Release 2023 R1 Highlights

Ansys Low Frequency Electromagnetics

Maxwell

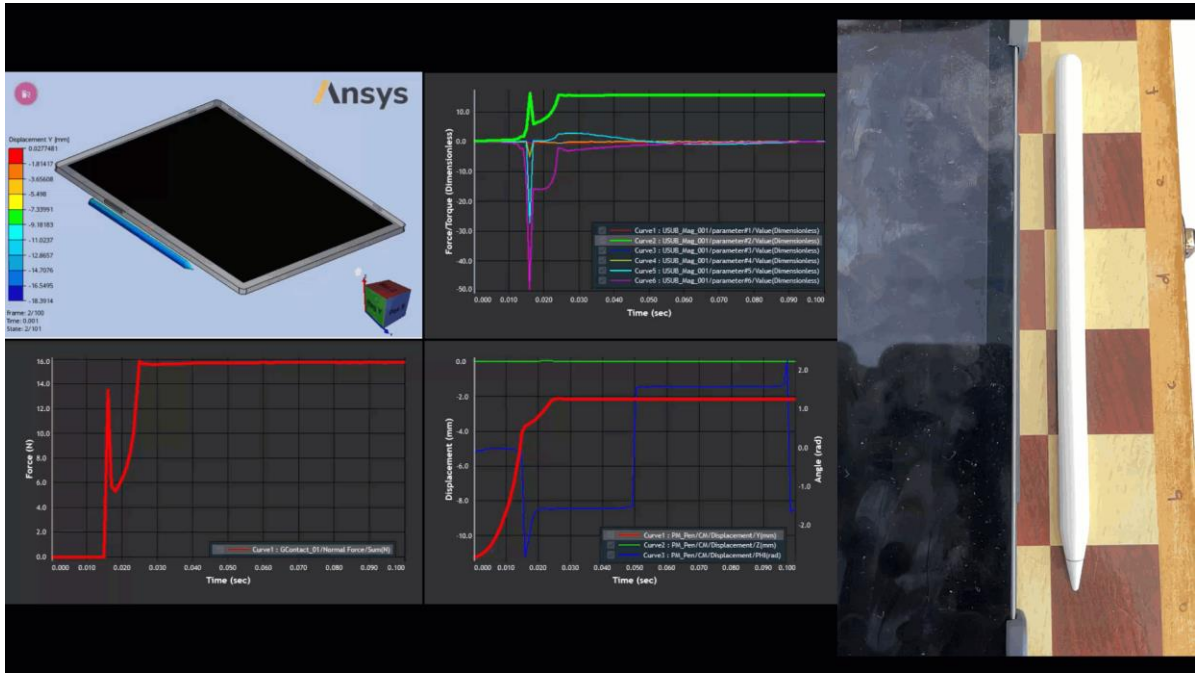
Feature Spotlight - 2022 R2

Ansys

What's New – Magnetic Latching Coupling Workflow with Structural Dynamics

What's New

- New best-in-class Multiphysics magnetic latching coupling workflow from Ansys Maxwell and Motion.



User Benefit

- Electromagnetic coupling with Kinematics ensures full degree-of-freedom control of permanent magnets motion.
- Tackle complex engineering challenges like creating enough force for a strong hold without the risk of magnets destroying adjacent metal or plastic materials.

End User and Applicable Industries

- ✓ Benefits electrical and mechanical engineers designing magnetic latching devices and mechanisms
- ✓ High-tech industry for portable devices. e.g., detachable keyboards, pencil that attaches to tablets, wireless charging pads, latching wall-mount security camera, smart screen covers for phones, etc.

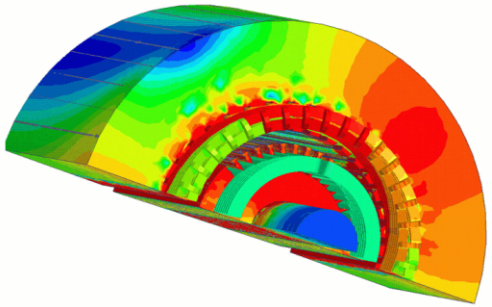
What's New – Core-loss Dependent ROM for Induction Machine

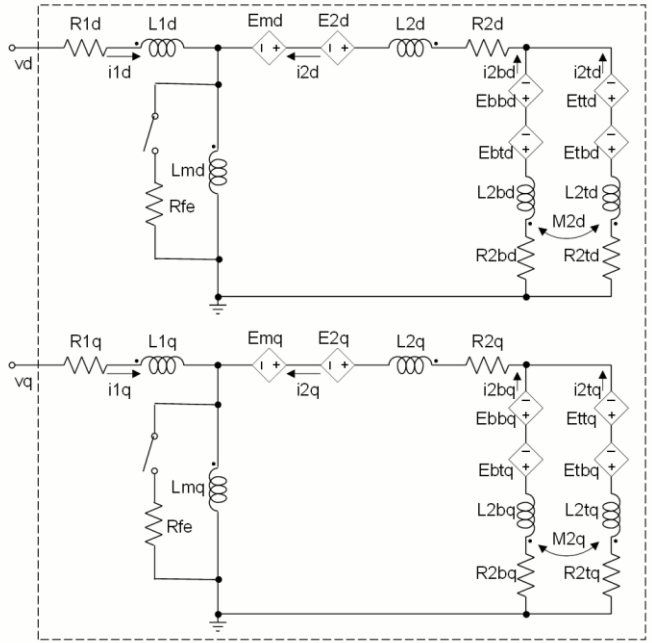
What's New

- Ability to generate the most accurate ROM model for induction machine to be leveraged into Twin Builder for larger drive system simulation.

User Benefit

- Increase induction machine ROM accuracy at the system integration level by incorporating loss dependency
- Time-domain circuit realization made easy based on frequency dependent core-loss parameters identified in the frequency domain





End User and Applicable Industries

- ✓ Hugely benefits the electrical machine designers and system designers who are evaluating the impact of component design into the entire drive system.
- ✓ Electrification through its electrified power train systems topologies (traction applications) is the main industry segment where ROM for induction machine can be used.

