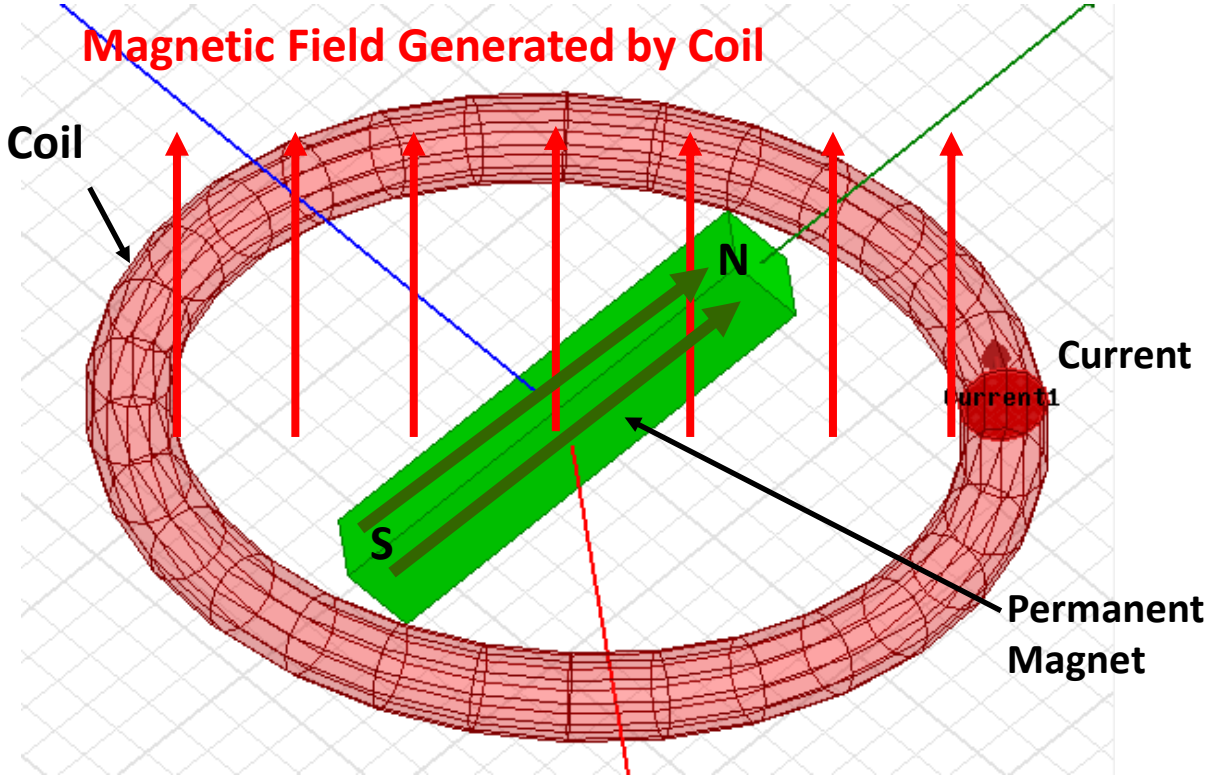
Ansys Maxwell Getting Started

Workshop 1.2: Magnetostatic 3D Analysis

Release 2020R2

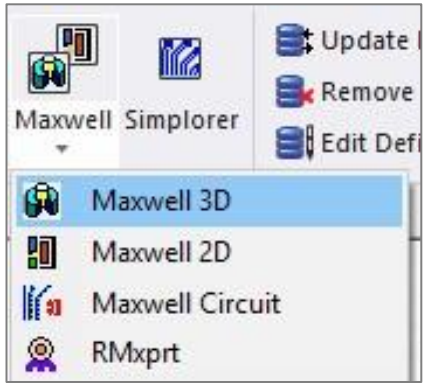
Overview

- Background
  - This workshop assumes little or no prior experience of Maxwell. Basic principles will be demonstrated through the creation of a simple cylindrical symmetry.
- Force calculation in Magnetostatic Solver
  - This workshop will discuss how to set up a torque calculation in the 3D Magnetostatic Solver.
- Problem Description
  - As shown in the picture, the current in the coil generates a magnetic field pointing along Y-axis. The permanent magnet in the middle is magnetized along X-axis, hence a torque around Z-axis is generated



