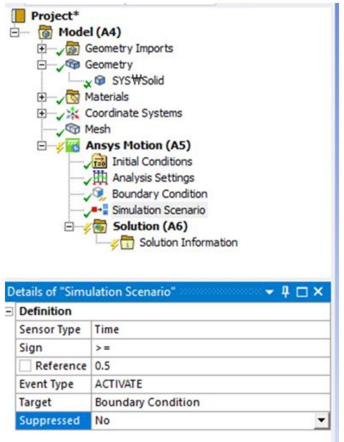
Release 2023 R1 Highlights
Ansys Motion

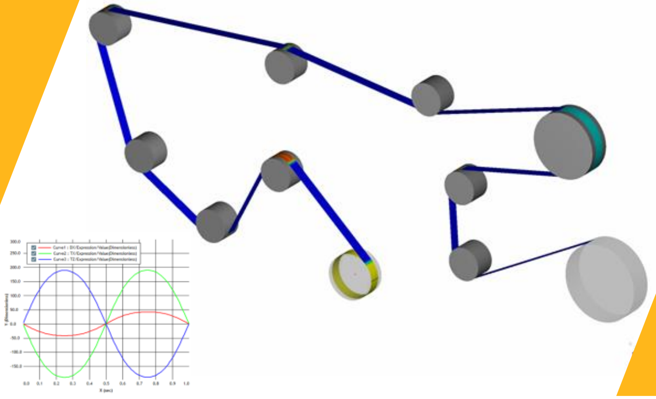
Ansys

Ansys Motion 2023 R1 Top Highlights



Motion Enhancements in Mechanical Interface

- ✓ Increased commonalities between Motion in Mechanical and other systems using Mechanical.
- ✓ Drives ease of use for customers
- ✓ New updates to Motion include joint consistency, flexible edge contacts, & co-simulation possibilities with FTire



Post-Processor Updates

- ✓ New utilities in post-processor include preset parts window properties, multi-axis charts, independent contact pressure plots and stress/strain plots for multi-layered elements,

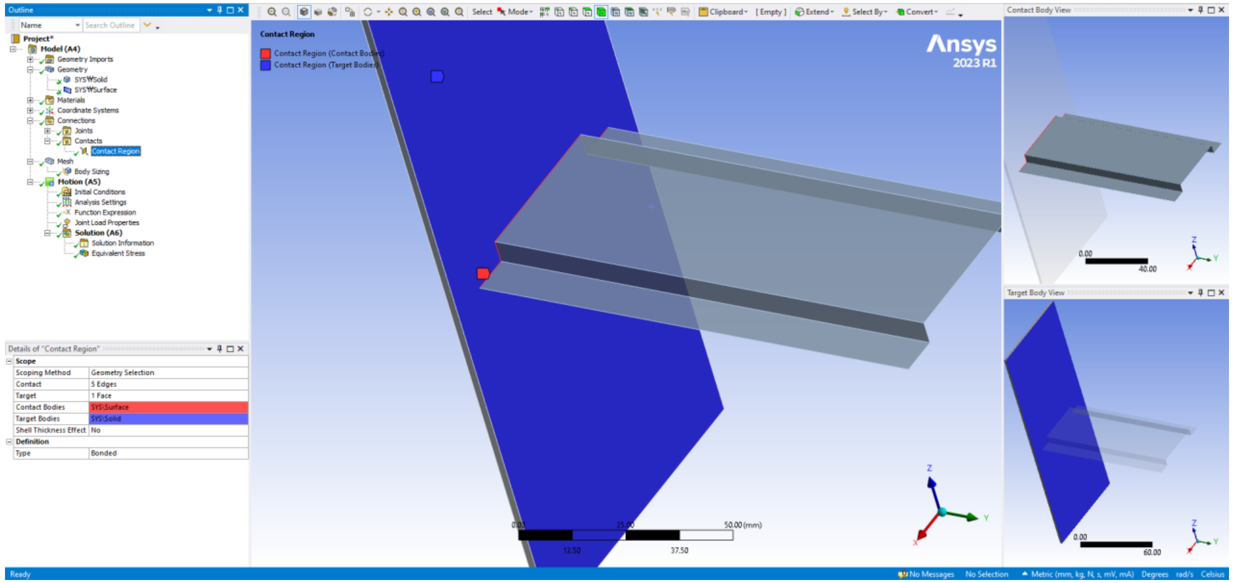
Solver Performance And Accuracy Improvements

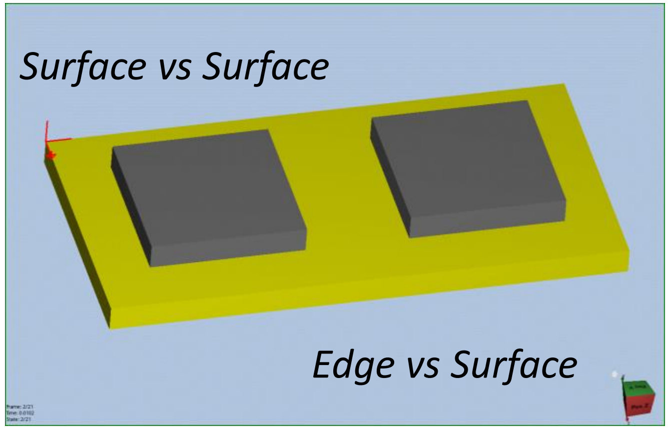
- ✓ Improvements to constraint formulations, electromagnetic force data handling lead to speedups of up to 3x
- ✓ Solution accuracy improvements to the eigenvalue solver mean models involving complex constraints can be solved more accurately first time around

Motion in Mechanical

Edge Contact

- Flexible body edge contact is available when contact region scoping contains edges.
  - The contact entity is automatically converted when the mechanical solution is linked schematically to a Motion solution.



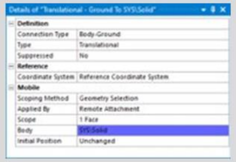


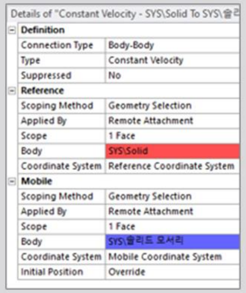
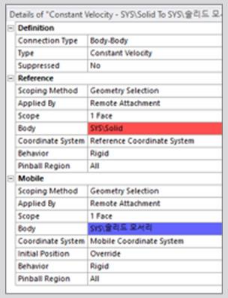
< Possible combinations >

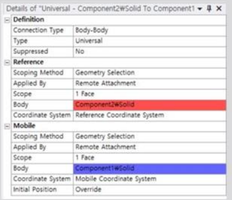
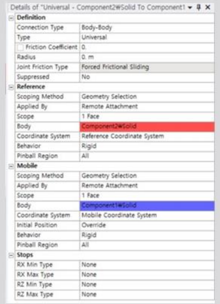
		Contact/Base	
		Face	Edge
Target / Action	Face	O	O
	Edge	X (O-STD)	O

Joint consistency

- Universal Joint, Constant Velocity Joint and Translational Joint, that were not using consistent degrees of freedom between Motion and Rigid Dynamics have been made consistent.

Translational Joint	Motion	RBD
Details		
Axis of the translation	X Axis (but use Z Axis in Motion Solver)	X Axis

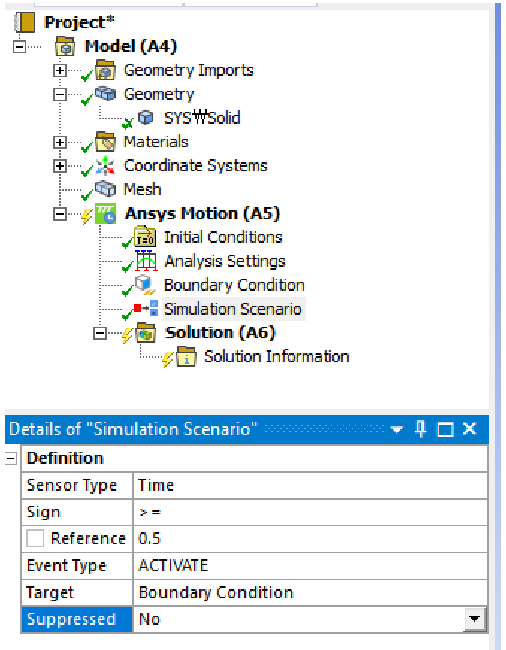
Constant Velocity Joint	Motion	RBD
Details		
Axis of the rotation	Z Axis	Y Axis
Orthogonal Axis	X Axis	X Axis