What's New – Skew Modeling to a New Paradigm

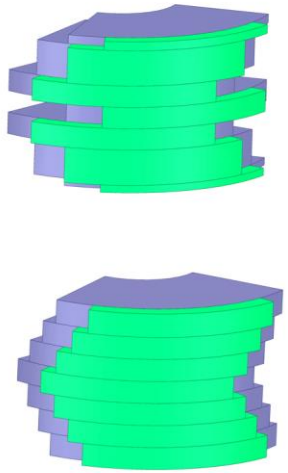
What's New

- Skew Modelling in Maxwell – Touching a New Paradigm

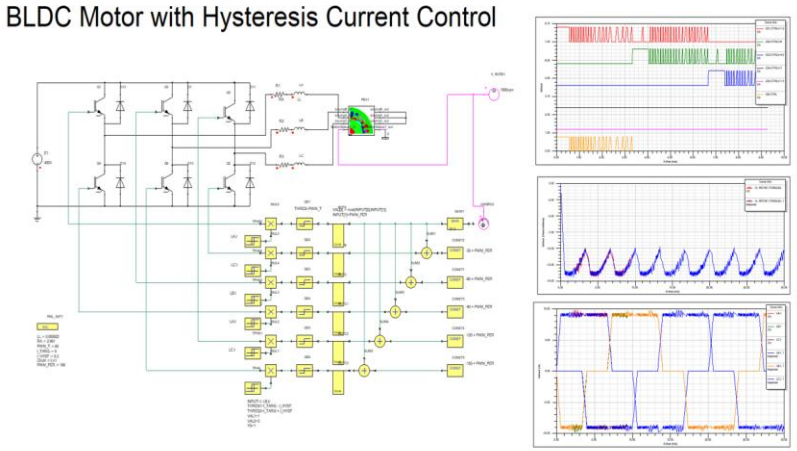
User Benefit

- The new ROM technique can be leveraged to extract an equivalent circuit of a 2D skew design benefitting the system engineer.
- HPC enables parallelization of the existing multi-slice technology increasing the speed of entire 2D FEA simulation including circuit coupling.

ROM of a 2D Skew Design



HPC Skew Modeling with External Circuit



End User and Applicable Industries

- ✓ Benefits both the system engineers and electric motor designers.
- ✓ Electrification through its electrified power train systems topologies (traction applications) is the main industry segment where skewed electric motor configurations are used.

Feature Spotlight - 2023 R1

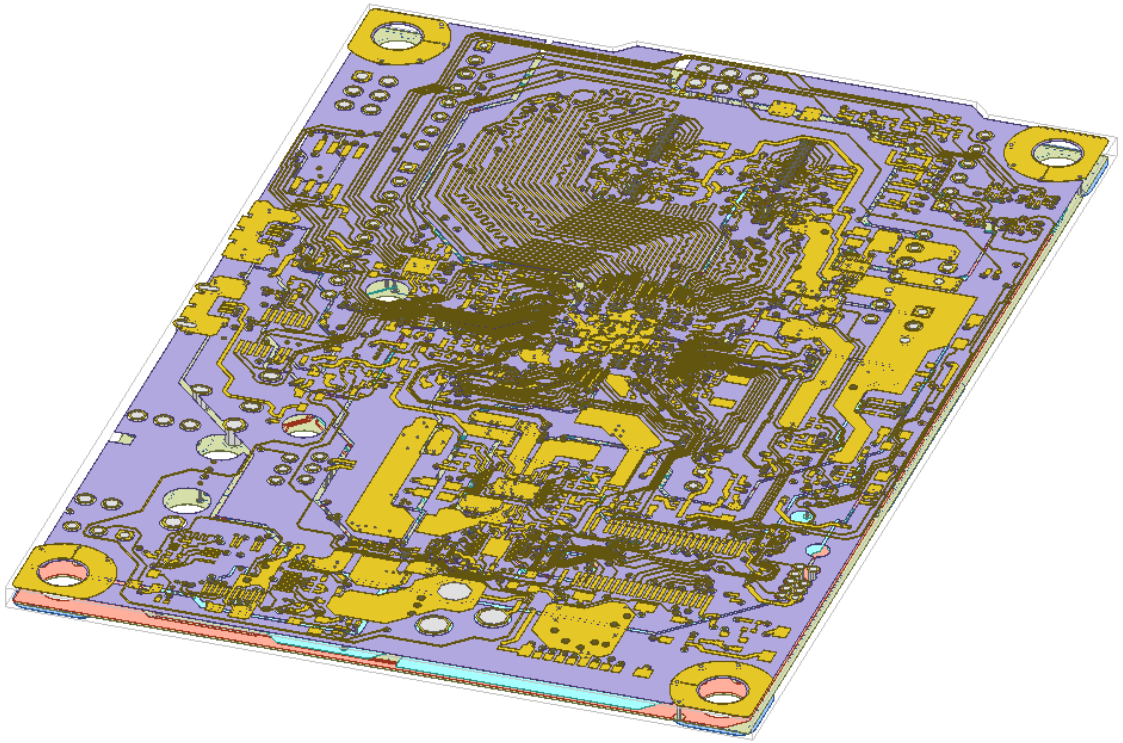
Ansys

Speed Up Solution for PCB Analysis

- In PCB simulation the conduction path includes complex geometry (large number of excitations), the step of field assignment is time consuming

$$\mathbf{H} = \mathbf{T} + \nabla\Omega + \mathbf{H_p} + \sum i_k \mathbf{H}_k$$

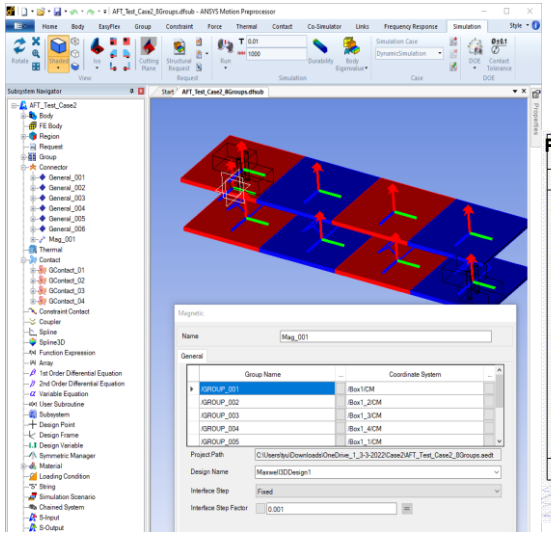
- CPU time of field assignment for the PCB simulation with 4 millions mesh size is 51 hours, with the improvement, this time is reduced to 7 minutes

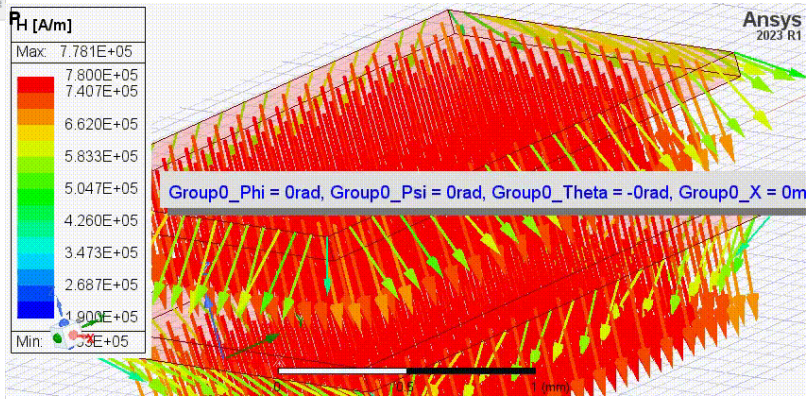


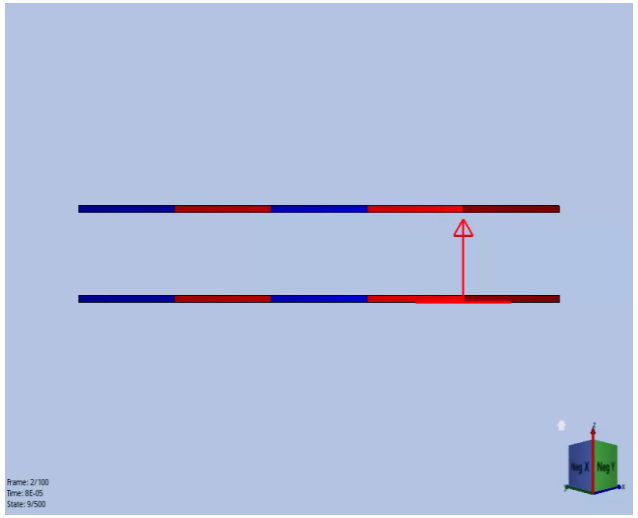
Improve the Field Assignment for Eddy and Magnetostatic Solvers