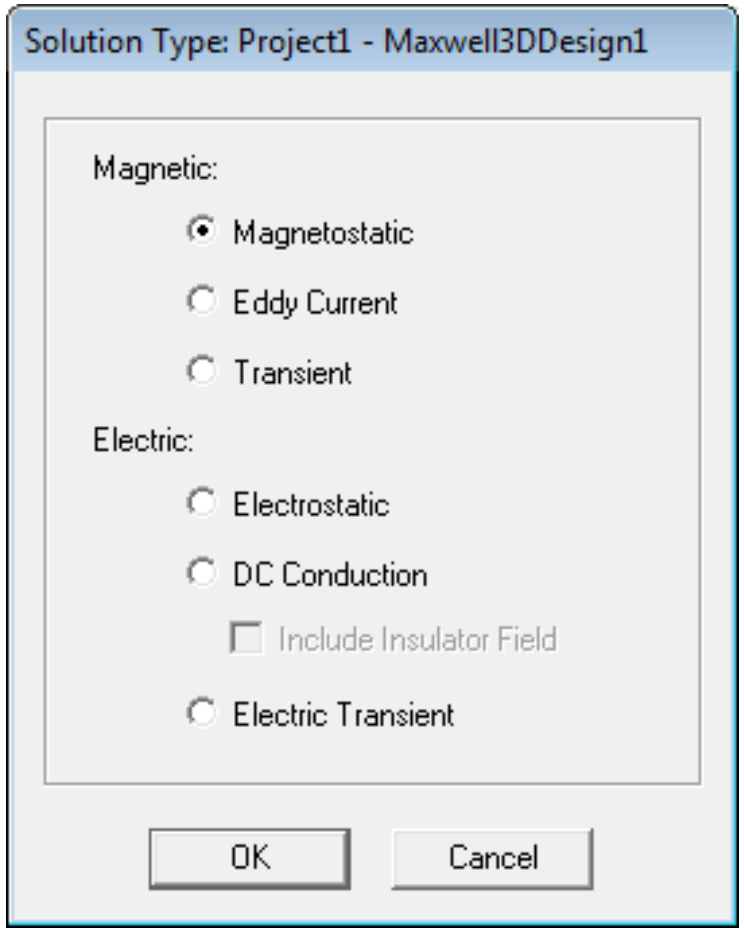
Model Setup

- **Insert Design**
  - **Select the menu item *Project → Insert Maxwell 3D Design*, or click on the icon in drop down list Maxwell on panel Desktop**