Universal Joint	Motion	RBD
Details		
Cross-shaft orientation of Reference coordinate	X Axis	Z Axis
Cross-shaft orientation of Reference coordinate	Z Axis	Z Axis

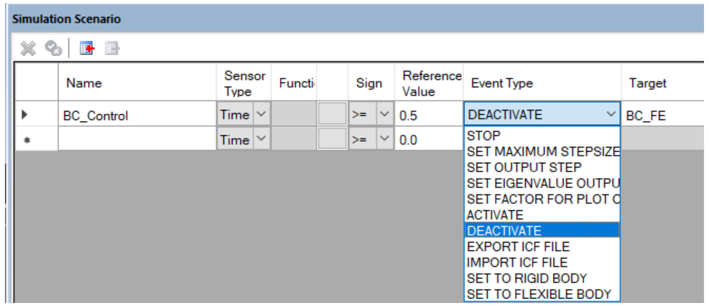
Simulation Scenario with Boundary Conditions

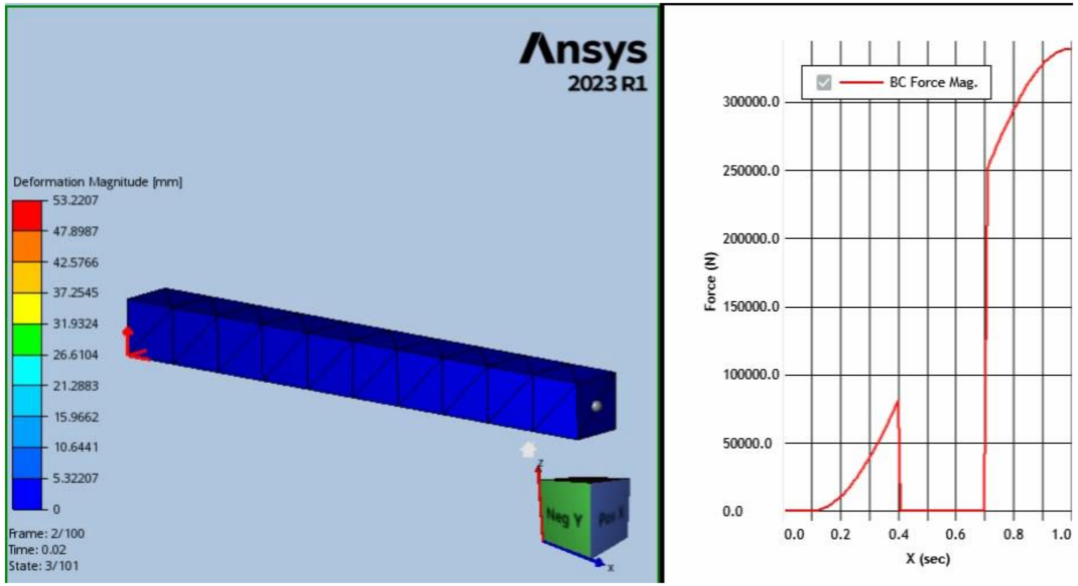
- A ‘Simulation Scenario’ is available to disable or enable boundary condition while running simulation according to the user-defined criterion.

Mechanical



Standalone

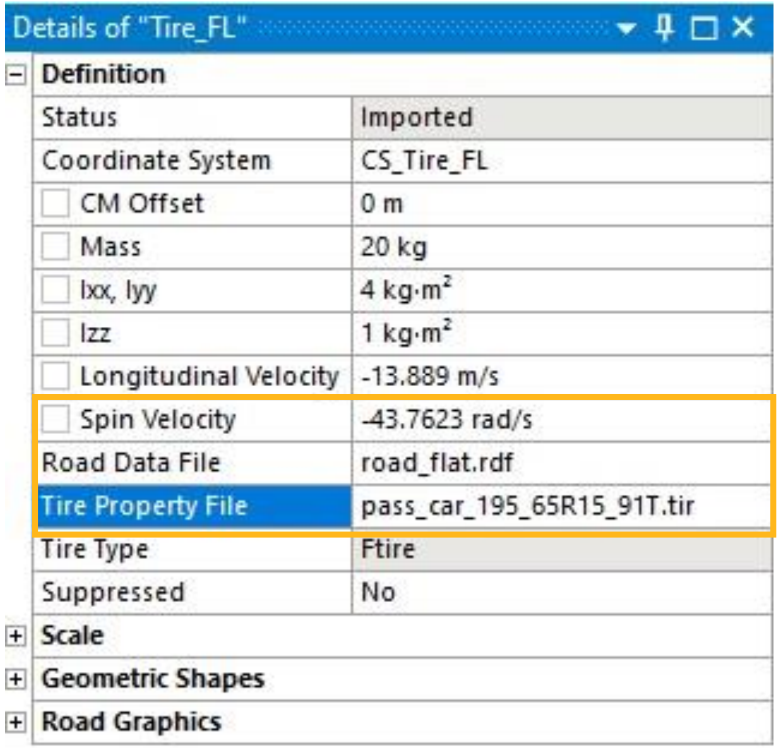




< Disable/Enable BC relative to sphere >

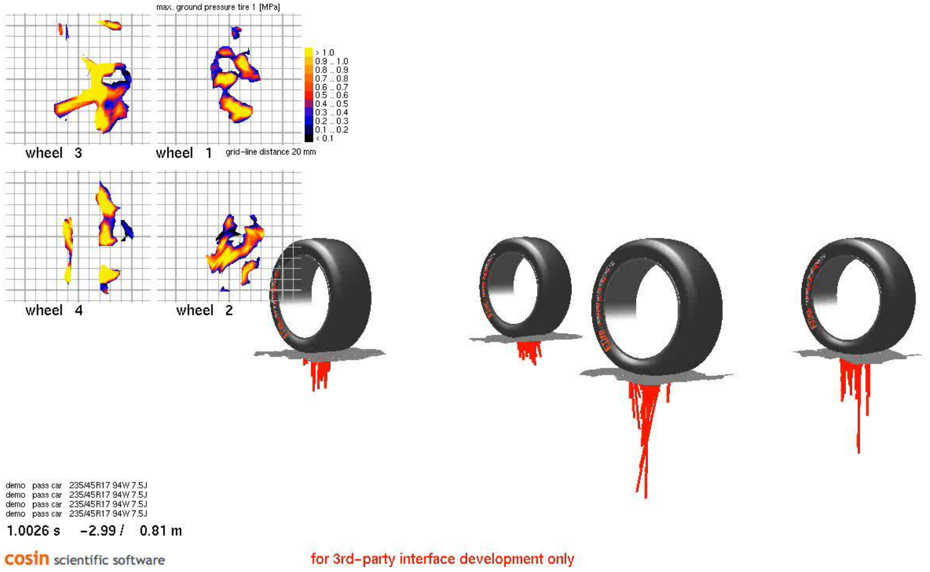
FTire Interfacing

- It supports the co-simulation with *COSIN* scientific software by using FTire format tire property file.
- RGR and CRG files can also be used as a road data file.



Details of "Tire_FL"

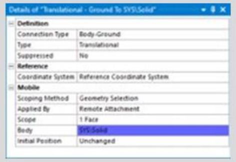
Definition	
Status	Imported
Coordinate System	CS_Tire_FL
CM Offset	0 m
Mass	20 kg
Ixx, Iyy	4 kg·m²
Izz	1 kg·m²
Longitudinal Velocity	-13.889 m/s
Spin Velocity	-43.7623 rad/s
Road Data File	road_flat.rdf
Tire Property File	pass_car_195_65R15_91T.tir
Tire Type	Ftire
Suppressed	No
Scale	
Geometric Shapes	
Road Graphics	

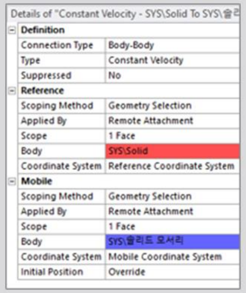
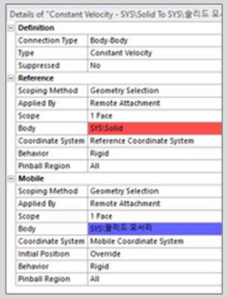


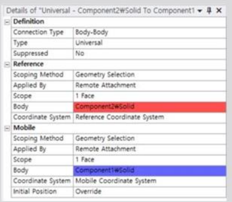
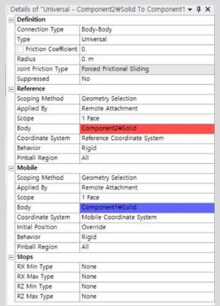
< Visualization of FTire simulation >

Joint Consistency

- Universal Joint, Constant Velocity Joint and Translational Joint, that were not using consistent degrees of freedom between Motion and Rigid Dynamics have been made consistent.

