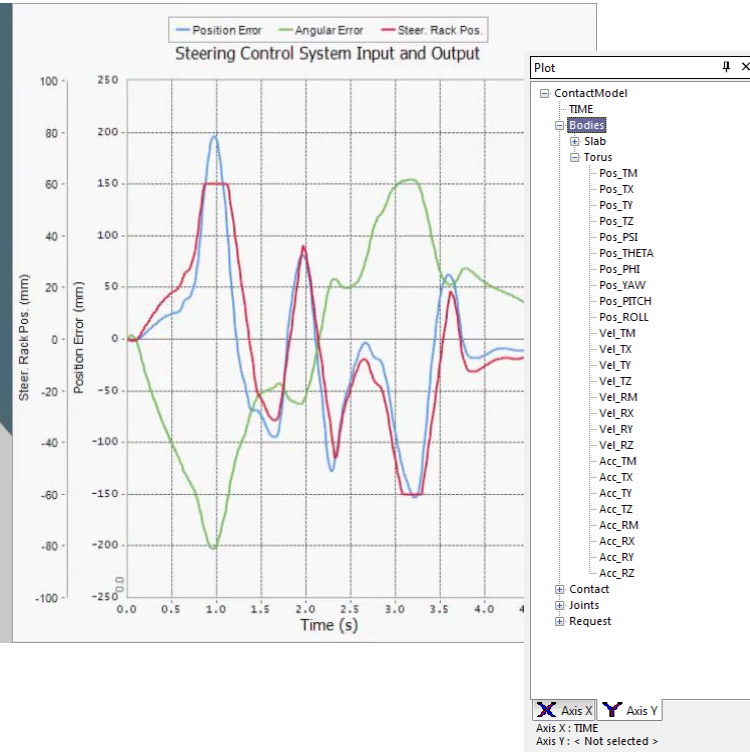
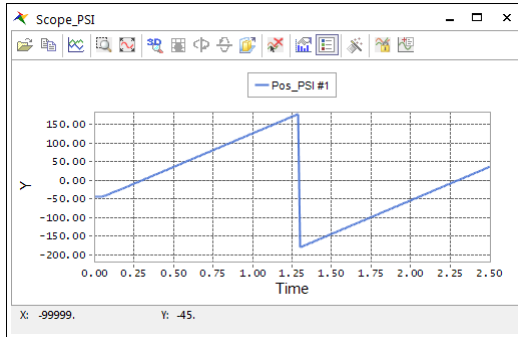