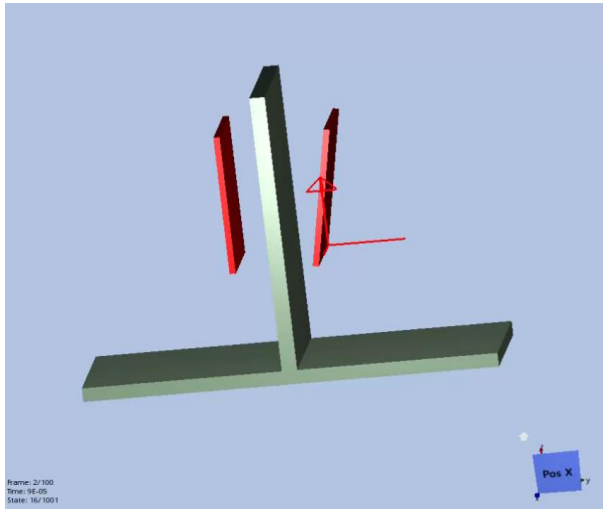
Enhanced Magnetic Latching Workflow with Maxwell and Motion

- Full DOFs' kinematic control on Magnetostatic solution
- Achieve automation on Maxwell design generation in
  - Geometry generation
  - Material and magnetization assignments
  - Material overwrite setting (enabled)
  - Objects CS and magnetization CS creations
  - Force and Torque parameters setup
  - Excitations depending on motion simulation time
  - Solve setup
  - Automatically created reports on force/torque vs motion simulation time step
  - Animation on field results vs motion simulation time step
- User can customize:
  - Material assignment and magnetization direction
  - Mesh operations / Solve setup









