD
1	20	80.36	0.16
2	40	73.39	0.16
3	60	67.03	0.16
4	80	61.06	0.16
5			

Temperature Distribution



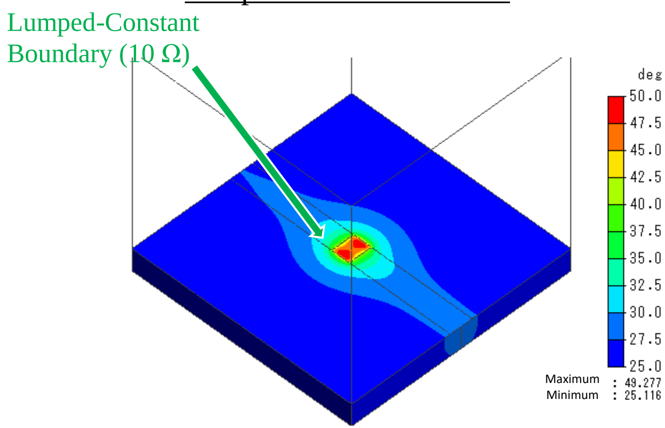


Calculation of Surface Loss Density in Electromagnetic-Thermal Analysis

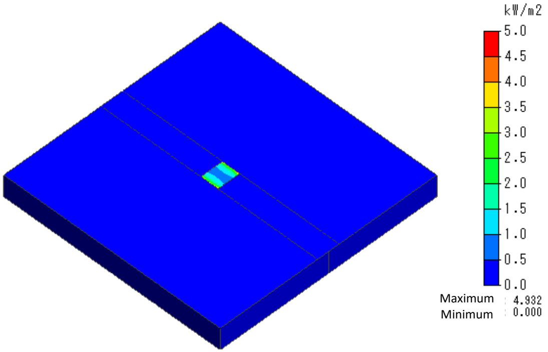
Allows you to calculate surface loss density and display the result.

- If lumped-constant or surface impedance is set to boundary conditions, you can calculate the surface loss density.
- The result display permits you to check the distribution of surface loss density visually.

Temperature Distribution



Surface Loss Density [W/m2]



Surface Loss Density: $\frac{1}{2} Real\left(\frac{(\boldsymbol{E} \times \boldsymbol{n}) \cdot \overline{(\boldsymbol{E} \times \boldsymbol{n})}}{\bar{Z}}\right)$

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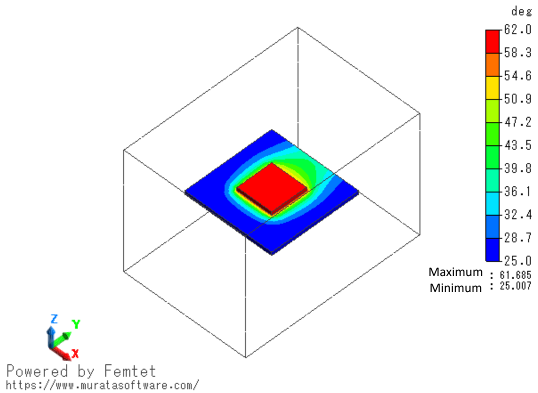
Allows the fluid-thermal-stress coupled analysis.

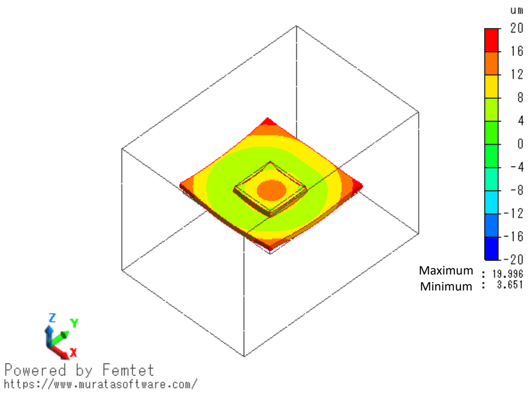
- Perform the stress analysis using temperature distribution obtained from the fluid-thermal analysis.
- The coupling is one-way from thermal to stress. It is not possible to analyze how the deformation affects the flow and temperature fields.

Fluid-Thermal-Stress Coupled Analysis
Example 1: Substrate Warping Caused by IC Heat Generation

Temperature Distribution (Chip Heating)



Displacement Distribution (Substrate Warping)



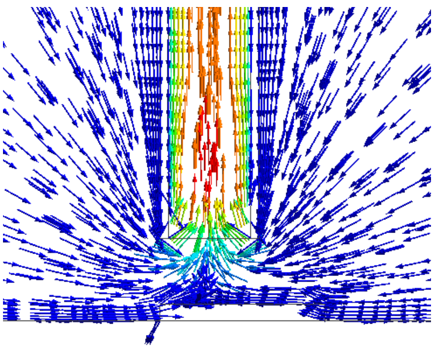
Allows the fluid-stress coupled analysis.

- Perform the stress analysis using the pressure/shear stress distribution on a solid surface obtained from the fluid analysis.
- The coupling is one-way from flow to stress. It is not possible to analyze how the deformation affects the flow field.