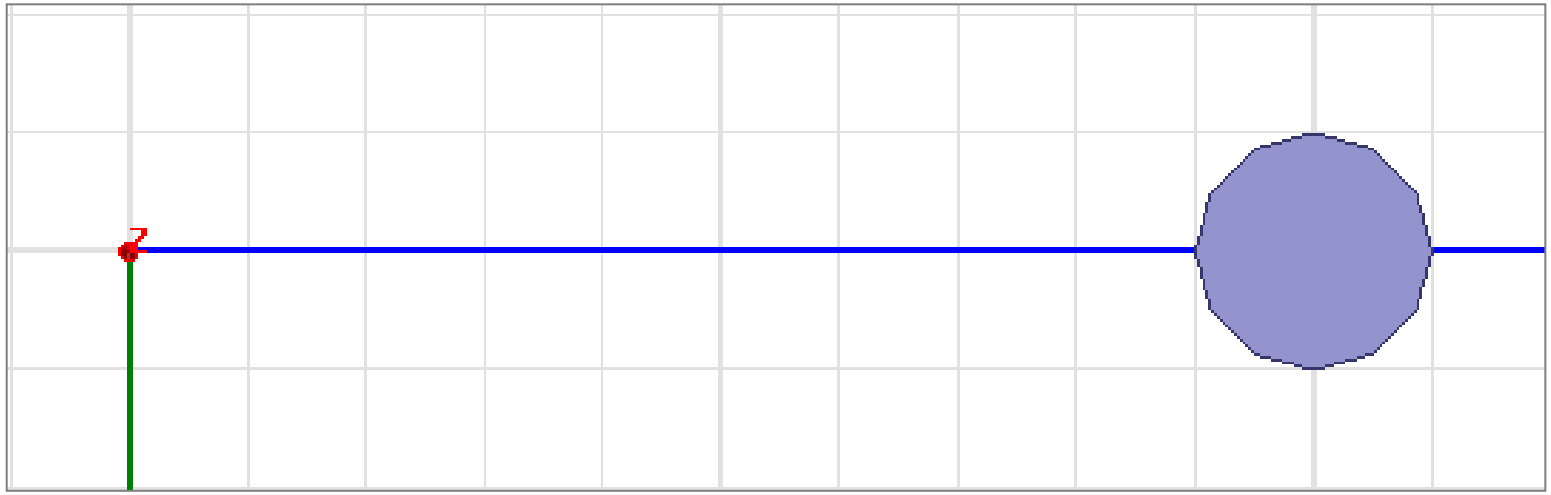
- **Set Solution Type**
  - **Select the menu item *Maxwell 3D → Solution Type***
  - **Choose *Magnetic → Magnetostatic***
  - **Click the OK button**

- **Set Model Units**
  - **Select the menu item *Modeler → Units***
    - **Select units: mm (millimeters) and press OK**



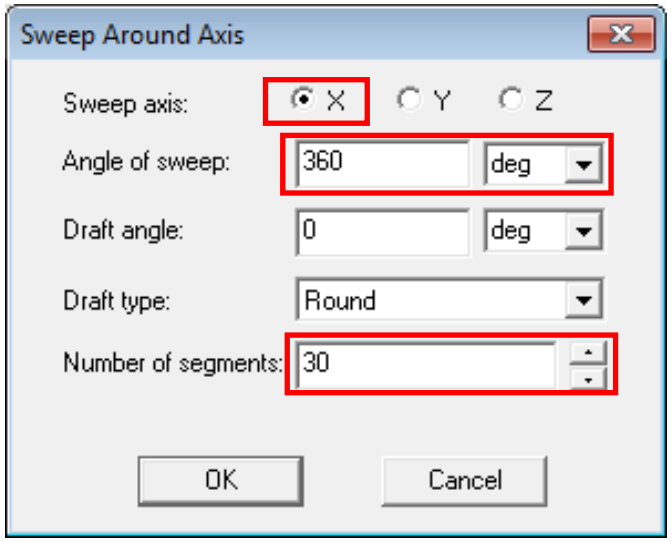
Create Coil

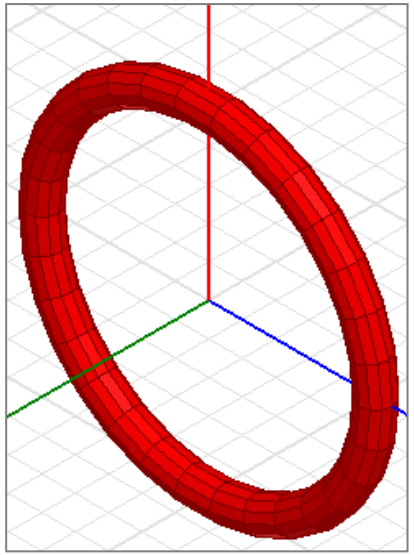
- Create Profile for Sweep
  - Select the menu item *Draw → Regular Polygon*
    - Using the coordinate entry fields, enter the center position
    - X: 0, Y: 5, Z: 0, Press the Enter key
    - Using the coordinate entry fields, enter the radius
    - dX: 0.5, dY: 0, dZ: 0, Press the Enter key
    - Number of Segments: 12
    - Press OK
  - Change the name of resulting object to Coil