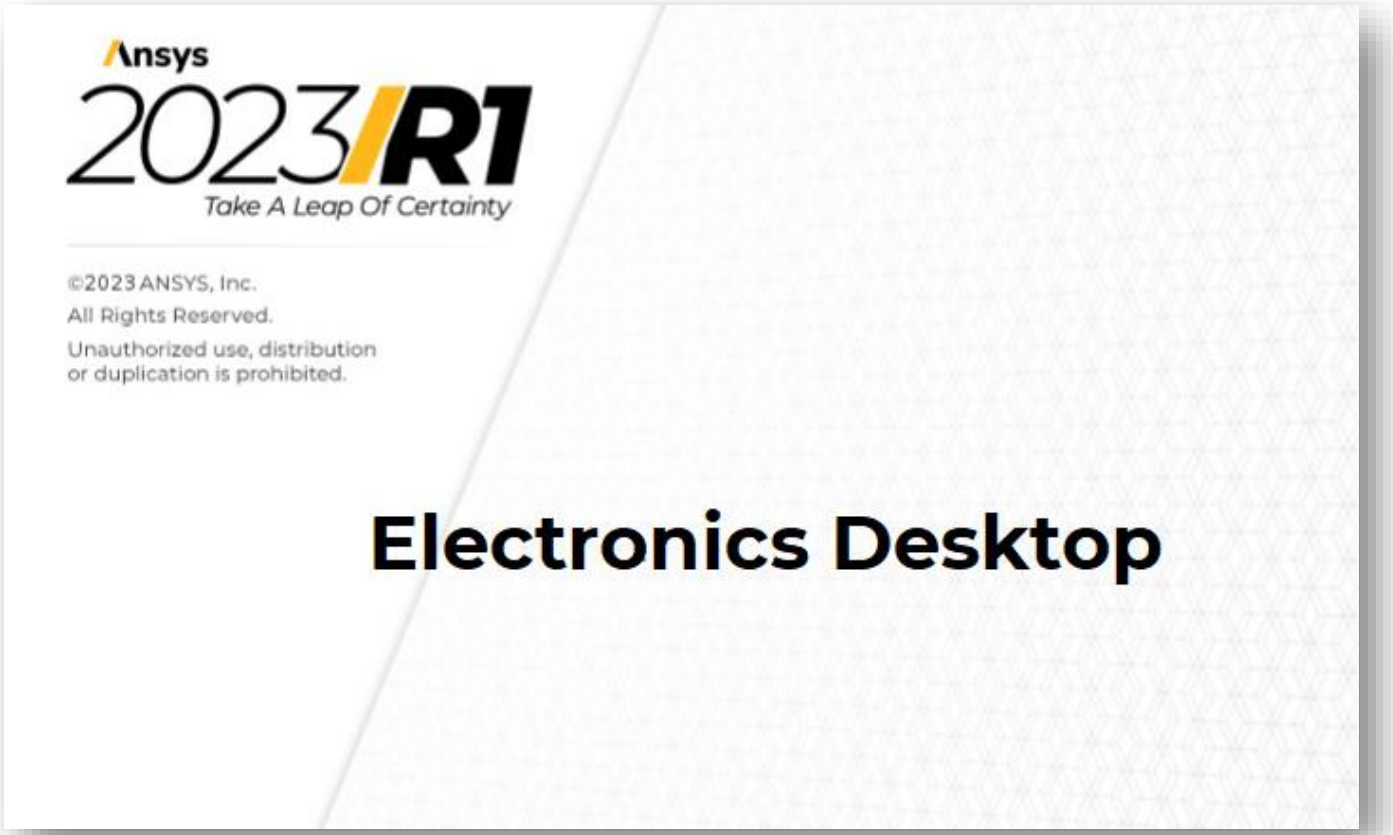
Agenda

Core Technology/Solvers

Electric Machine Enhancements

High Performance Computing

AEDT Desktop and Core

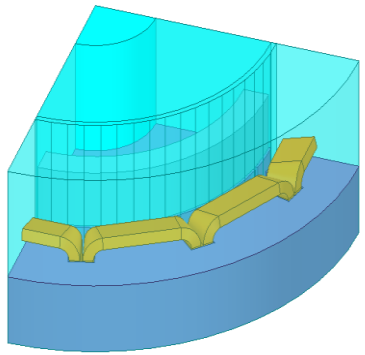


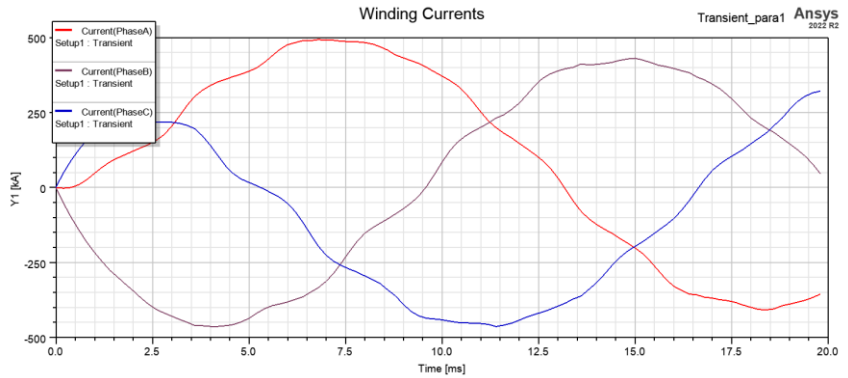
Core Technology

Ansys

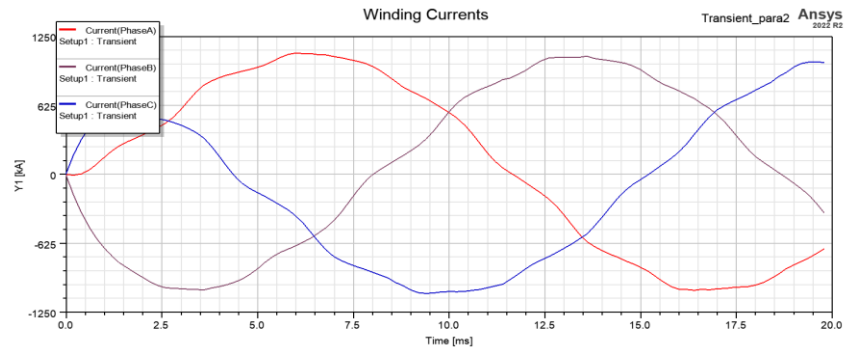
Parallel Branch in Solid Windings

- In Maxwell:
  - All coils are defined to be series-connected as default
  - Parallel branch setting is used to define parallel-connected coils
- Assumption:
  - There is no circulating current in any parallel connected loop
- Advantages:
  - No need to make the windings parallel-connected by external circuit
  - Avoid circulating current caused by numeric error due to mesh





Parallel number = 1



Parallel number = 2

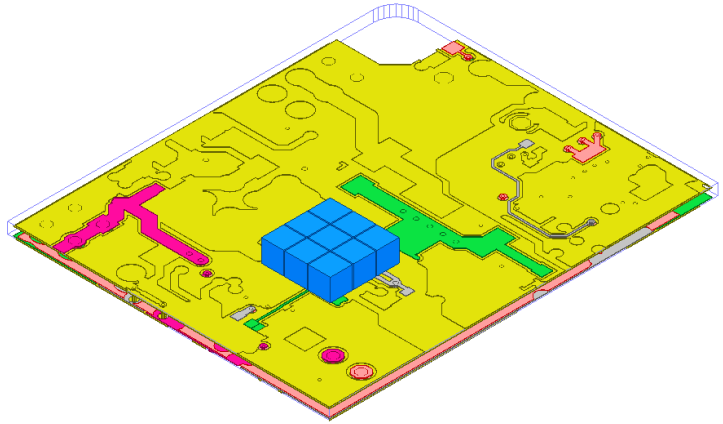
Improve Force Calculation on Conductors (PCB Applications)

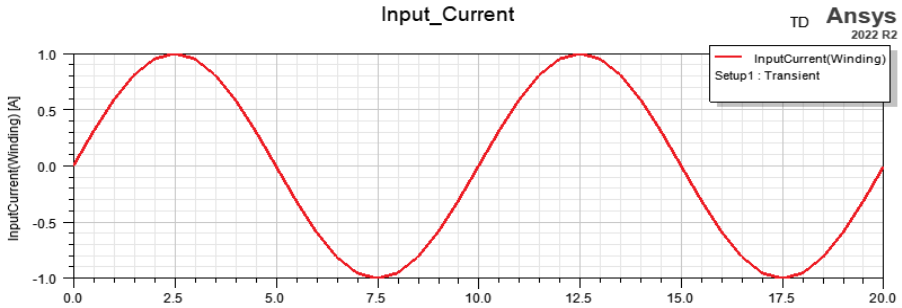
Option of Lorentz force calculation for parameter force

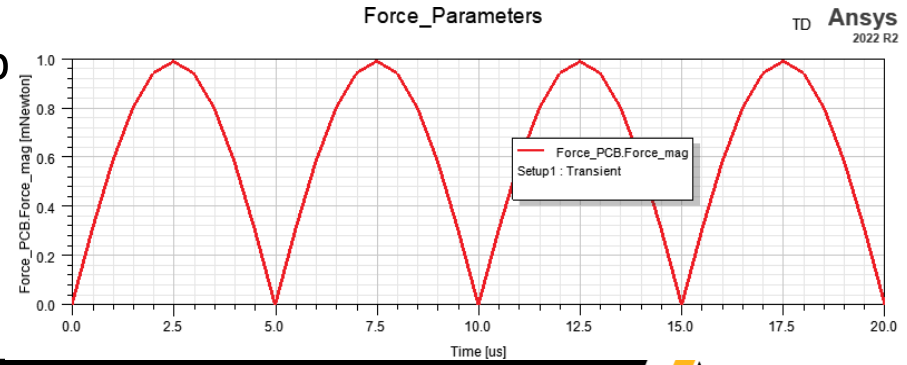
- Object-based force computation in addition to existing virtual-work force
  - Support multiple bodies in one force parameter
- Same output format of transient data as virtual-work force
- Transient data plot

Advantages:

- Identify major frequencies to monitor for vibration
- Accurate integrated force components on selected object group