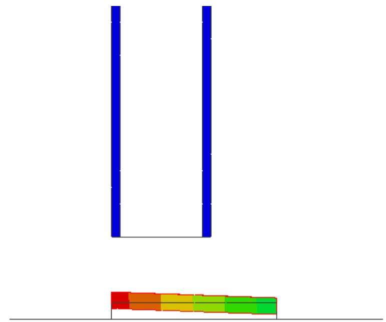
(The example allows you to analyze the movement of the disc just after the moment when the disc has been pulled up.)

Fluid-Stress Coupled Analysis
Example 1: Nozzle Suction Analysis

Flow Velocity Distribution in Pulling Up



Movement Just After Being Pulled Up



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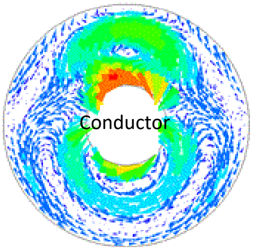
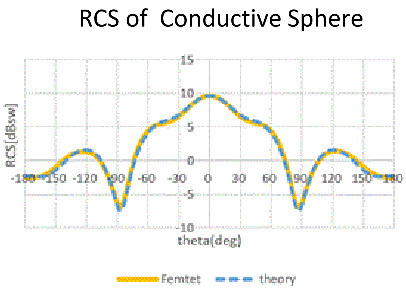
Electromagnetic Analysis Examples are added.

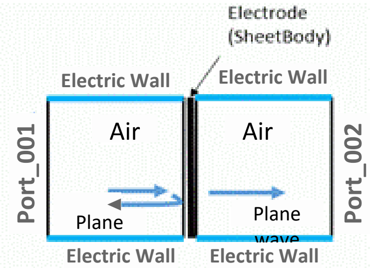
Example 45: Radar Cross Section (RCS) of Conductive Sphere

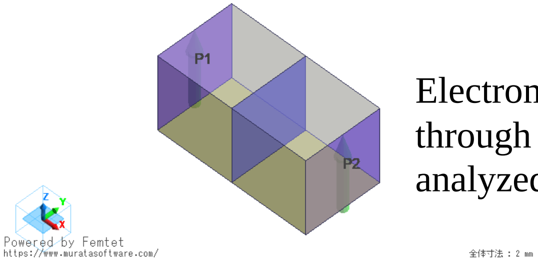




Femtet can not calculate RCS directly. Just adding the values from Femtet in Excel will give you RCS [dBsw].

Example 44: Thin Electrode Elements





Electromagnetic waves passing through a thin electrode are analyzed.

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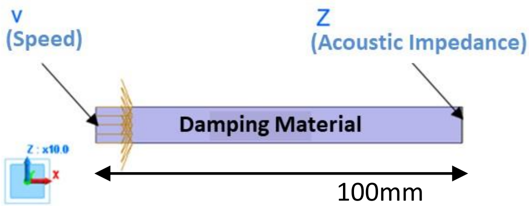
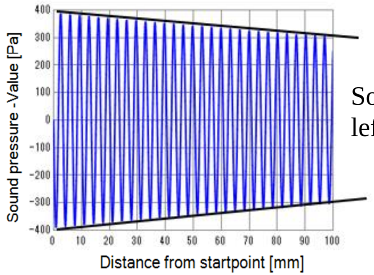
Acoustic Analysis Examples are added.

Example 12: Damping

This example demonstrates how to apply a known attenuation rate [db/m] to a simulation.



Analysis Model

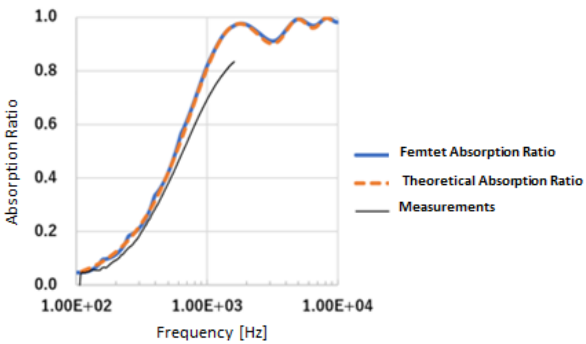


Sound waves propagating from left to right are analyzed.

Change of Sound Pressure Distribution (Instantaneous Value)

Example 13: Sound-absorbing Material

- This example demonstrates how to perform the acoustic analysis using a sound-absorbing material.
- Enter the frequency response of complex sound speed and complex density in the table.
- Obtain the frequency response of the absorption ratio as shown on the right.