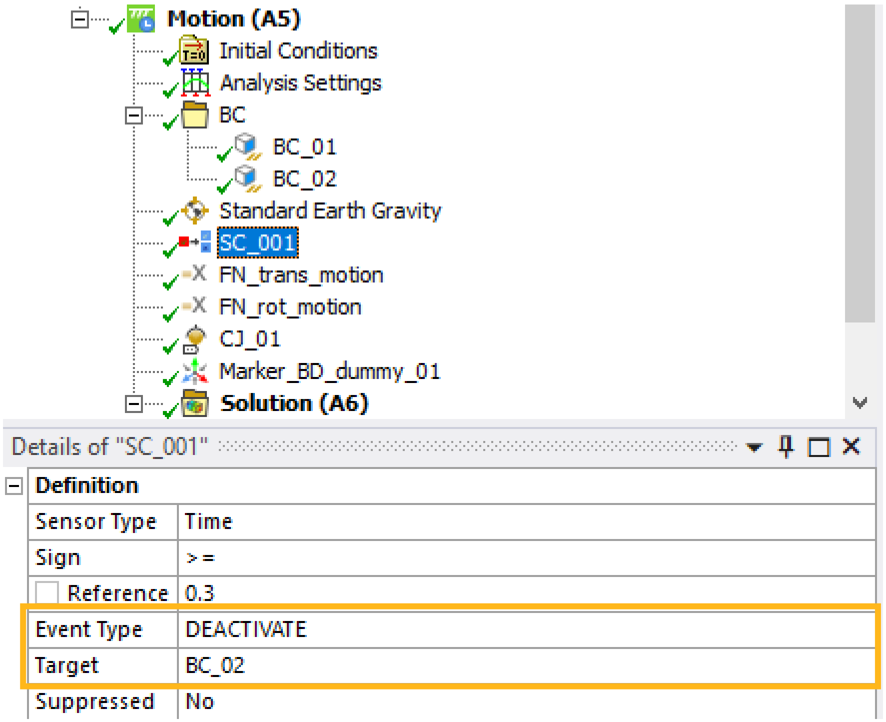
Translational Joint	Motion	RBD
Details		
Axis of the translation	X Axis (but use Z Axis in Motion Solver)	X Axis

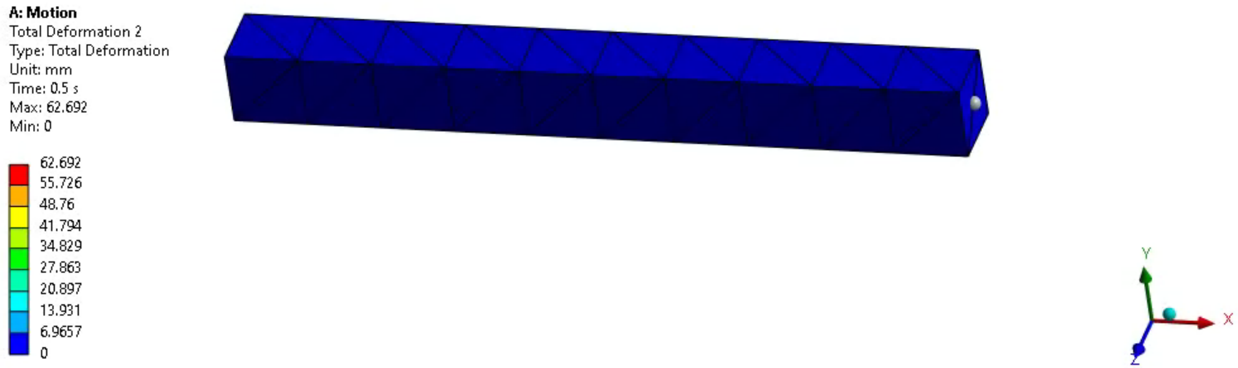
Constant Velocity Joint	Motion	RBD
Details		
Axis of the rotation	Z Axis	Y Axis
Orthogonal Axis	X Axis	X Axis

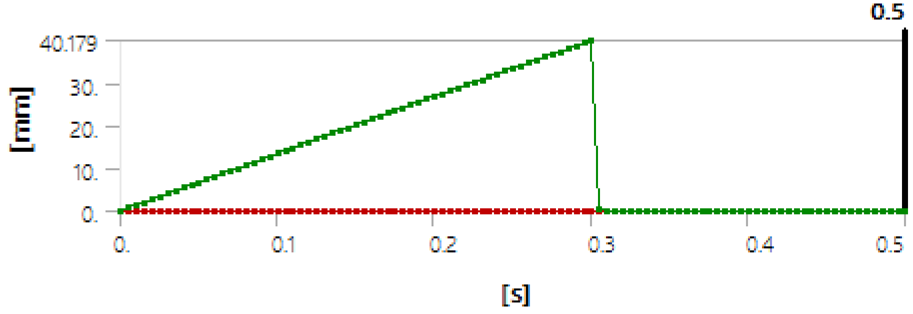
Universal Joint	Motion	RBD
Details		
Cross-shaft orientation of Reference coordinate	X Axis	Z Axis
Cross-shaft orientation of Reference coordinate	Z Axis	Z Axis

Simulation Scenario with BC

- Simulation Scenario is available to DEACTIVATE or ACTIVATE Boundary Condition while running simulation according to the user-defined criterion.



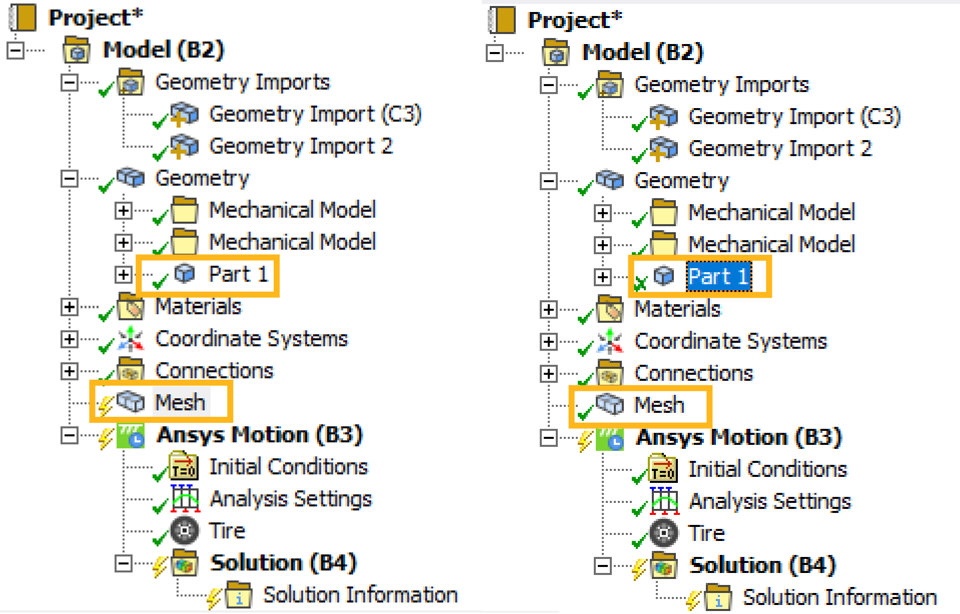




< Deactivate BC relative to sphere at 0.3 s >

Mesh Automation

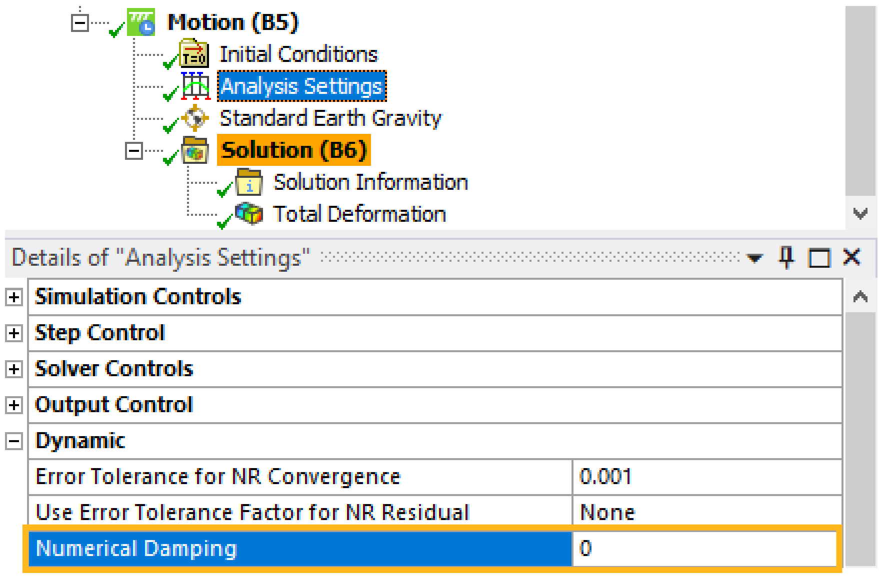
- In assembly model, users should generate mesh for imported bodies to make the model ready to solve. It is difficult for users to notice and cumbersome to mesh manually.
- Now mesh will be generated after importing the bodies. So, it is possible to use geometry importing capability in Motion without considering this limitation anymore.
- Example: After creating a geometry for Tire object.
  - Previously in this case, the state of mesh was ***Not Solved***.
  - From 2023 R1, it will change to ***Solved***.