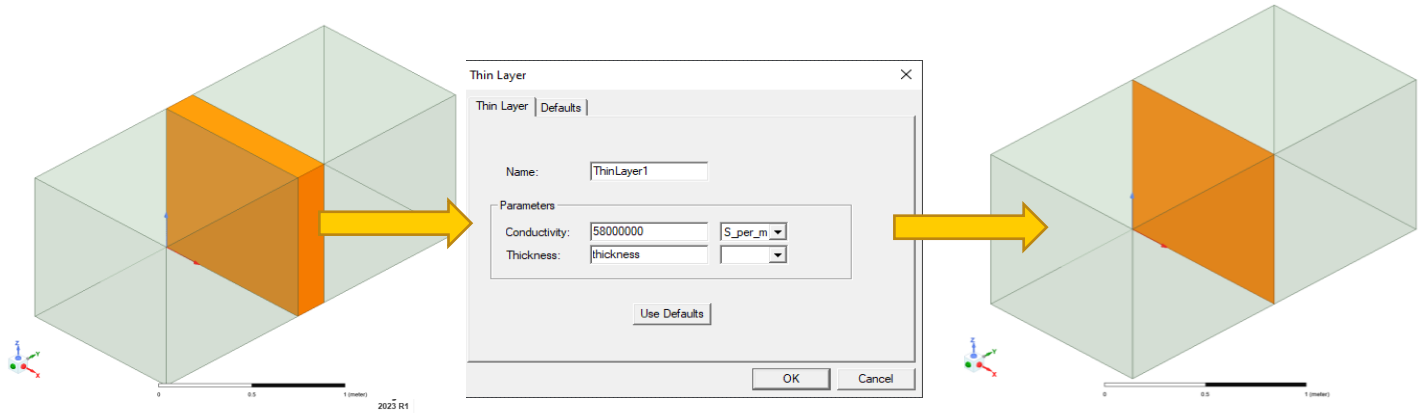


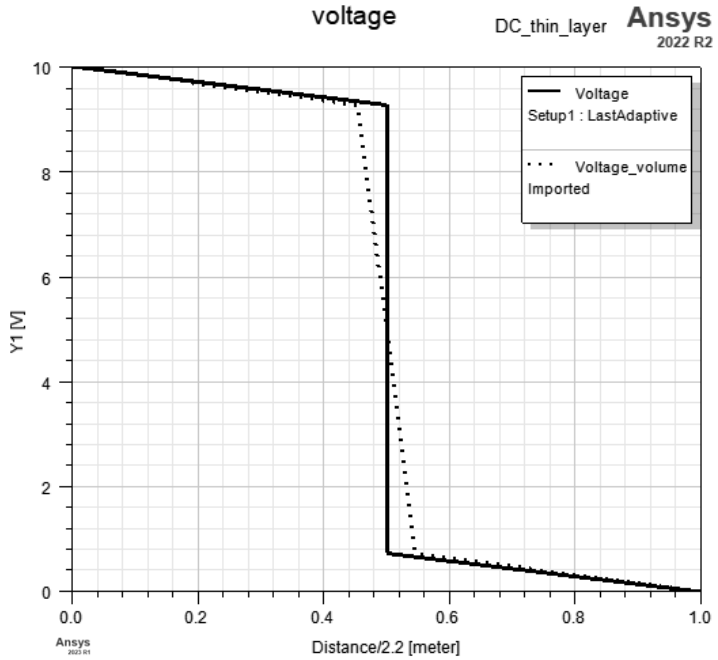


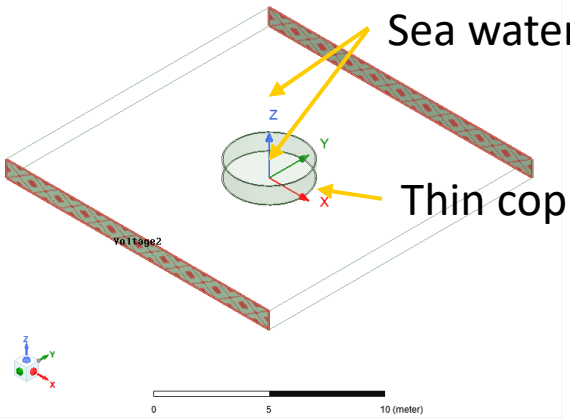


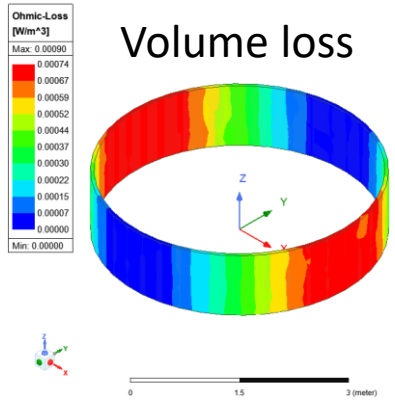
Support Thin Layer for 3D DC Conduction Solution

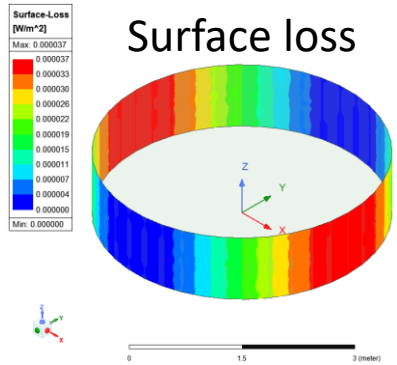
- Element based thin layer model
  - Potential jump defined between the nodes of each side of the surface
- Enable 2-way thermal coupling (AEDT and WB)