Improvement in Results Import

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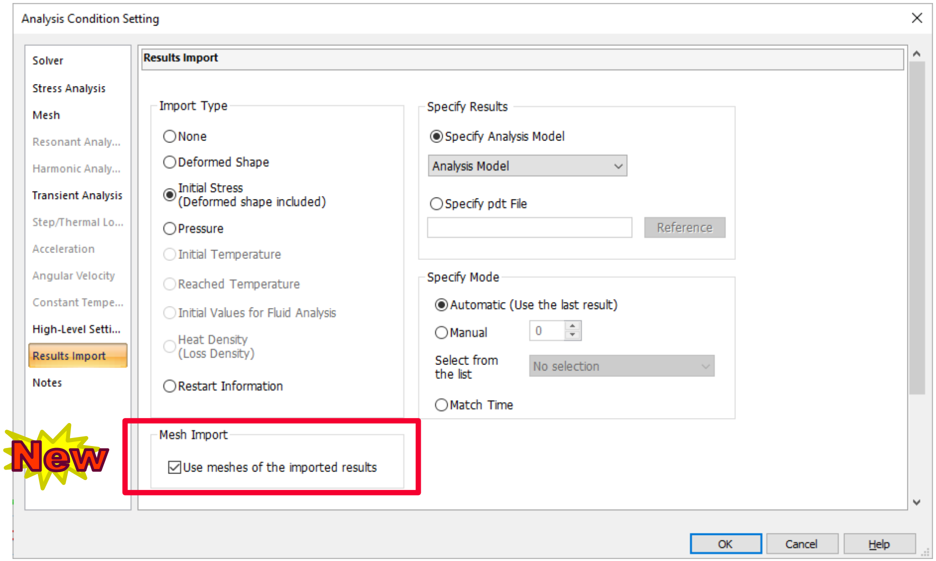
Allows you to use the meshes of the imported results for analysis



- In some functions of the results import, if the meshes of the analysis model and imported result are different, the results import may fail.
- This option can solve the problem above.
- Meshes of the imported results are applicable for analysis if [None] is selected for the import type. The effect is the same as [Run Solver with Existing Meshes].

Solver: Stress
Higher Analysis Accuracy for 1st-order Hexahedral Elements

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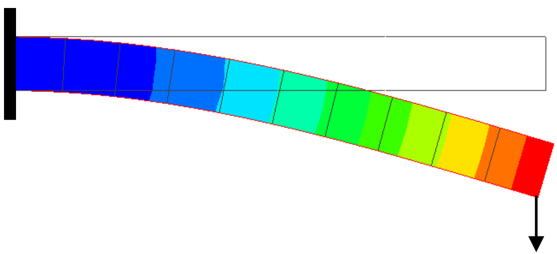
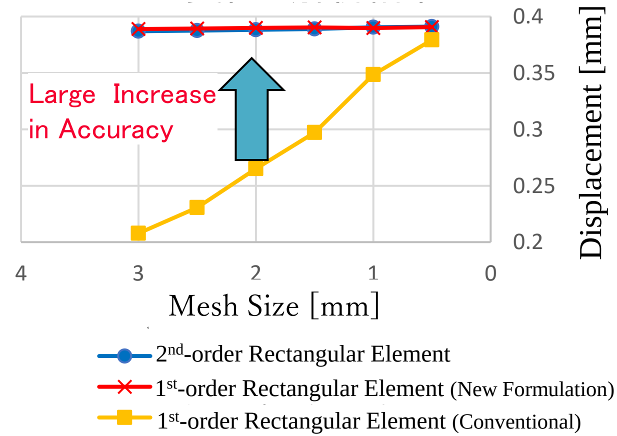
Improves analysis accuracy for hexahedral and rectangular elements in the stress analysis.

- If meshes are coarse, Femtet ver. 2022.0 may not achieve the intended analysis accuracy.
- The newly introduced formulation method, Enhanced Strain Assumption Method, has greatly improved the analysis accuracy for 1st-order elements of 3D hexahedrons and 2D rectangles.

Cantilever Simulation



Analysis Result of Displacement



*Hyperelastic, elasto-plastic, and shell elements are not applicable.
*Not supported by the piezoelectric analysis.

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Imaginary Part Entry on Acceleration Tab

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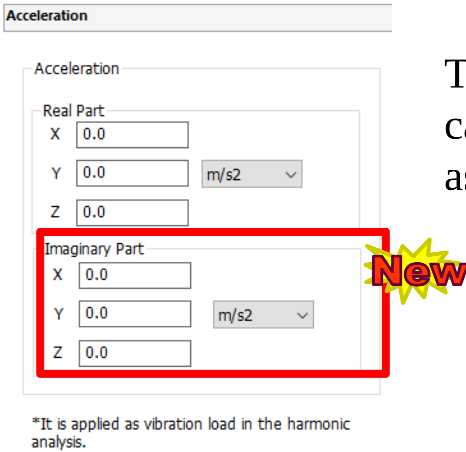
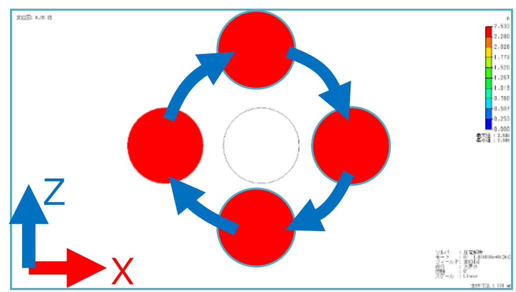
Available in the stress-harmonic analysis.

Analysis Condition
Acceleration Tab



The stress solver has been able to calculate the imaginary part as well as the piezoelectric solver does.

By entering the values above, a vibration revolving about a center can be generated, as illustrated on the right.