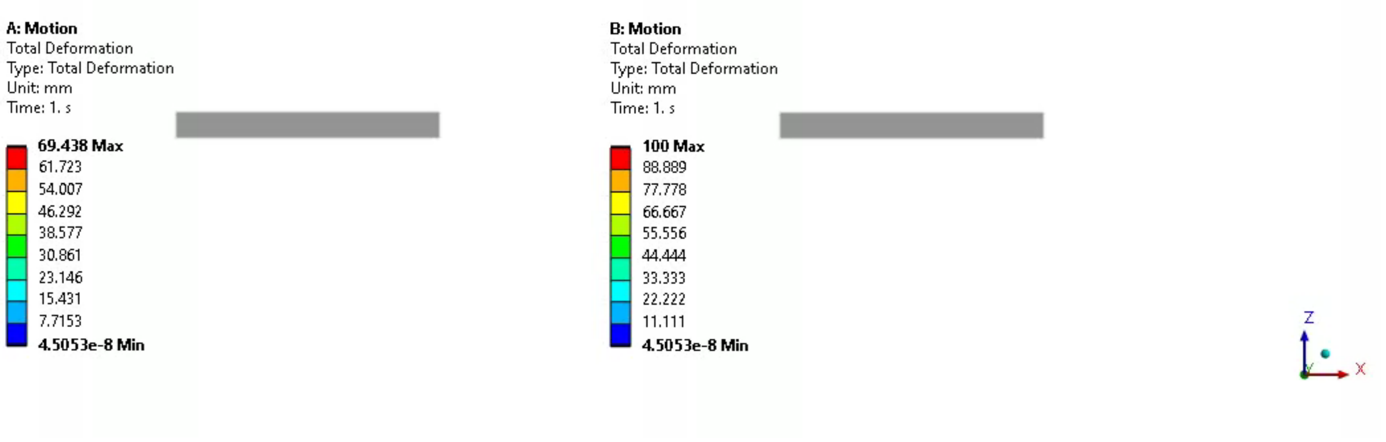


< Previous vs. 2023 R1 >

Numerical Damping

- It is now possible to input Numerical Damping within the range of values between zero and less than 4.
- Example: Pendulum simulation with Numerical Damping of 3.99 and 0.



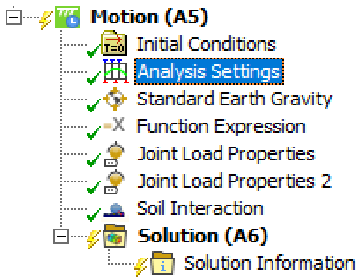


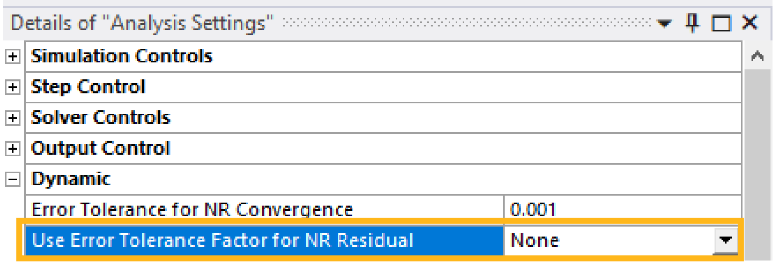
< Numerical Damping 3.99 vs. 0 >

-> It can be seen that the smaller the value, the more freely the movement is.

Residual Tolerance

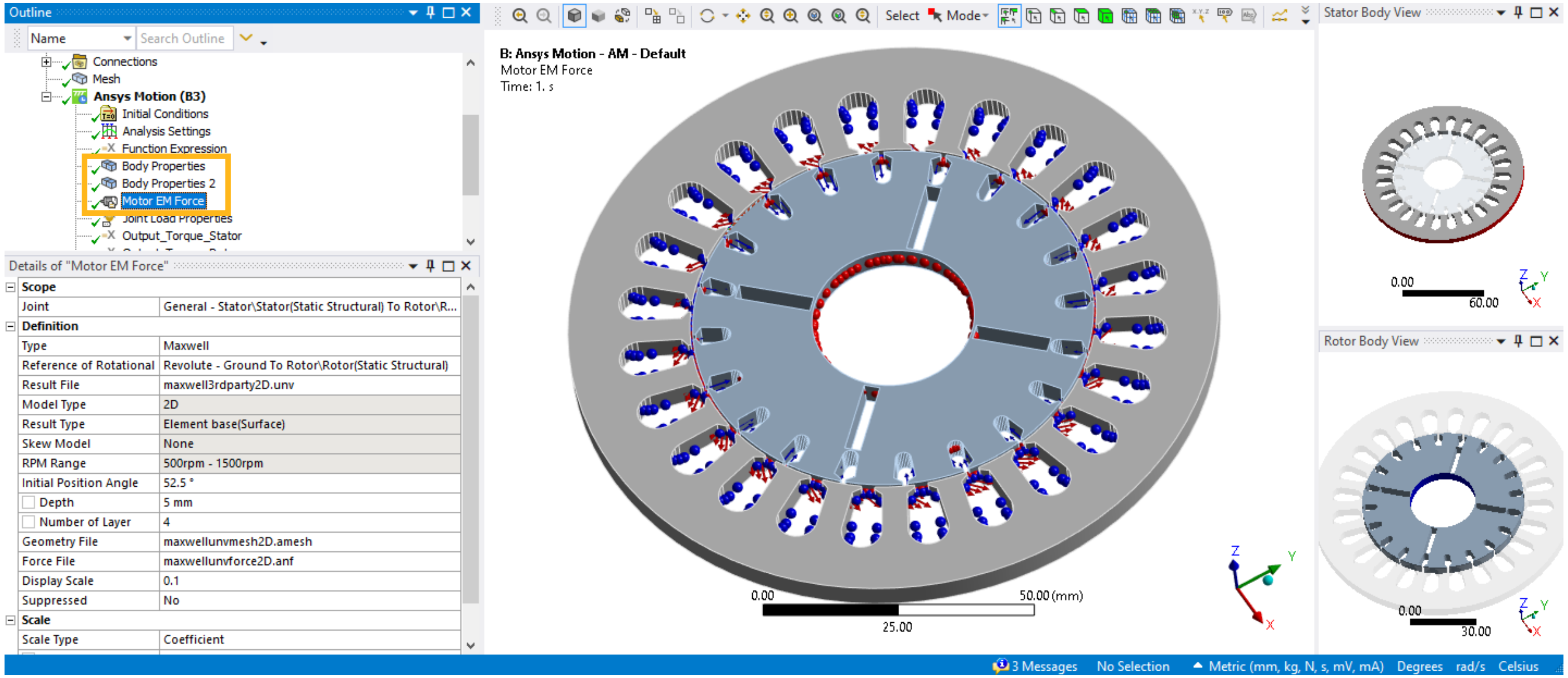
- An option to use Error Tolerance Factor for NR Residual is now available in Analysis Settings.
- It may be helpful to clear this option if the number of NR failures is greater than number of integration failures.
- Solver provides recommendations via log file message, for better options in subsequent solutions.





Solving Speed for Motor EM Force (with modal bodies)

- By optimizing the way of managing Electromagnetic force data that is imported from Maxwell, the simulation performance has been improved up to three times over previous versions.