Create Coil

- **Sweep Profile**
  - Select the object Coil from the history tree
  - Select the menu item ***Draw → Sweep → Around Axis***
  - In Sweep Around Axis window
    - Sweep Axis: X
    - Angle of Sweep: 360 deg
    - Number of Segments: 30
    - Press OK
  - Change material of resulting object to Copper
  - Change its Color and Transparency if desired



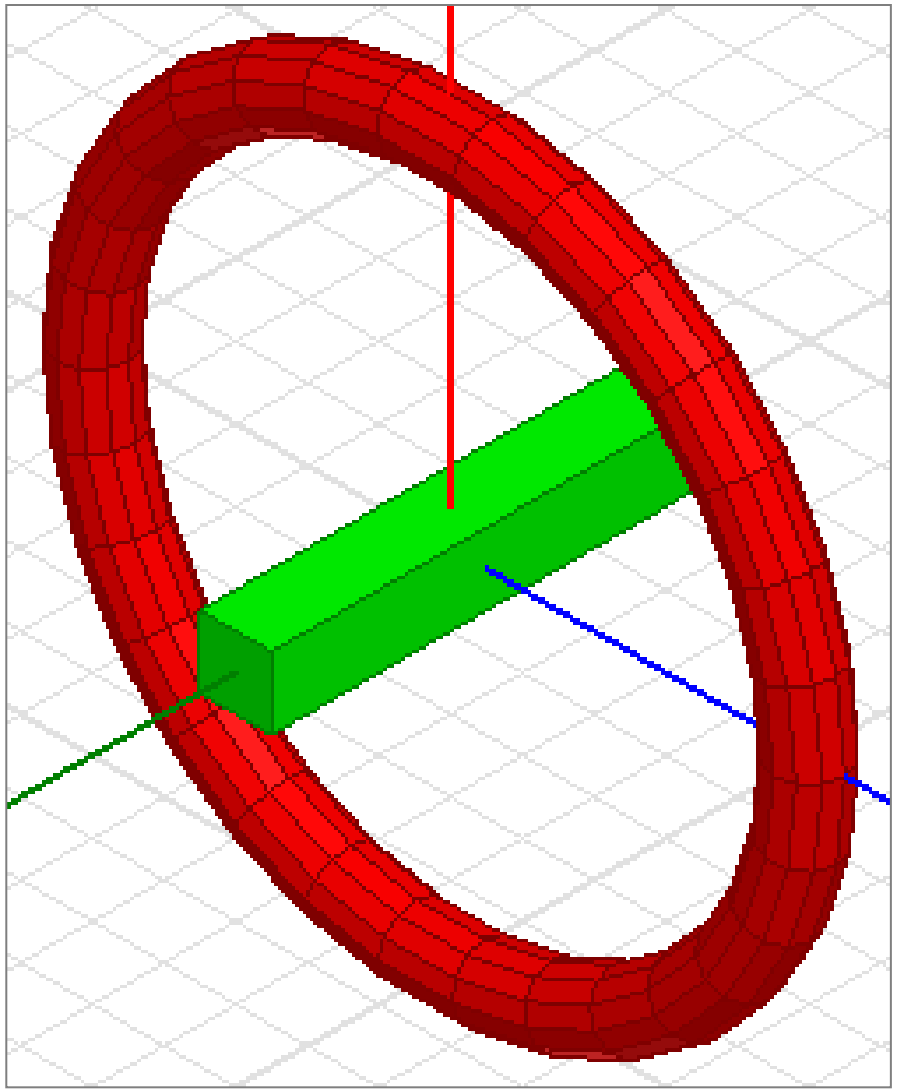


Create Magnet

- Create permanent Magnet
  - Select the menu item *Draw → Box*
    - Using the coordinate entry fields, enter the box position