Solver: Fluid & Fluid-Thermal
Type and Unit of Diffusion Quantity Setting

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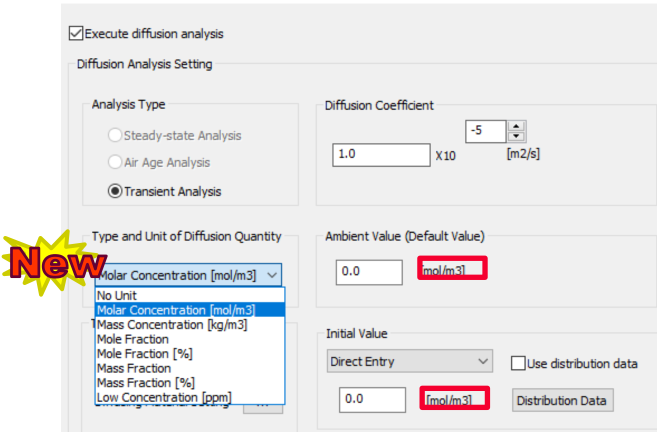
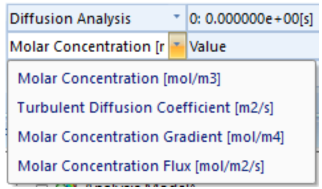
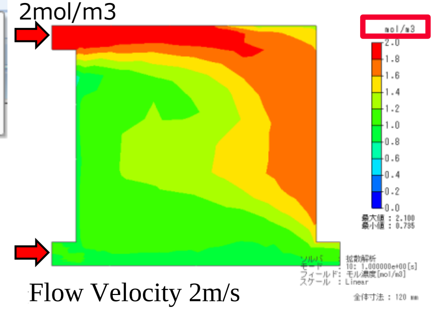
Allows you to set the type and unit of diffusion quantity.



Field Types for Molar Concentration



Flow Velocity 1m/s
Molar Concentration 2mol/m3



Flow Velocity 2m/s
Molar Concentration 1mol/m3

- By setting a type and unit of diffusion quantity in the dialog box above, a concentration value in the diffusion analysis becomes easy to set, and a result display becomes easy to view.
- The field value of a field type is indicated accompanied by a unit.

Solver: Fluid & Fluid-Thermal
Output of Quasi-steady State

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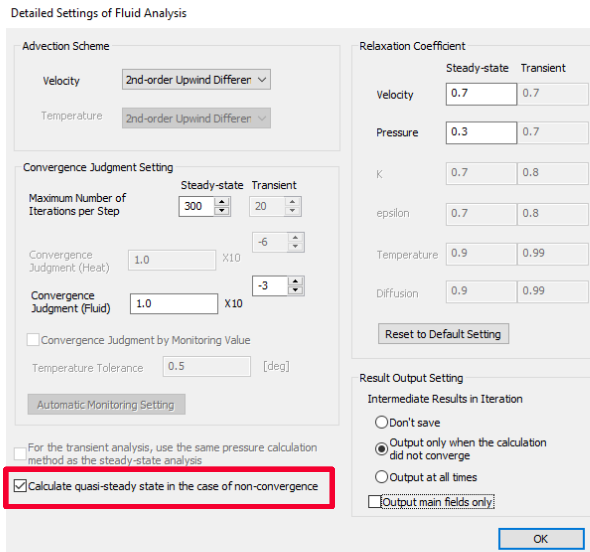
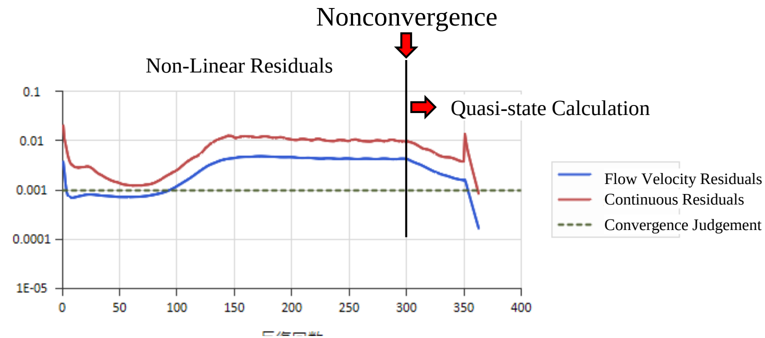
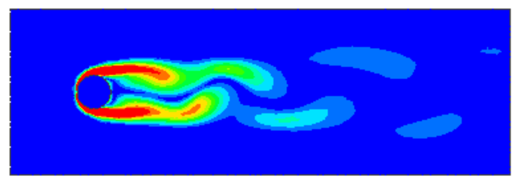
Allows you to output quasi-steady state if periodically fluctuating vibration prevents analysis residuals from reducing and causes non-convergence.