10/25/2017



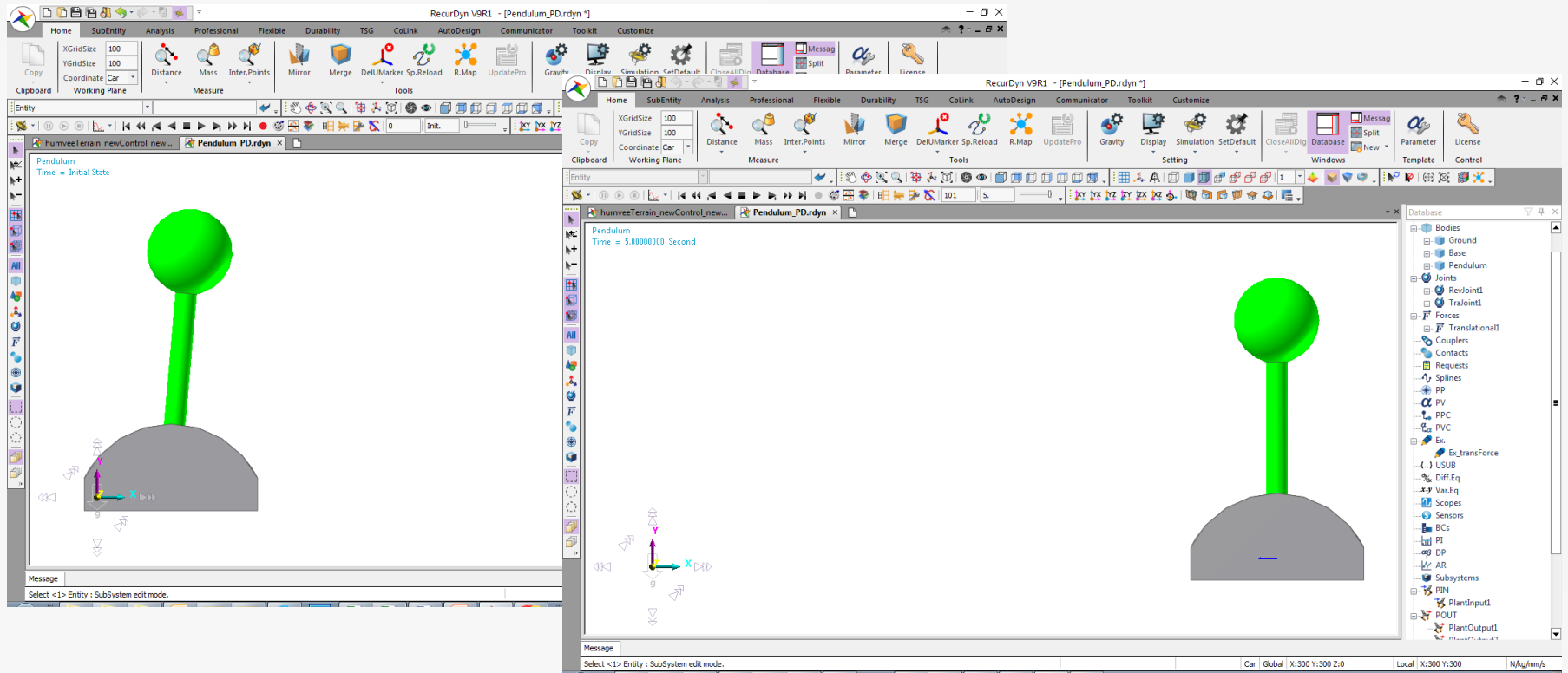
Nelson Woo

MotionPort

# Topics Covered

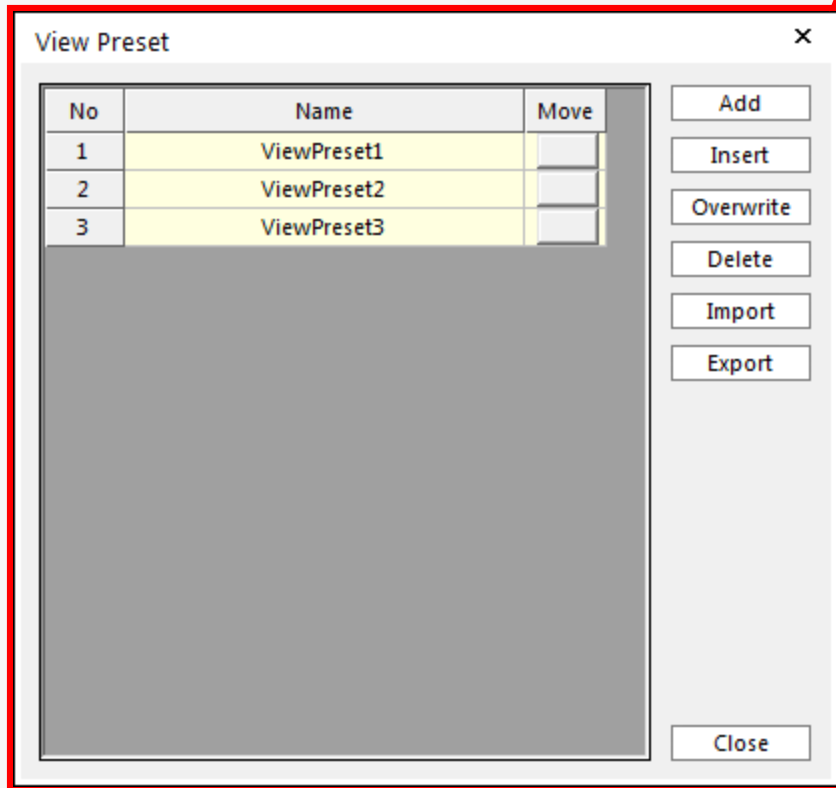
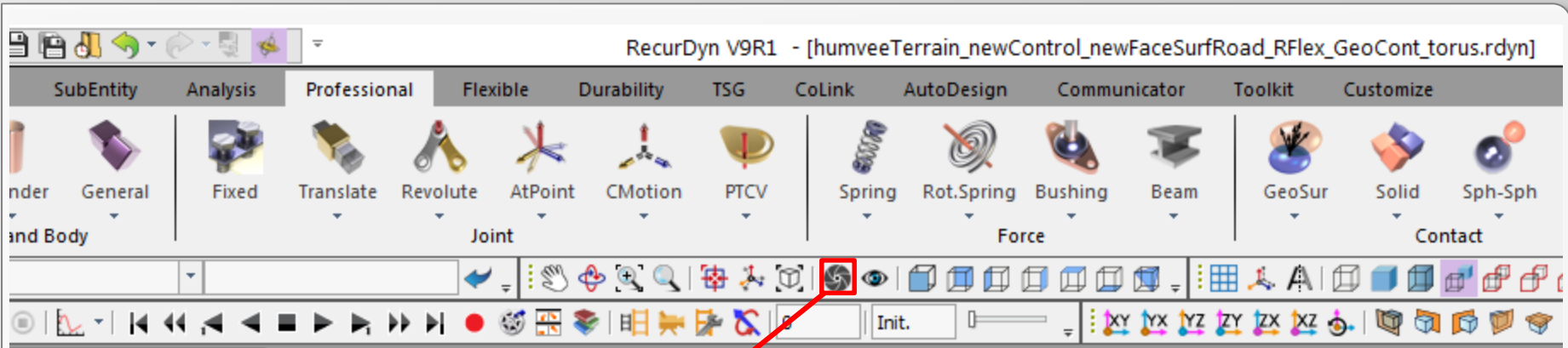
- Working with Views
  - View Presets
  - Custom View
- Cameras
  - Camera control panel
  - Following camera
- Multi-Animation
- Scopes
  - Orientation
    - Euler Angles
    - Angle Expressions (Projected Angle)
  - Gap/Interference
- Marker Trace
- Plot Output
  - Bodies
  - Geo Surface Contacts
  - Multi-Axis Control