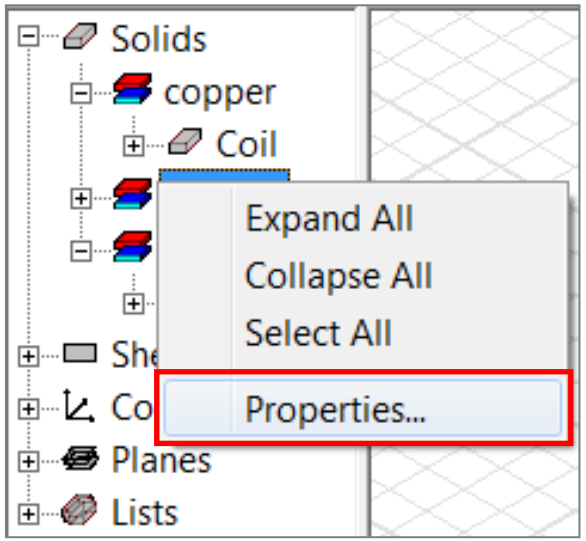
      X: -3, Y: -0.5, Z: -0.5, Press the Enter key
    - Using the coordinate entry fields, enter the opposite corner

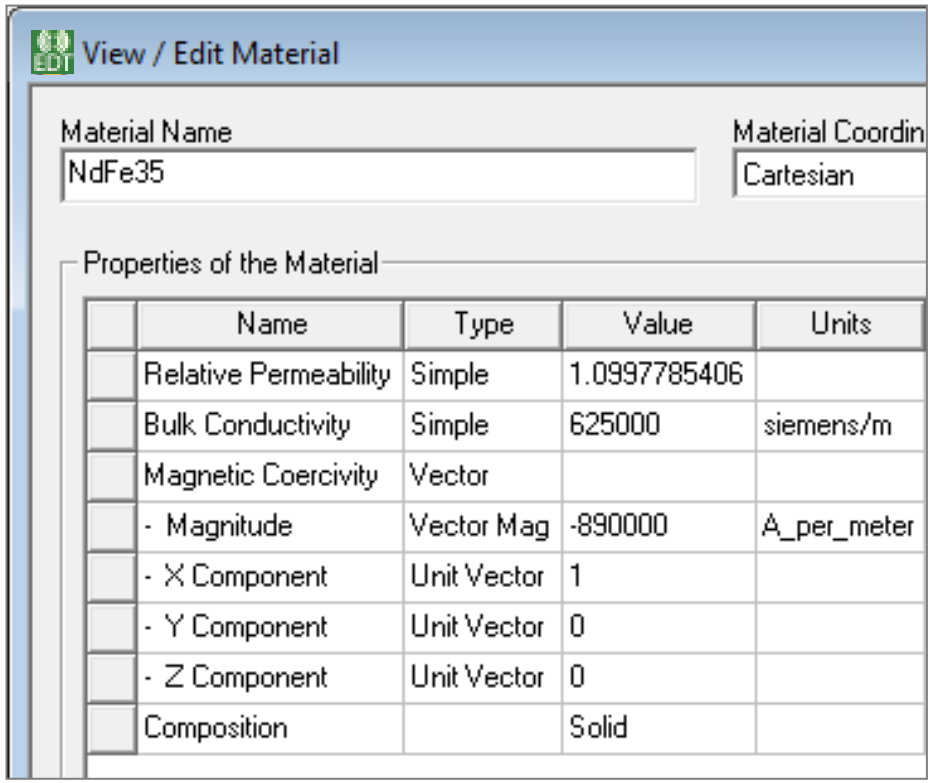
      dX: 6, dY: 1, dZ: 1, Press the Enter key
  - Change the name of the resulting object to Magnet
  - Change material of the object to NdFe35
  - Change its color and transparency if desired