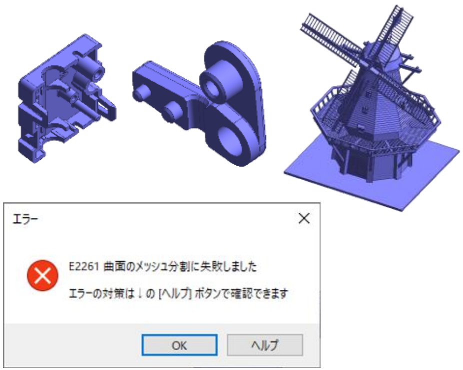
Quasi-state of Karman Vortex

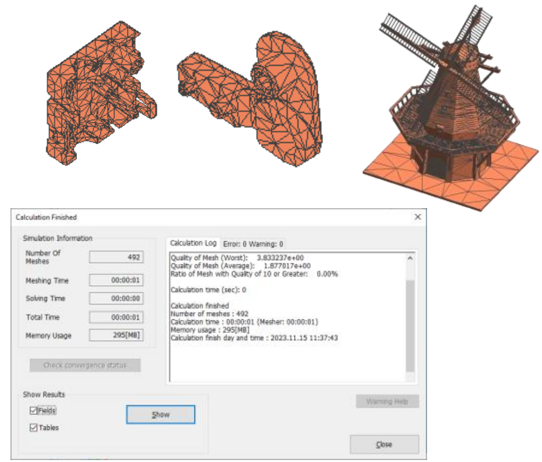
- If not converging, switch the analysis type to the transient analysis with finite timesteps and calculate the quasi-steady state.
- An instantaneous state of the vibration is output.
- After the calculation with no convergence, restart allows you to start calculating the quasi-steady state.

Murata Software

Improves meshing success rate by the updated algorithm

Error occurrence rate has decreased by 80% and meshing success rate has increased.





Extract the models that cause meshing errors from big data of CAD models or ABC Dataset. *1

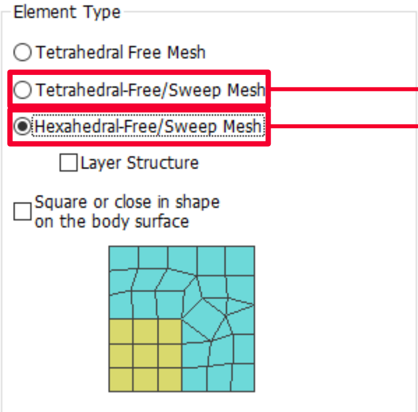
The algorithm that divides curved faces and restores edges and faces has been improved to increase the meshing success rate.

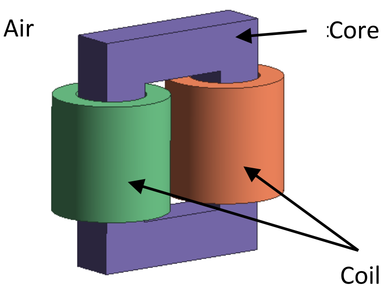
*1 ABC Dataset: https://deep-geometry.github.io/abc-dataset/

Murata Software

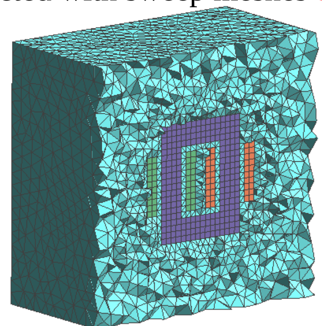
Allows sweep and free coexisting meshes

New Meshing Setup Dialog

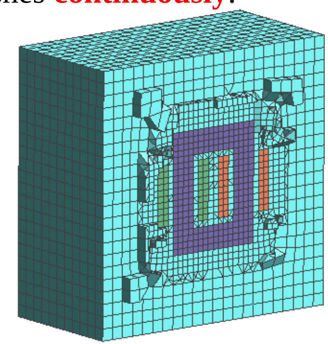




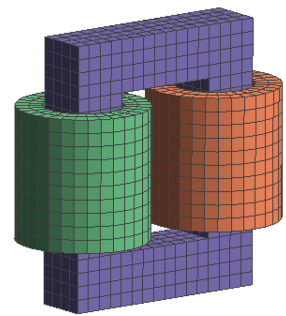
Air is divided by tetrahedral free mesh.
Connected with sweep meshes **by bond boundary**.



Air is divided by hexahedral free mesh. Connected with sweep meshes **continuously**.



Coil and core are divided by sweep mesh.

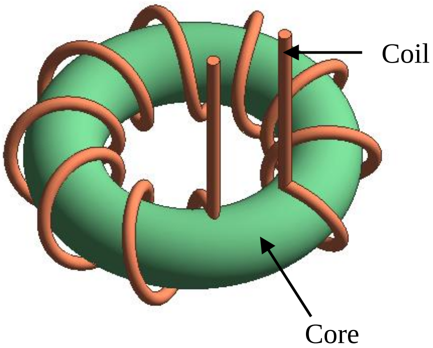


Adaptive Mesh on Curved Face

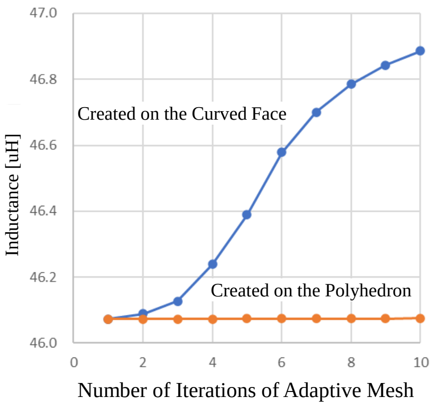
Murata Software

Allows you to create adaptive meshes on a curved face.