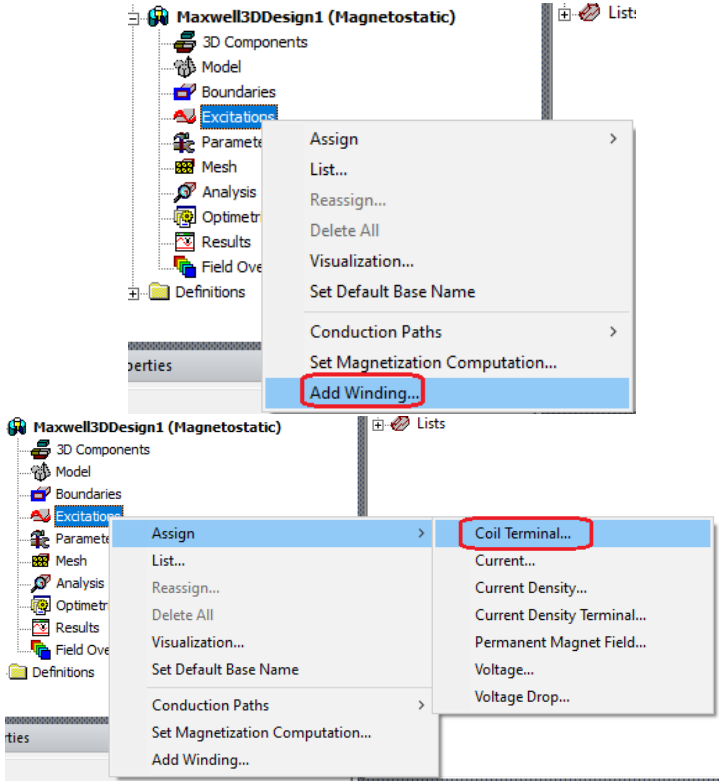




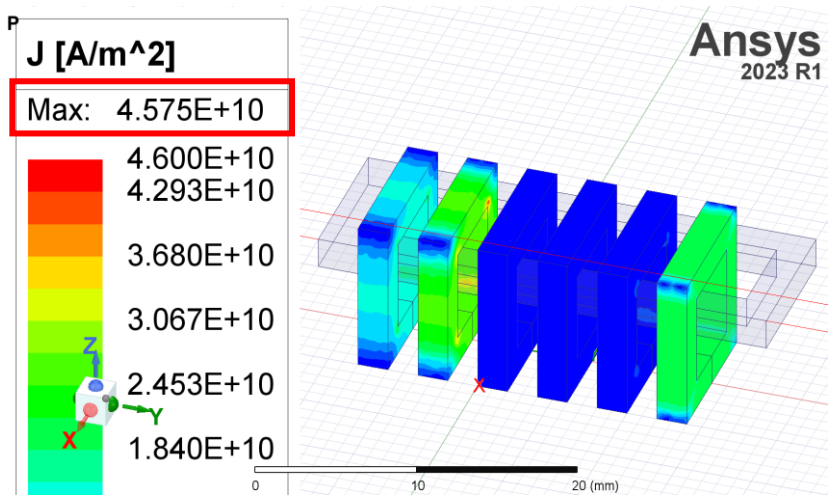


Support Winding for Maxwell Magnetostatic Solution

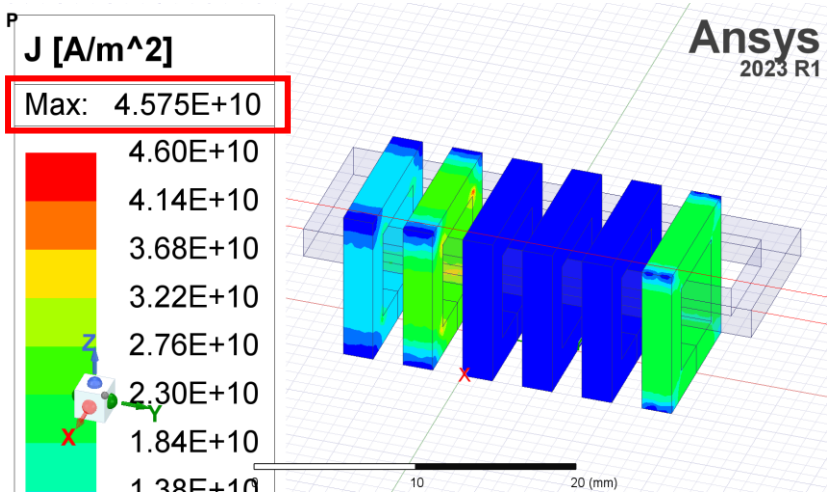
- Winding support in the Maxwell 2D/3D magnetostatic solvers
- Types: stranded and solid windings with current or voltage excitations
- Reports: flux linkage, inductance matrix, input current and voltage, total current, and solid and stranded losses in the windings



3D test model : solid and stranded windings excited with current or voltage



3D Eddy solution example (frequency = 0.1 Hz)

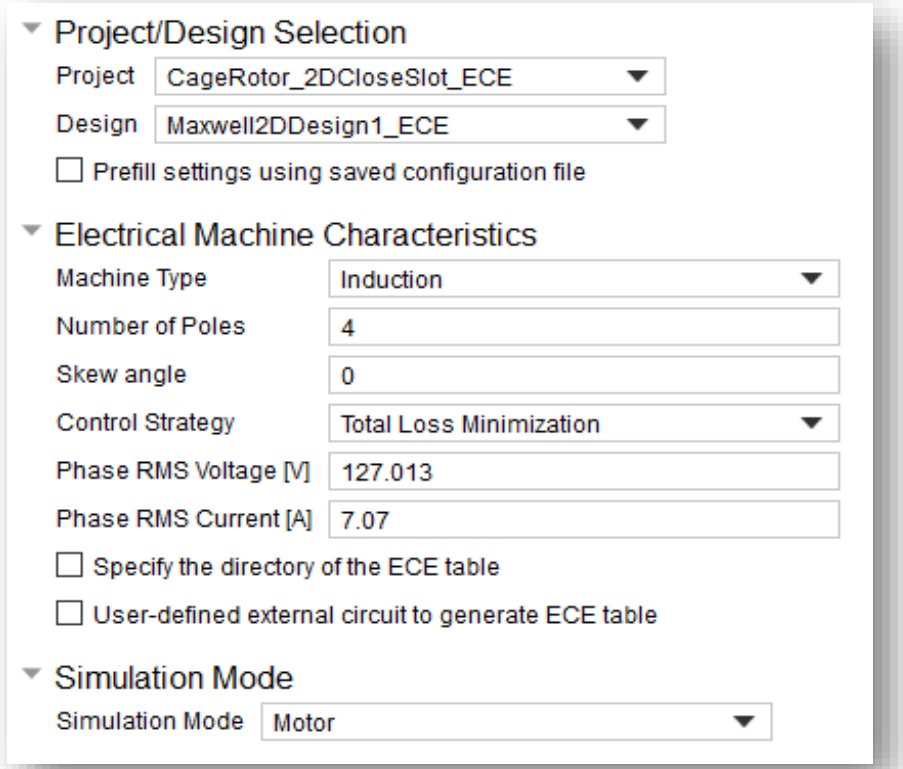


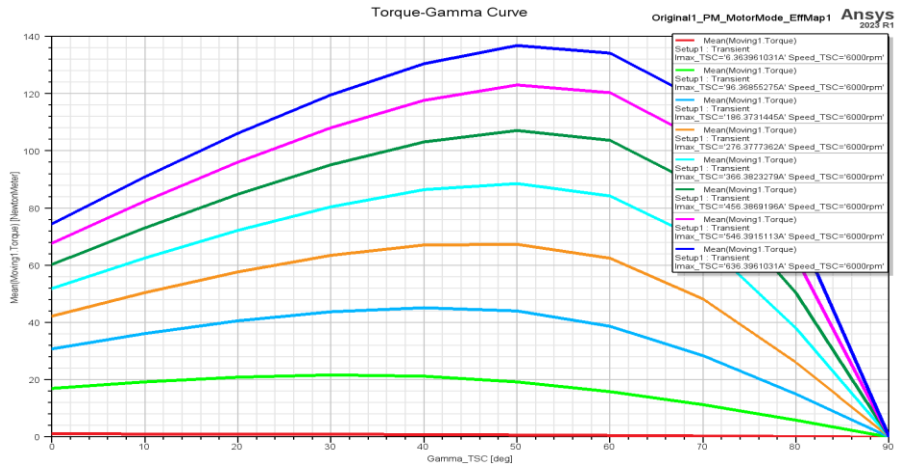
3D Mangetostatic solution example

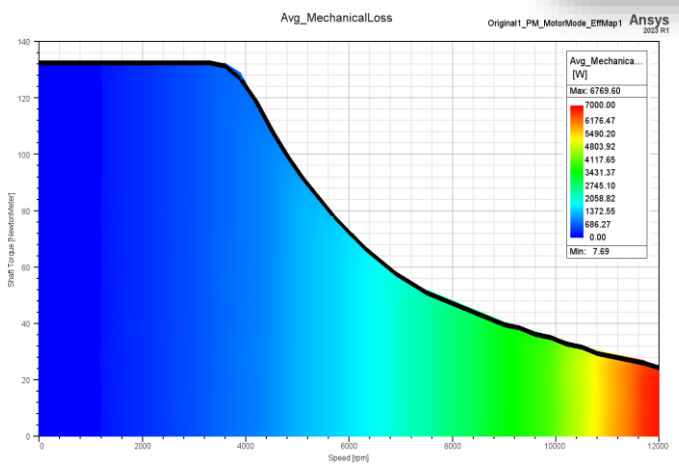
Electric Machine Enhancements

Electric Machines Toolkit

- Integrate ROM based efficiency map for induction machine
  - Faster than existing approach using parametric analyses of Maxwell transient designs to create performance maps
  - Three options on the selection or creation of the ROM table
- Allow users to input the table of mechanical loss versus speed
- Output the machine performances versus the sweep table of the original three variables for each machine type
- Report on the torque vs. slip and the torque vs. gamma