  - Plot with Animation
  - Plot Templates

# Working with Views



- View: Position / Orientation / Zoom
- Ability to save, load, export and import views.
- Views saved in model or XML files.
- Purpose: allows the user to view results in a consistent manner from one result set to another.
- Two methods: View Presets and Custom Views

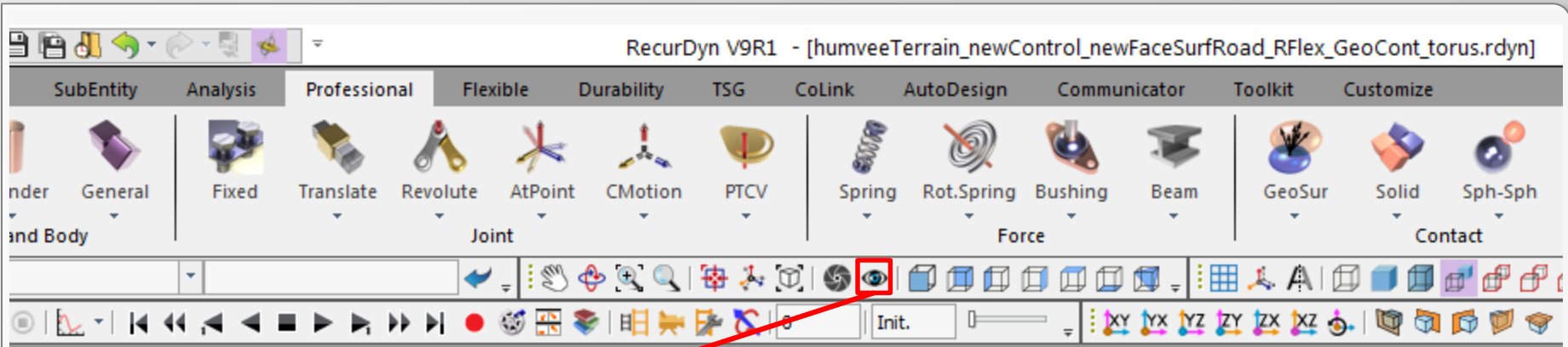
# Working with Views: View Presets



1. Views saved in model.
2. Very easy to save or load ("Move") views.

(DEMO)