- We have tried adaptive meshes on the polyhedron, the plate, that was used for the initial meshing. We noticed due to this, the errors in shape to the curved face have been disadvantageously larger.
- Femtet ver.2023.0 can create adaptive meshes on a curved face, decreasing in errors.
- The graph below indicates as the number of iterations of applying the adaptive mesh method increases, the inductance increases and approaches the real value.

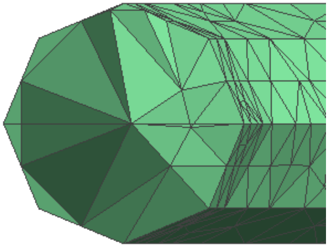


Number of Iterations of Adaptive Mesh vs Inductance

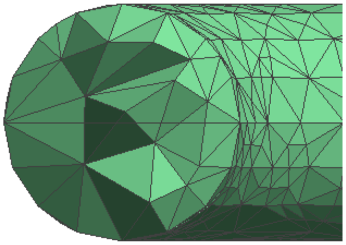


Meshes on the Cross Section of a Core

Created on the Polyhedron



Created on the Curved Face



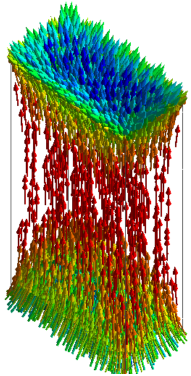
Mesher
Adaptive Meshing Improved in Quality

Allows the mesh elements to change gradually instead of becoming locally concentrated.

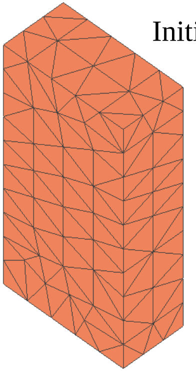
- We tried the adaptive mesh method to notice as follows. It arranges much smaller elements in the area where the electric field and the stresses concentrate or drastically change. This may cause the quality of meshes to degrade and the convergence of calculation to be delayed.

- The adaptive mesh method of Ver.2023.0 has achieved a good quality of meshes by changing the mesh elements gradually from properly small elements.

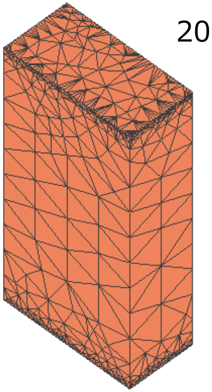
- The diagram on the right shows the meshes of a bar magnet after the adaptive mesh method has been applied ten times. The meshes concentrated around Edge exhibit gradual variation in size.



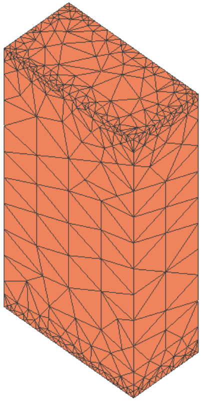
Magnetic Flux Density



Initial Meshes



2022.1



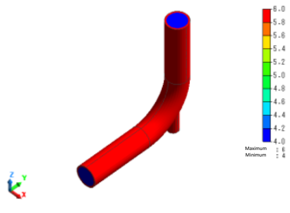
2023.0

Improved Creation of Layer Meshes for Fluid Analysis

Murata Software

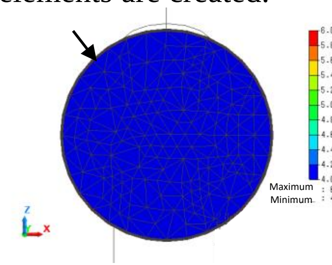
Improves the layer mesh creation.

- Meshing errors during mesh generation process have been greatly reduced.
- The layer meshes can have proper thickness regardless of the models.



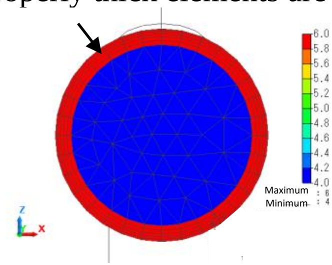
Pipe Model

Very thin elements are created.

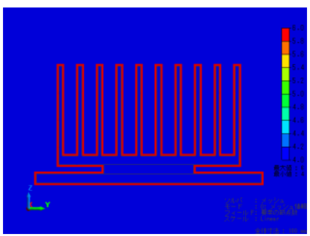


Bofore

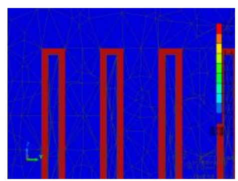
Properly thick elements are created.