Speed[rpm]	MechLoss[W]
1000	100
4000	800
7000	2000
10000	4000
12000	7000

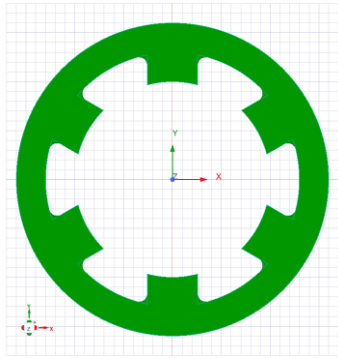
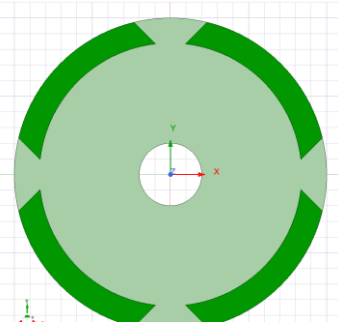
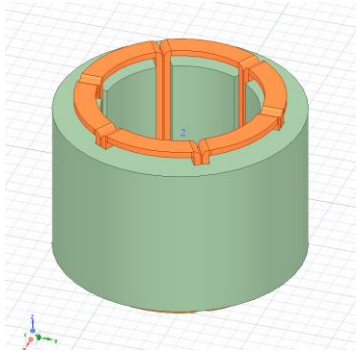
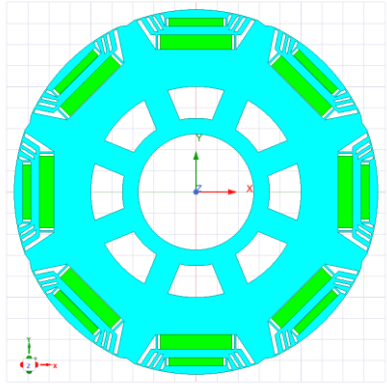
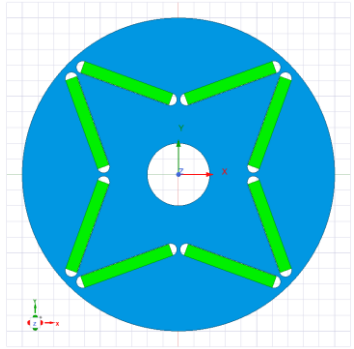
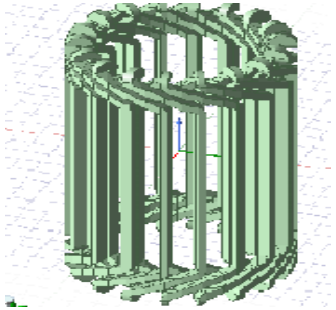
UDP Development for ANSYS Motor-CAD

UDP Development

- **Enhanced UDPs**: SRMCore UDP to support corner fillet and V-shape bottom slots; PMCore UDP to support insert surface PM Cores; LapCoil to support tooth coils
- **New UDPs**: UPMCore UDP to support U-type IPM cores; VPMCore UDP to support V-type IPM cores; VentCore UDP to support cores with vent ducts

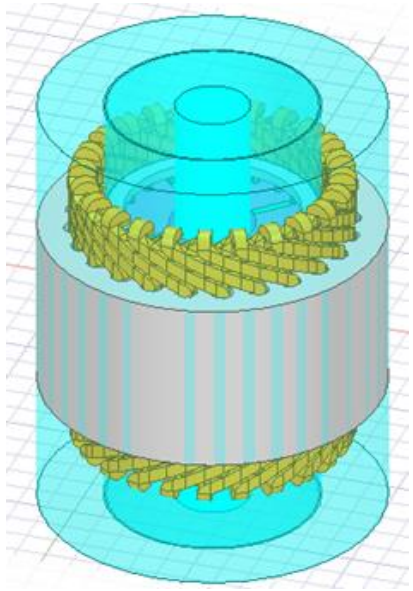
Advantages

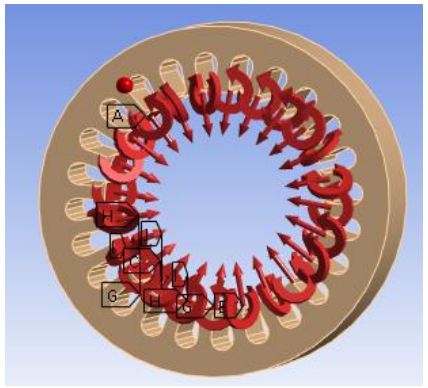
- **Convenient**: all UDP parameters are based on Motor-CAD parameters, not require to transfer parameters
- **Flexible**: arbitrary number of PM duct layers; any combination of IPM types and vent cores
- **Stable**: parameter values are validated or adjusted to avoid invalid input

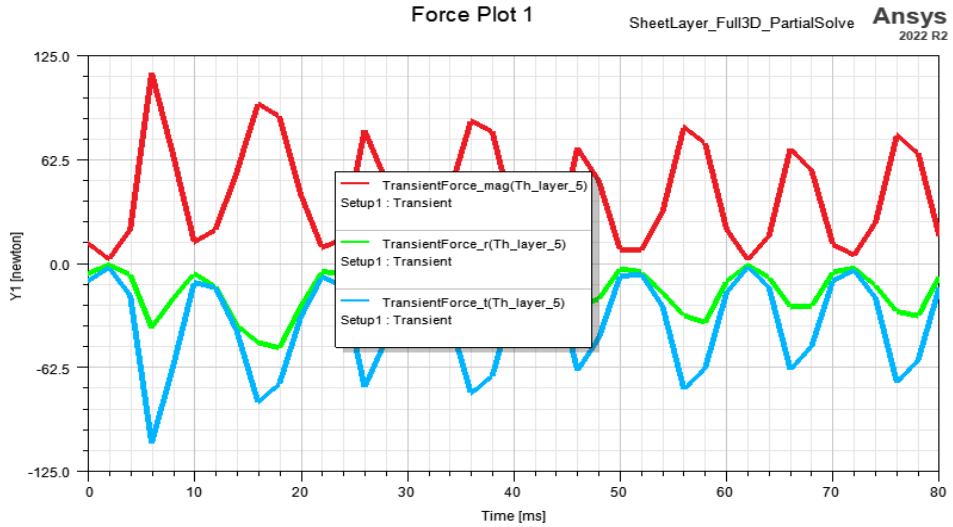







Support Half-axial Symmetry for Harmonic Force Calculation in 3D Transient

- Half-axial symmetry multiplier applied to object-based harmonic force calculation
- Symmetry multiplier applied to radial and circumferential components, zero axial force
- Position of object center adjusted to the symmetry plane (one slice machine)
- Allows for fast NVH simulation of electrical machines
- Takes advantage of partial to full model for NVH