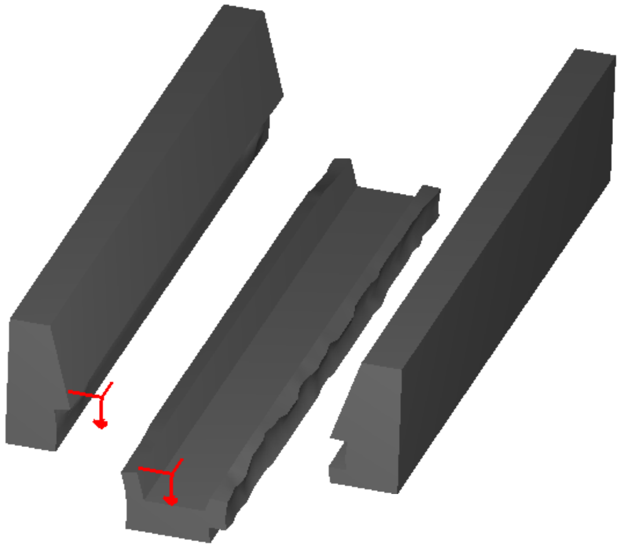


< Motor EM Force with modal stator and rotor >

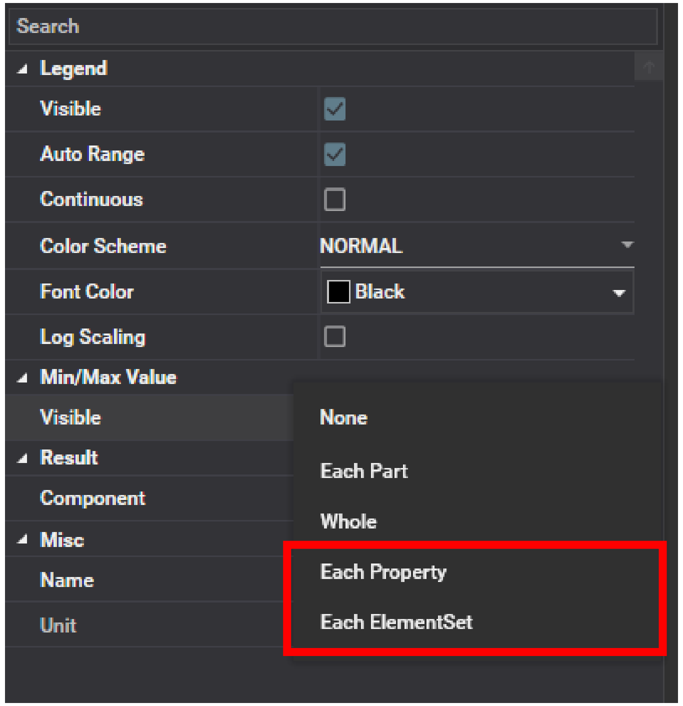
Solver & Standalone

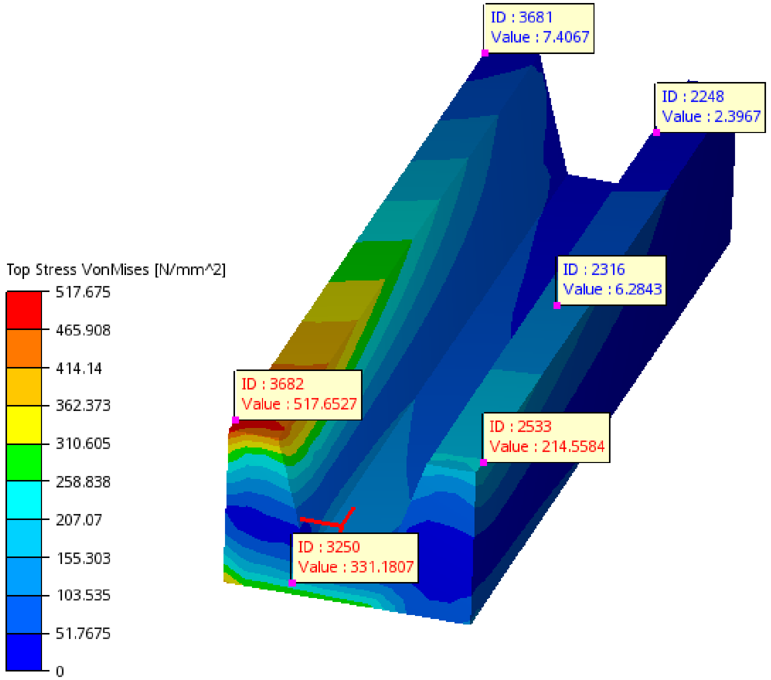
New available visible type

- A new *visible* type has been added. (Property, ElementSet)
- The *visible* option is useful to investigate the maximum contour values only for all displayed bodies.



< Composed of 3 different Element Sets >

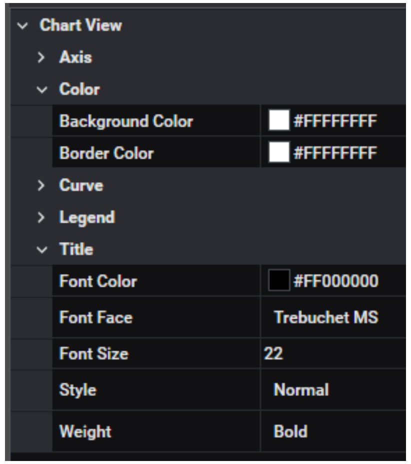


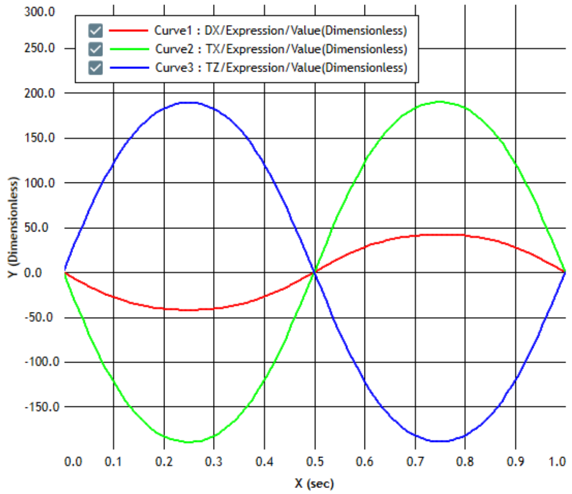


< Min / Max in Element Sets >

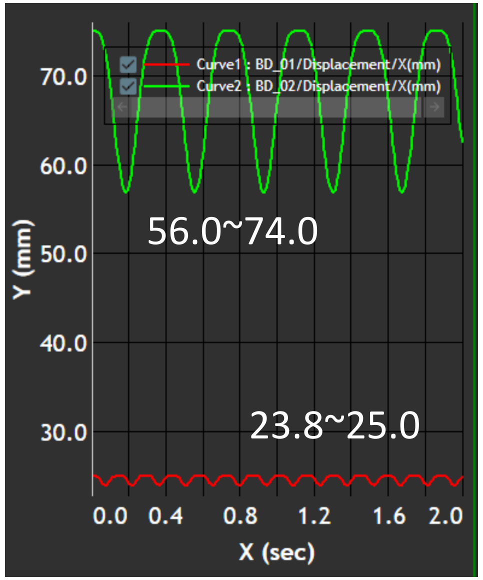
New utilities of Postprocessor

- Presets of chart windows properties are available.
  - Predefined background color, X, Y grid scale and other major properties that customer want to use as default can be applied.

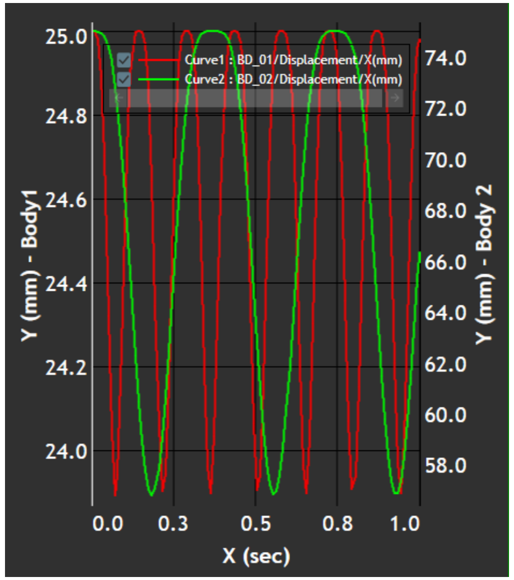




- Multiple Axis with the same unit
  - Postprocess allows to use separated axis for same unit result. It help to trace pattern of graph when two result has huge offset with same unit.