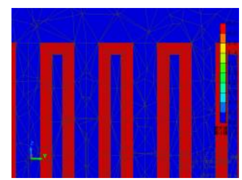
Ver.2023.0



Heatsink Model



Before

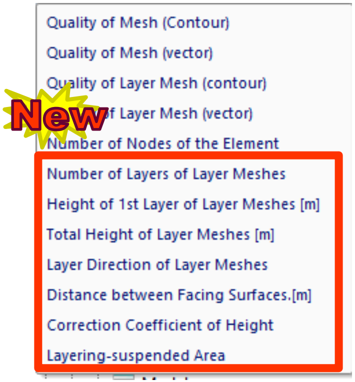


Ver.2023.0

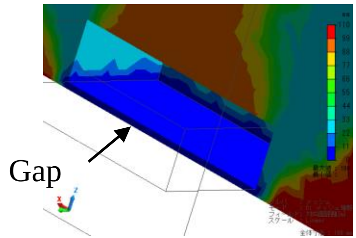
Layer Mesh Check for Fluid Analysis

Murata Software

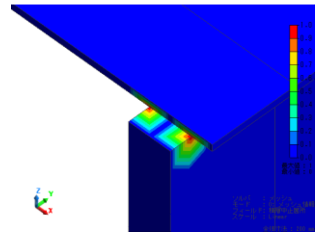
Allows you to check the state of layer mesh generation.



- You can check the information on the meshes on the wall surface by the field values.
- If you cannot get your desired convergence or accuracy, the information will give you some hints for a better model.



Distance Between Facing Surfaces



Layering-suspended Area

Correction Coefficient of Height

- You can check the area where the height has been corrected lower during the layer mesh process.
- The area where the correction coefficient is extremely small may have problems in the model.

Distance between facing surfaces

- You can check the distance to the facing wall.
- If the distance is extremely small, the model may include an unintended gap.

Layering-suspended area

- You can display the non-layered area.
- The non-layered area may hinder the convergence.

Result Display
Improved Cross-Section Display

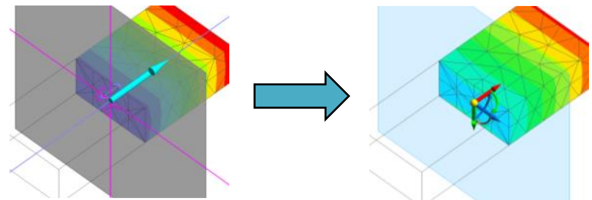
Allows improved cross-section display for result display.

Time of processing cross section for large-scale model

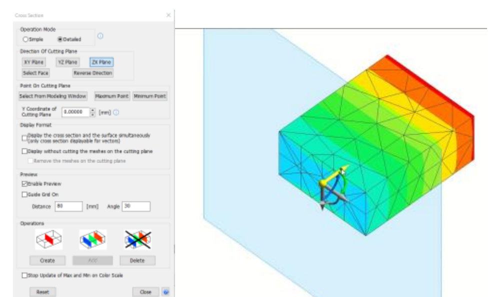
Previous	Improved
6 [s]	2 [s]

- Faster generation process of the cross-section
  - Parallel processing
  - Reconstructed cash data structure

Previous UI **Improved UI**



- Improved user interface for intuitive operation



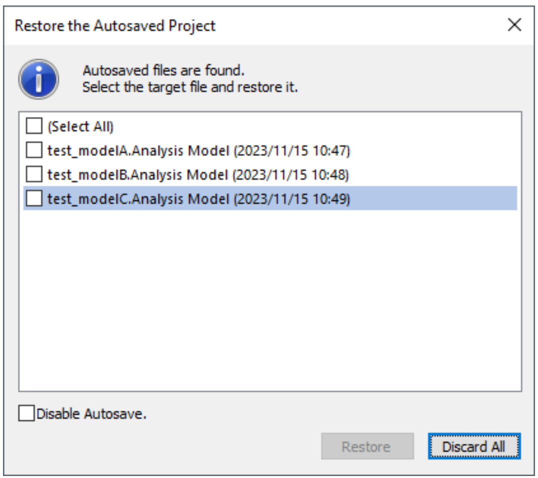
- Cross section preview in response to cross section operation

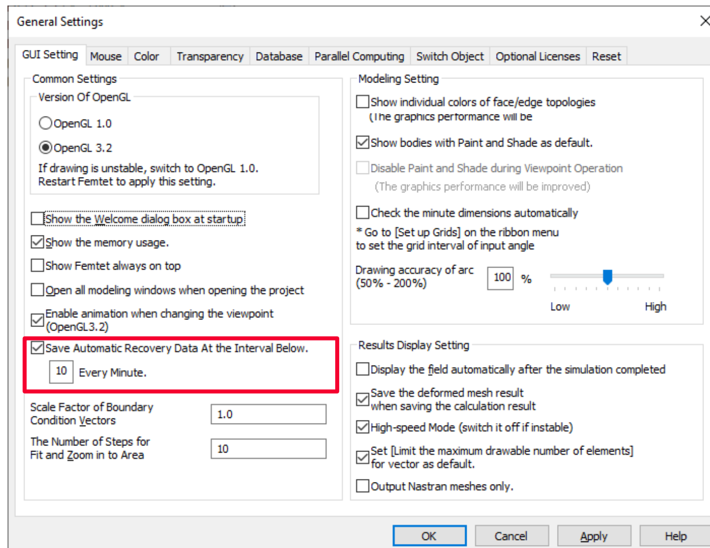
Autosave of Project Data File

Murata Software

Allows automatic regular saving of the restoration Femtet project file.