Check Magnetization Direction

- Check Properties of Material
  - Right click on NdFe35 from the history tree and select Properties
  - In Select Definition window, select View/Edit Materials
    - Ensure X Component is set to 1
    - Ensure Y and Z Component is set to 0





Name	Type	Value	Units
Relative Permeability	Simple	1.0997785406	
Bulk Conductivity	Simple	625000	siemens/m
Magnetic Coercivity	Vector		
- Magnitude	Vector Mag	-890000	A_per_meter
- X Component	Unit Vector	1	
- Y Component	Unit Vector	0	
- Z Component	Unit Vector	0	
Composition		Solid	

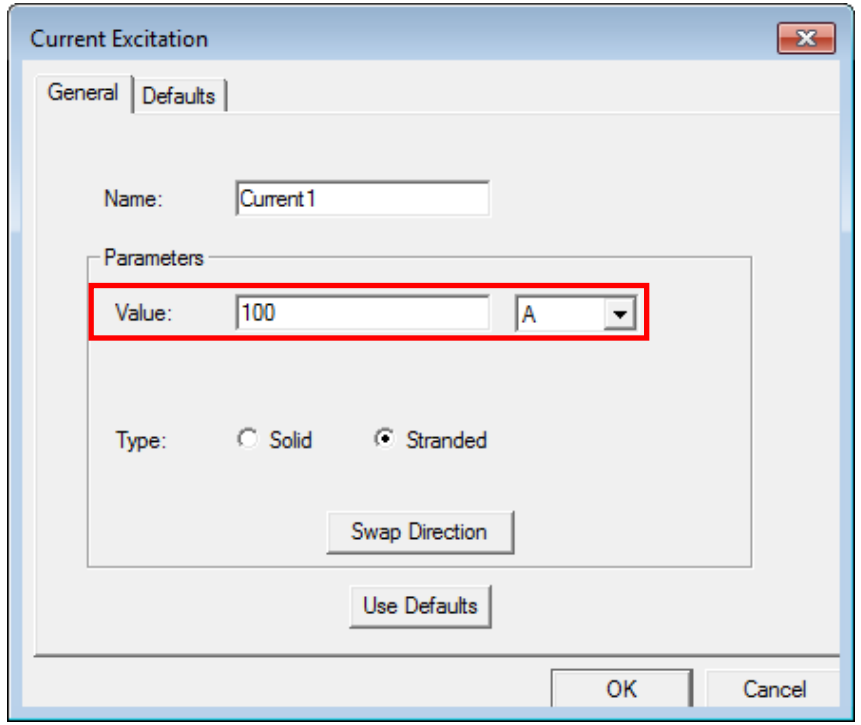
Note: It is important to check the direction of magnetization. By default Maxwell assigns magnetization direction as X axis of assigned co-ordinate system. Users can either modify the direction or create a coordinate system in required direction to alter the direction of magnetization