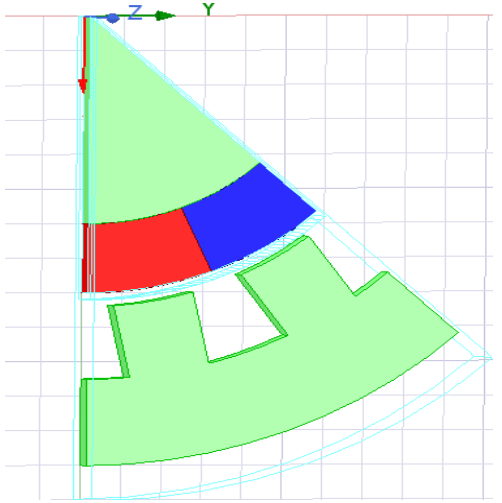
Improvements and Consolidation of Force Calculation in 3D Transient

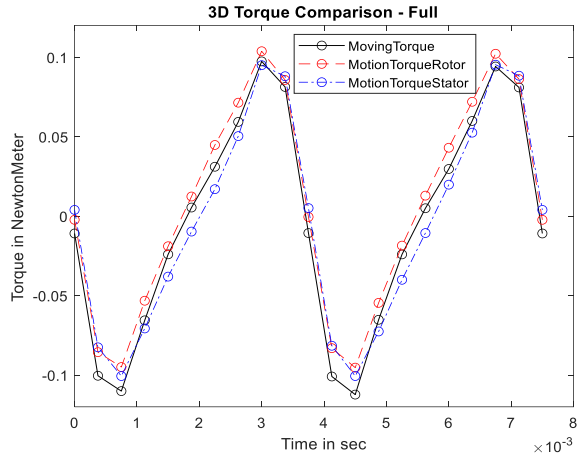
Improvements of surface force density

- Hybrid algorithm for surface force density (virtual work + surface force density)
- Available for 3D Transient solver

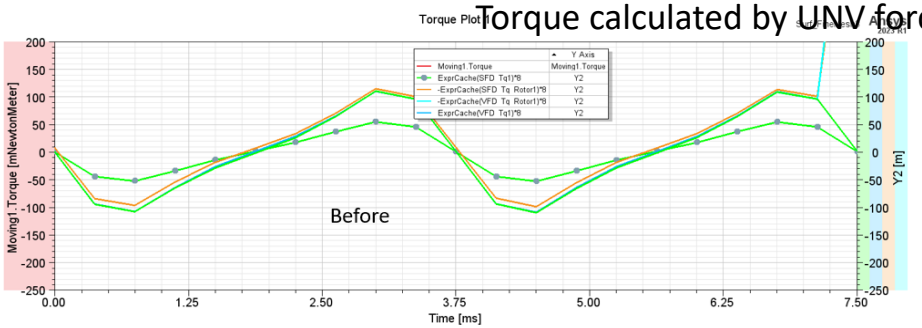
Benefits:

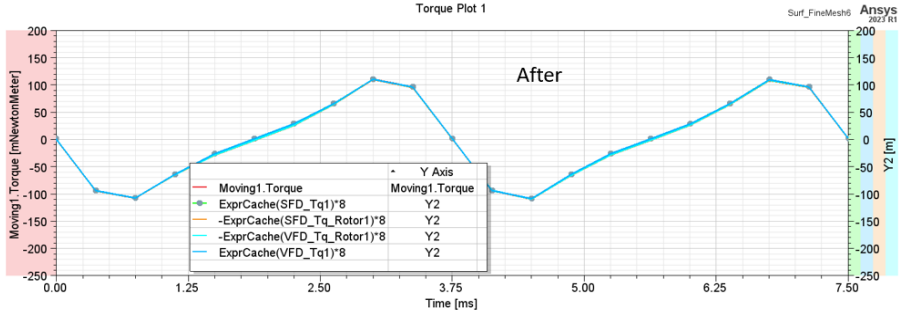
- FEA Validation:
  - Integrated force from surface force density and volumetric force density consistent with parameter force
  - Calculated torque from surface force and volumetric force match moving torque
  - Transient force for third party (.UNV File) consistent with surface force and volumetric force





Torque calculated by UNV force





High Performance Computing

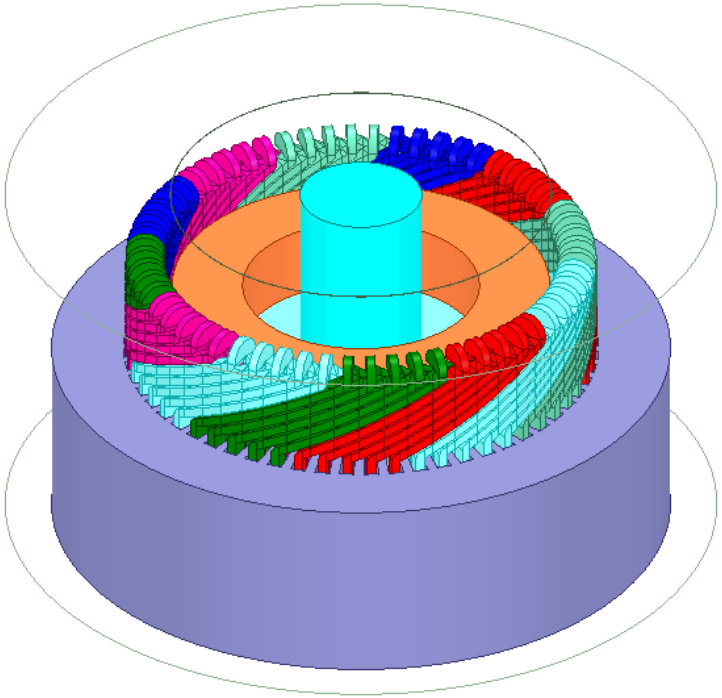
Ansys

Support Variable Time Steps with External Circuit in TDM Simulation

Enable TDM on FEA transient coupled with external circuit when:

1) The time steps are not constant
2) The time steps of source design and target design are differen

The test case is a project excited by external circuit where the time steps of source design and target design are different



AEDT Desktop and Core

Ansys Electronics Desktop

- Parasolid kernel for 3D Modeler
  - Official migration to Parasolid modeling kernel

- Auto multi-level distribution for LSDSO
  - Each distributed process automatically determines best allocation of available cores
    - frequency point distribution, solver distribution, etc…

- Native non-graphical image export
  - ExportModelImageToFile script command works in graphical and -ng mode on both Windows & Linux


Ansys