- The restoration file for Femtet project data has been saved automatically and regularly. In case of emergency for Femtet applications, that file allows you to restore the normal state.
- By default, every ten minutes, the data is saved.
- In General Settings, autosave can be switched on/off and its interval time can be changed.



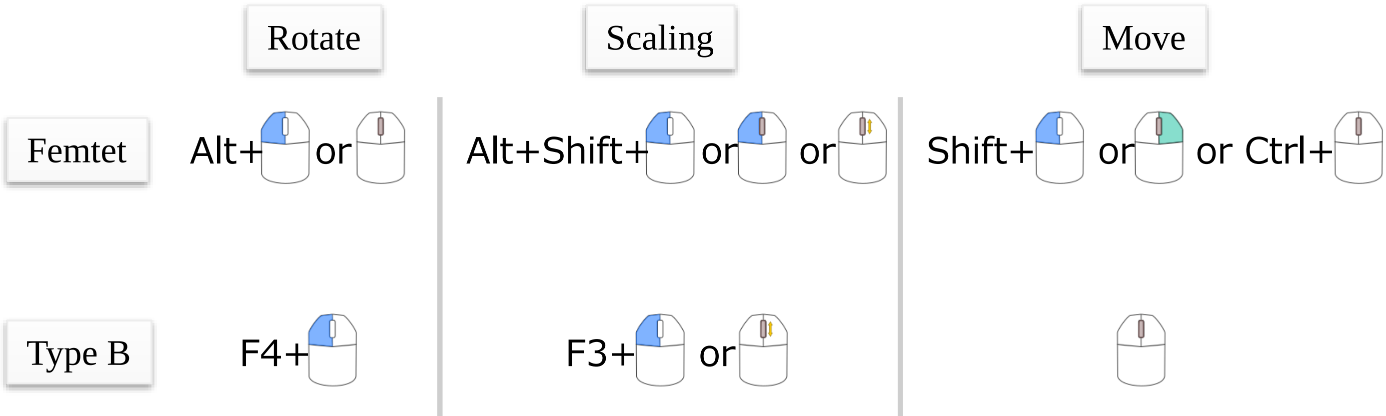


Murata Software

Customizes the operations of rotate viewpoint, scaling, and move by mouse.

Viewpoint operations by mouse can be tailored according to your preference.

Example: Change the default setting, Femtet, to Type B.

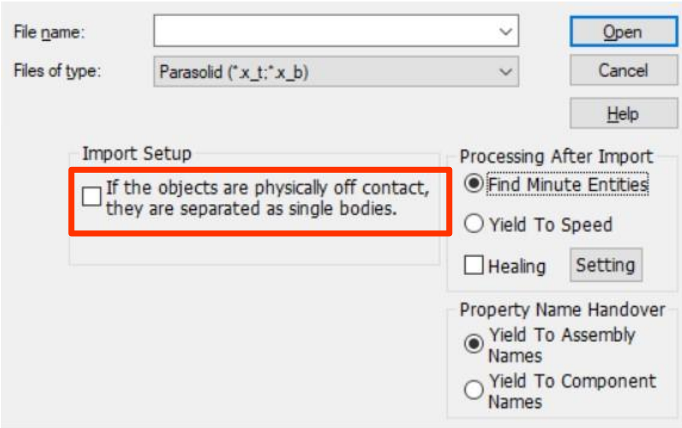


[Application Menu]>[General Settings], and select the [Mouse] tab

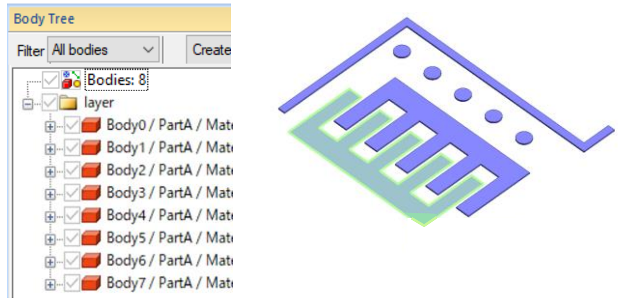
Body Separation in Importing

Murata Software

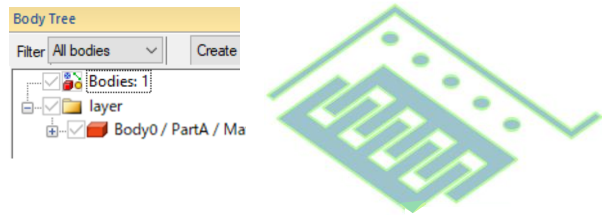
Allows you to separate physically off-contact objects into single bodies when .x_t files are imported.



Separated



Not separated



When imported, even physically off-contact bodies might be imported as one body. By selecting the [Import Setup], the bodies will be automatically separated.

For more information, contact us at

https://www.muratasoftware.com/en/support/inquiry/