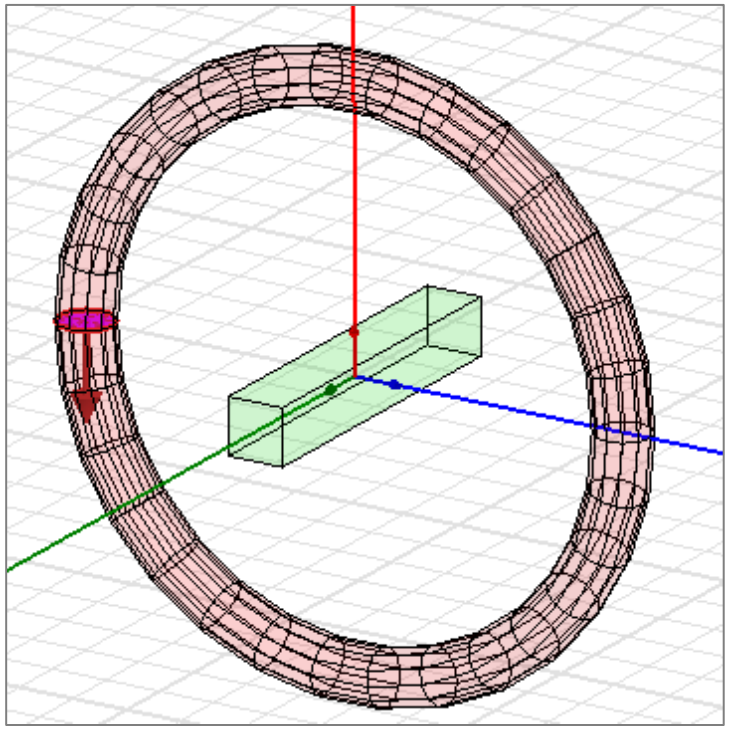
Create Coil Terminal

- Create Coil terminal
  - Select the object Coil from the history tree
  - Select the menu item *Modeler → Surface → Section*
    - Section Plane: XY
    - Press OK
  - Change the name of the resulting sheet to Terminal
- Separate Sheets
  - Select the sheet Terminal from the history tree
  - Select the menu item *Modeler → Boolean → Separate Bodies*
- Delete Extra Sheet
  - Select the sheet Terminal_Separate1 from the history tree
  - Select the menu item *Edit → Delete*

Assign Excitation

- **Assign Excitation**
  - **Select the sheet Terminal from the history tree**
  - **Select the menu item *Maxwell 3D → Excitations → Assign → Current***
  - **In Current Excitation window,**
    - **Name: Current1**
    - **Value: 100 A**
    - **Type: Stranded**
    - **Press OK**

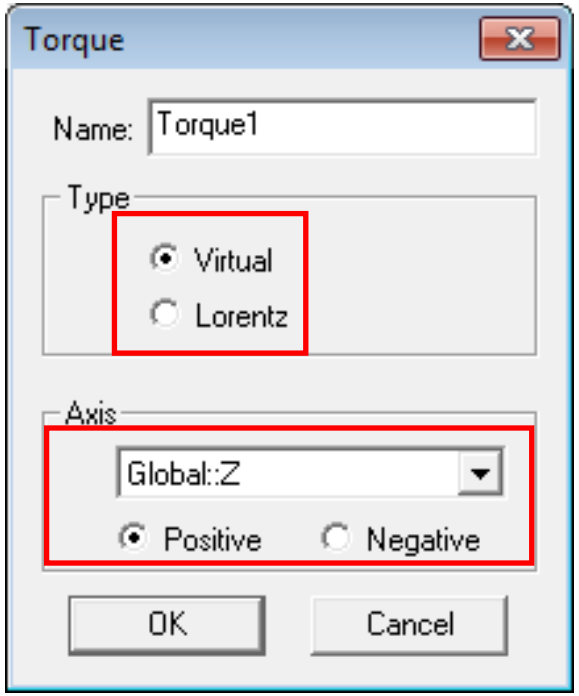




Note: The current value assigned for static solvers is in Ampere-Turns

Assign Torque Parameter

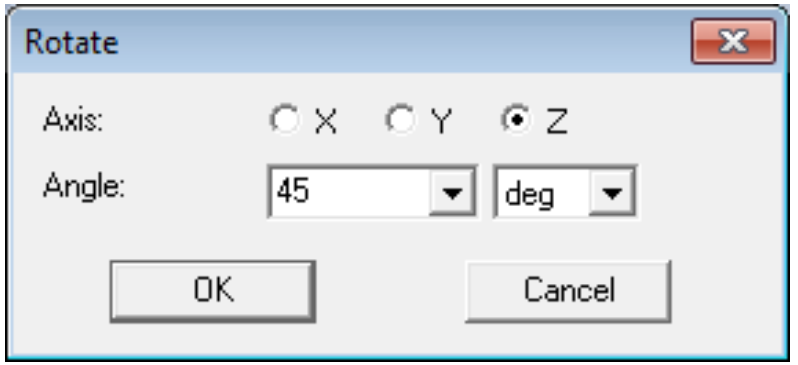
- Assign Torque Calculation
  - Select the object Magnet from the history tree
  - Select the menu item *Maxwell 3D → Parameters → Assign → Torque*
  - In Torque window,
    - Name: Torque1
    - Type: Virtual
    - Axis: Global::Z
    - Positive: ☑ Checked
    - Press OK