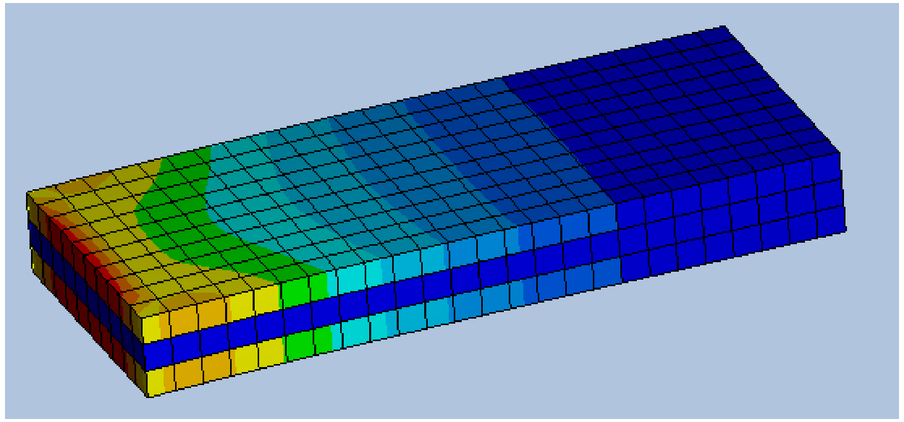
< Single Axis >



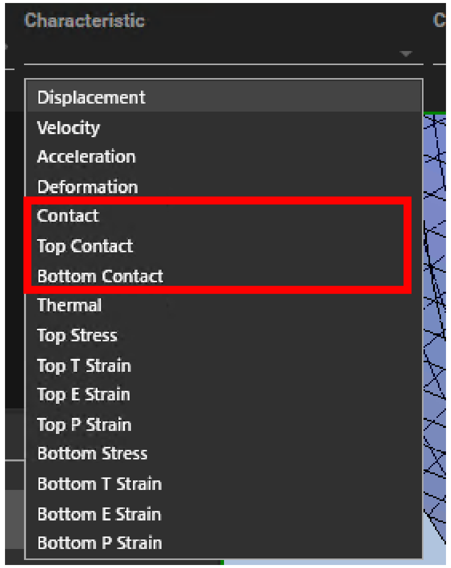
< Dual Axis >

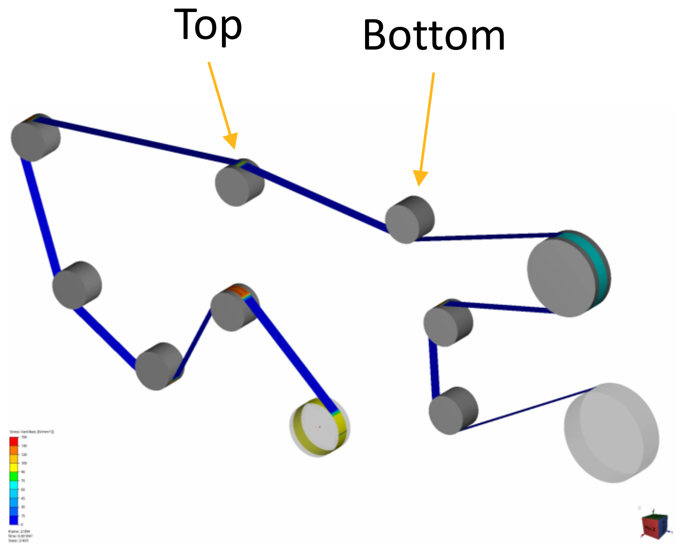
New utilities of Postprocessor

- Stress/Strain contour for multiple layered element
  - STD postprocessor was displaying nodal averaged stresses, even in the case of material discontinuity.
  - Unaveraged method to split nodal stress on material boundaries is now available.



- Independent Contact Pressure (Shell Top/Bottom)
  - Top or bottom surface stress value are selectable for stress contour.
  - Useful to investigate shell bending pattern



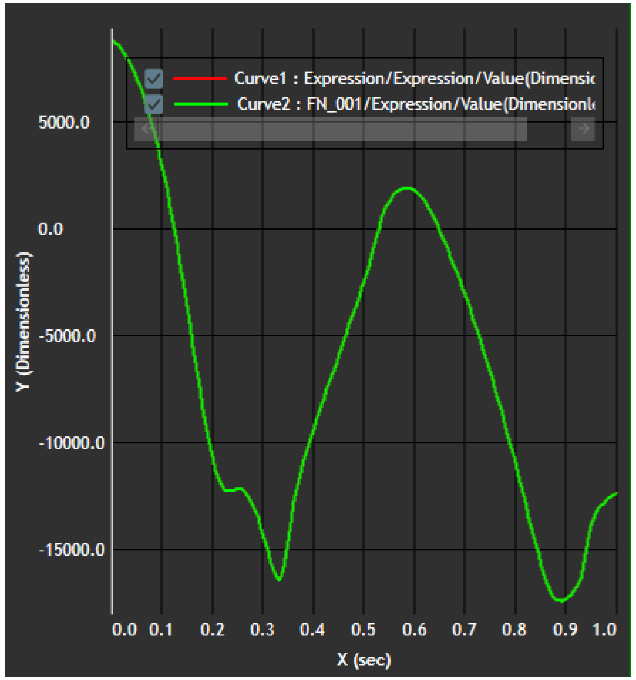


Post calculation after solving

- Function Expression in Postprocessor
  - Predefined Function entities in preprocessor are required to get a specific outputs before solving.
  - The more advanced Function evaluator that uses almost identical grammar to a preprocessor is now available in a postprocessor.

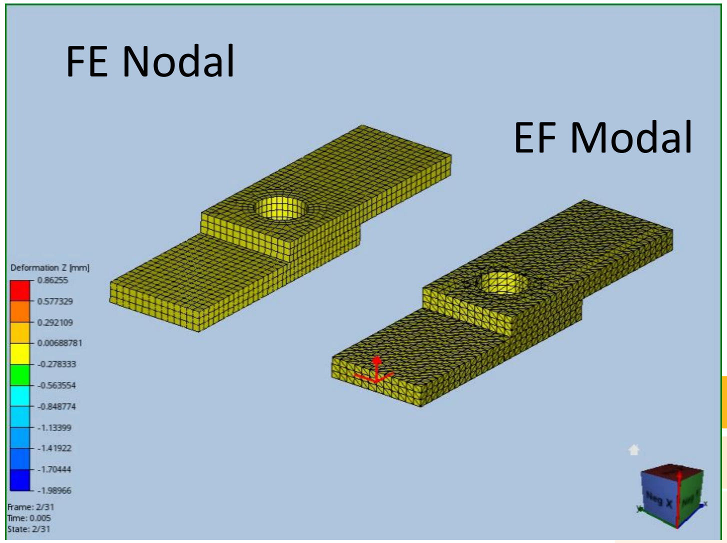
Before solving	STD preprocessor	Name: FN_001 1 VZ(/BD_03/CM)+DZ(/BD_02/CM)*100
	Mechanical Motion	Definition Function Expression: VZ(#1) + DZ(#2) ID: 32 Suppressed: No Argument List: Tabular Data
After solving	Postprocessor	Function Expression: VZ("BD_03/CM")+DZ("BD_02/CM")*100 Misc Name: Expression

Generates Identical Solution



Performance improvement

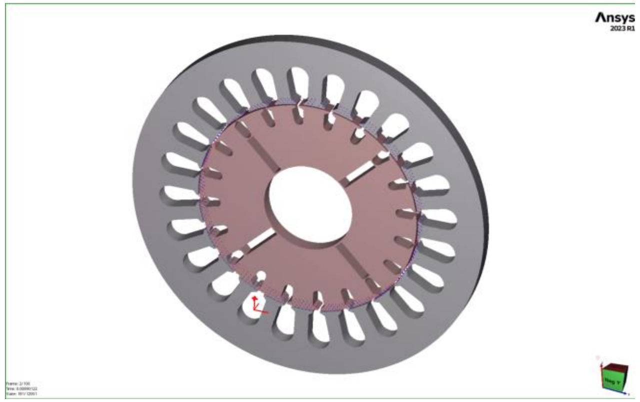
- Constraint formulation
  - Simulation performance is increased by the optimization of the constraint formulation.
  - As the number of constraint equations increases, the performance gain also increases.



	22R2	23R1	Speed-up
DOF	44030		-
N. Cst Eqn	120		-
Simulation time	958	739	X 1.3
Used time for constraints (s)	375	166	X 2.3

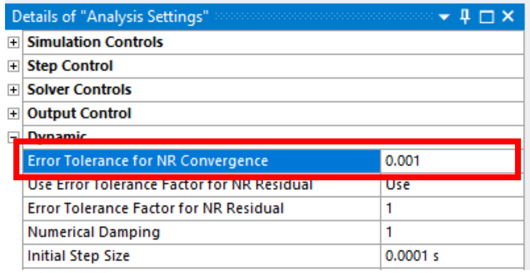
- Motor EM force
  - The calculation performance of EM force calculation is improved by optimizing data handling method.

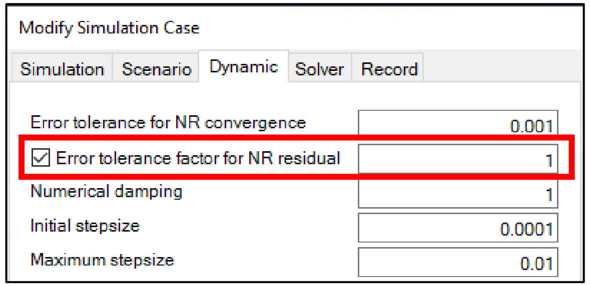
	2022 R2	2023 R1	Speed-up
System inf	Mode (108), EM Node(2,000)		
Simulation Inf	Output frame (50,000), End time (1sec)		
Time	36 min	12 min	X 3
Memory	2672 Mb	2707 Mb	-



Solution accuracy improvements

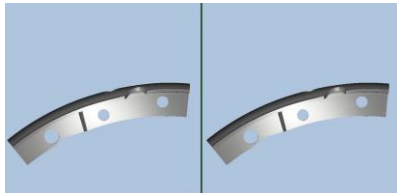
- Checking the residual criterion is added in order to control the solution's accuracy and stability.
  - Solver provides recommendations via log file message, for better options in subsequent solutions

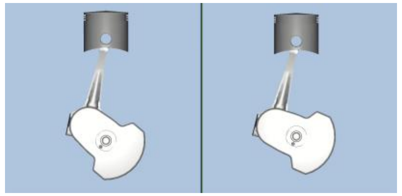





```
-----------------------------------------------------------------
< DF_SOLVER:: RECOMMENDED SETTINGS FOR ANALYSIS >
-----------------------------------------------------------------
* The newton-raphson failures occurred more than the integration failures.
  It may be helpful to turn off the 'Error tolerance factor for NR residual' option in the analysis settings.
-----------------------------------------------------------------
```

- Eigen analysis improvement
  - The new algorithm uses constraint equation directly rather than using penalty.
  - Various test shows that the solution accuracy is improved, and the dependency to the penalty value also is eliminated.





FE_Modal_CPLoad_SystemEig

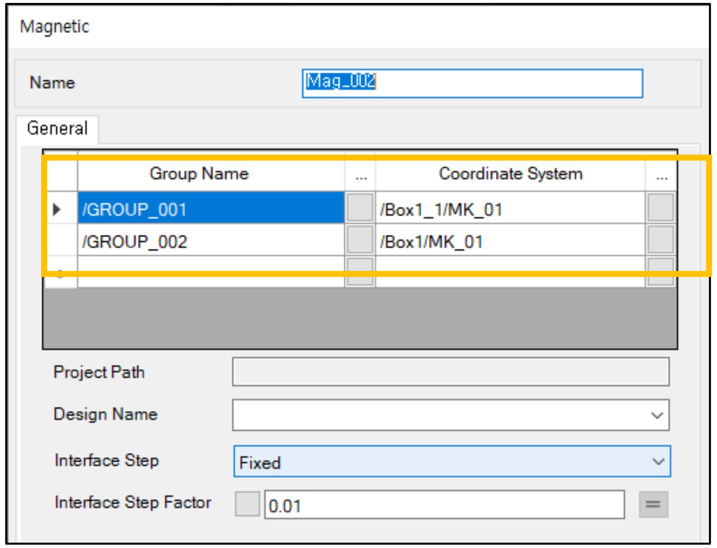
22R2 (Penalty)	New (Constratin)	
Freq.	Freq.	Error (%)
3.61E+03	3.75E+03	-3.71E+00
3.94E+03	4.18E+03	-6.08E+00
5.92E+03	6.02E+03	-1.80E+00
8.32E+03	8.33E+03	-1.64E-01
8.62E+03	9.04E+03	-4.76E+00
1.08E+04	1.15E+04	-6.85E+00
1.22E+04	1.24E+04	-1.85E+00

Modal_Flex_System Eigenvalue

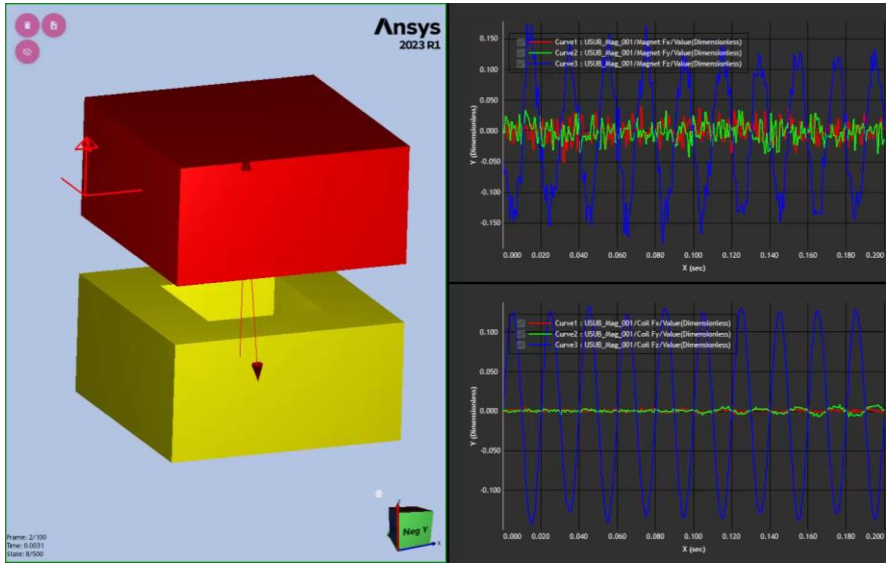
22R2 (Penalty)	New (Constratin)	
Freq.	Freq.	Error (%)
0.00E+00	0.00E+00	
1.76E+03	1.76E+03	-7.93E-04
2.88E+03	2.88E+03	-2.84E-02
5.49E+03	5.53E+03	-6.80E-01
6.40E+03	6.40E+03	-8.53E-04
1.30E+04	1.30E+04	-1.33E-01
1.32E+04	1.32E+04	-1.01E-02
1.42E+04	1.44E+04	-1.09E+00
2.15E+04	2.16E+04	-6.35E-02

Maxwell – Motion interface improvement

- Coordinate system at geometry center
  - The Coordinate system that represents a force/moment of Maxwell solution is automatically created at the total mass center.
  - It stabilizes numerical convergence than the case of the coordinate located at the first body’s center of mass.

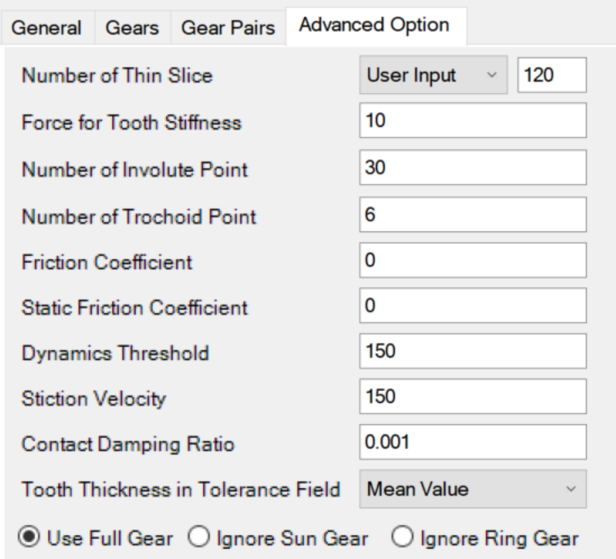


- Current simulation time
  - Transferring current simulation time enables to simulate of a system that need to apply various time-dependent functions such as a haptic.