Note: if Virtual is selected, the system uses virtual work principles to compute the torque on an object

Finalize Geometry

- Rotate Coil
  - Press Ctrl and select both objects Coil and Terminal from the history tree
  - Select the menu item *Edit → Arrange → Rotate*
  - In Rotate window,
    - Axis: Z
    - Angle: 45 deg
    - Press OK

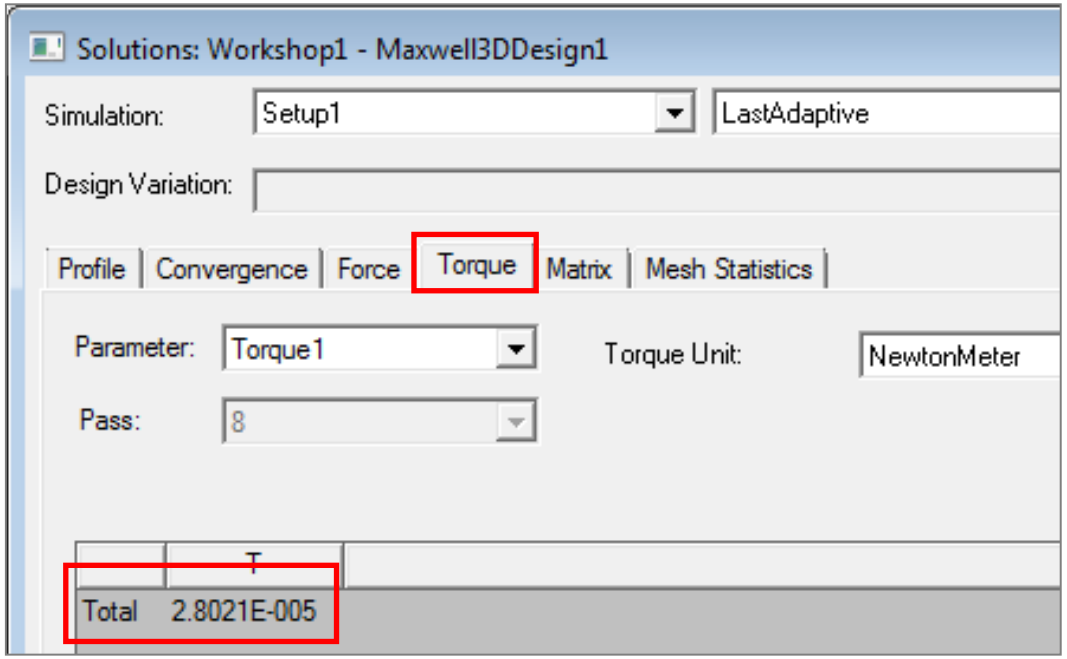


Note: Coil rotation done after Terminal creation in order to use global planes for sectioning

- Create Simulation Region
  - Select the menu item *Draw → Region*
  - In Region window,
    - Padding all directions similarly: ☑ Checked
    - Padding Type: Percentage Offset
    - Value: 100
    - Press: OK

Analysis and Results

- Create an analysis setup:
  - Select the menu item *Maxwell 3D → Analysis Setup → Add Solution Setup*
  - Solution Setup Window:
    - Click the OK to accept default settings
- Start the solution process:
  - In the Project Manager window *RMB on Setup1 → Analyze*
- View the Solution Results:
  - Select the menu *Maxwell 3D → Results → Solution Data*
    - To view Torque values
    - Select the Torque tab



Saving the Project

- This completes the workshop
- Save the file with the name Workshop_1_2 in the working folder

End of Presentation