Optional use of Sun/Ring gear

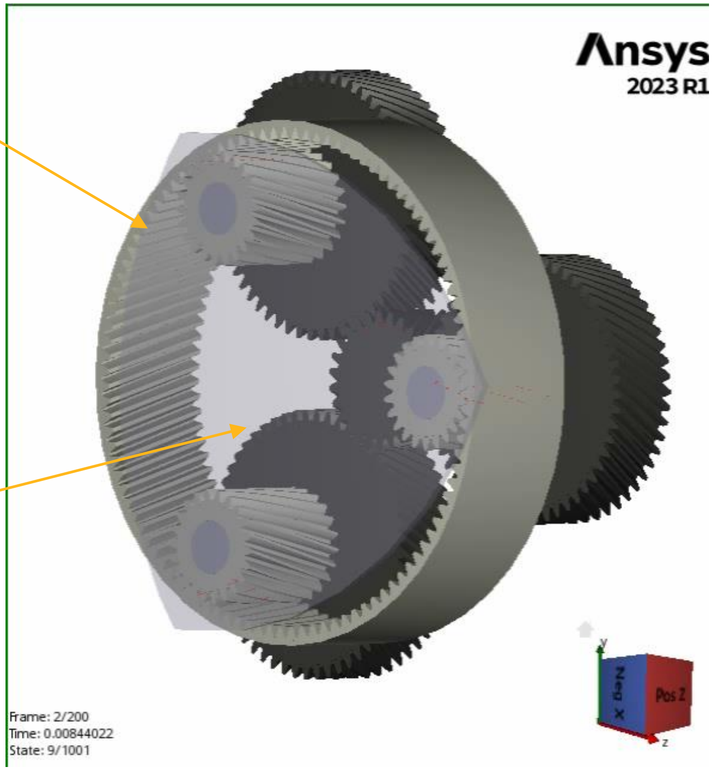
- In basic planetary gear system, suppressing Sun or Ring gear is now possible.
- Single pinion type Ravigneaux system can be modeled with the new options.



Suppress	Mechanical	Standalone
Sun gear	X	O
Ring gear	X	O
None	O	O

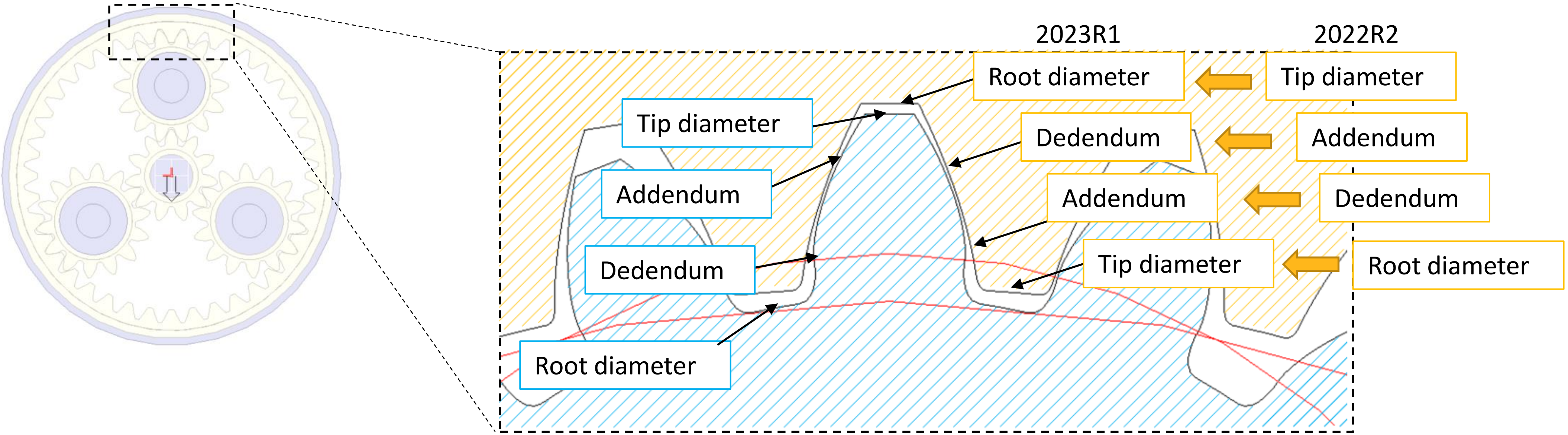
1st stage
: without sun

2nd stage
: without ring



Gear – macro geometry parameters

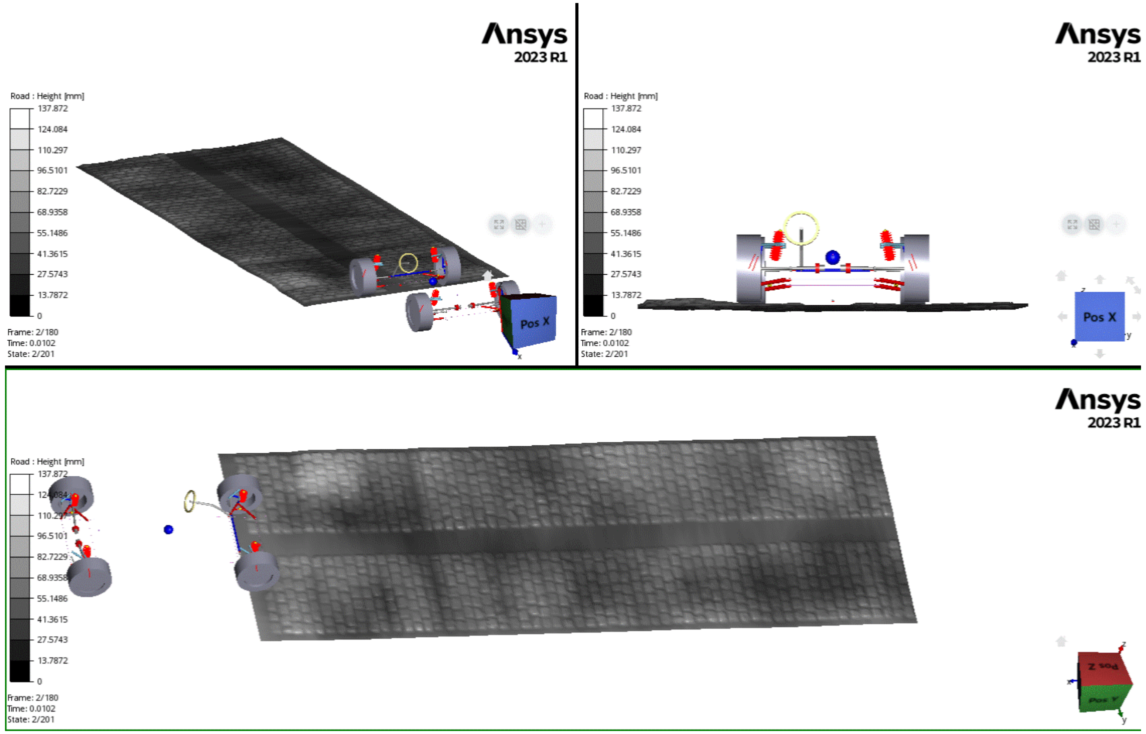
- The parameters related to macro geometry have been reorganized and updated
  - The parameter names for internal gear were significantly changed to meet the standard industrial definitions.
  - The locations of their input field also re-organized so that users can recognize and change them more easily. The parameters for other types are slightly changed.

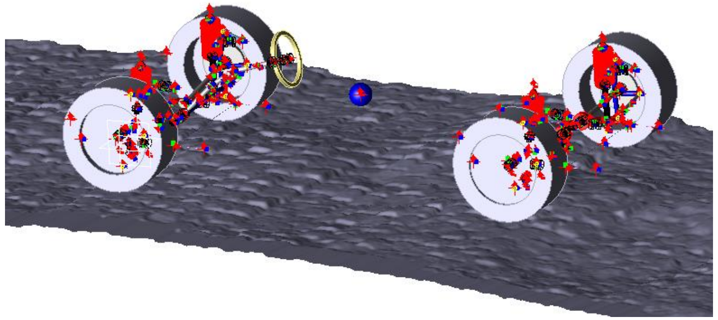


< parameters related to internal gear >

Road visualization

- Visualization of road geometry are available in Pre/Postprocessor.
  - In case of using CAR toolkit, the most common road geometry will be shown in Pre/Postprocessor
  - Other types are going to be available in next version include Mechanical Motion





Type		STD General	STD Car toolkit	Mechanical Motion
rdf	2D	X	X	O
	3D Spline	X	X	X(23R2)
	3D	X	O	X(23R2)
Open CRG		X	O	X(23R2)
RGR		X	O	X(23R2)

Ansys