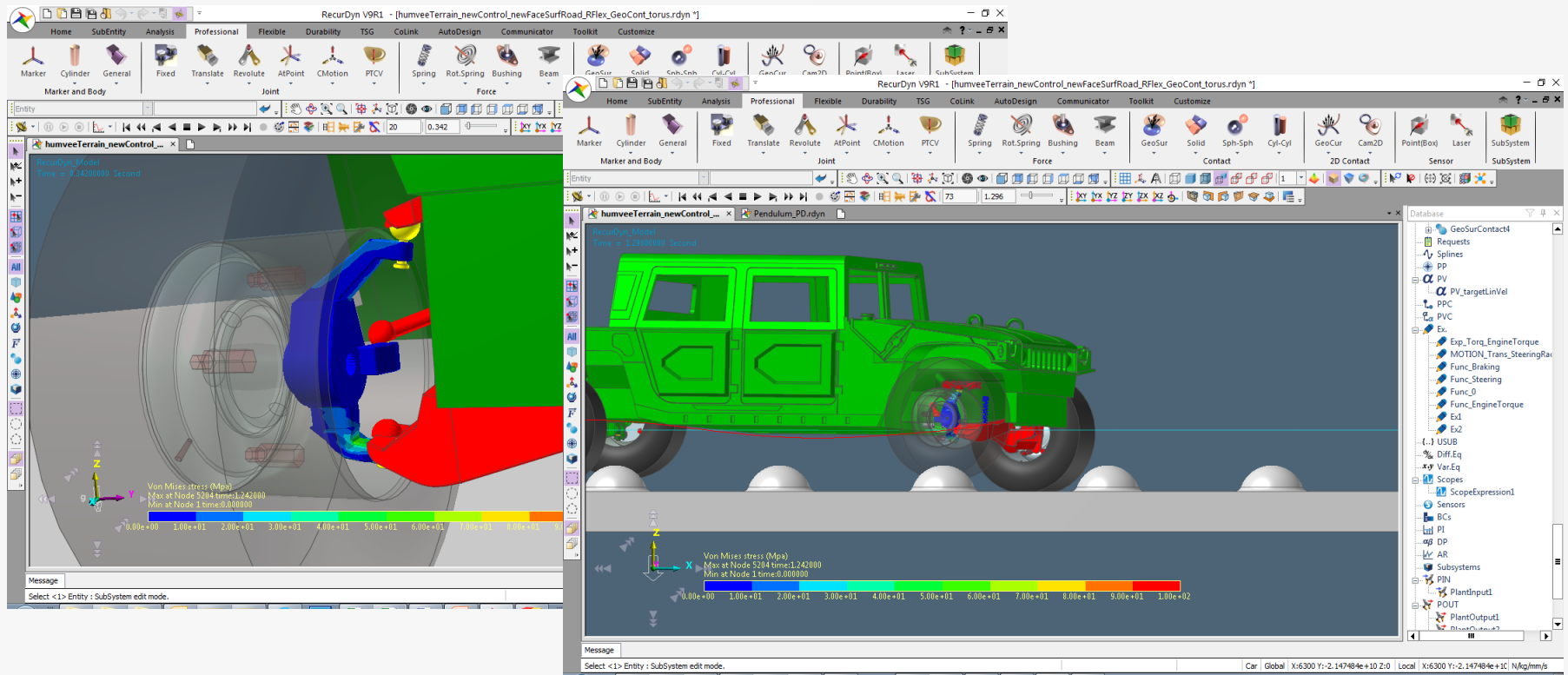
# Working with Views: Custom View



- Views imported from / exported to XML files.
- Can be used to save view to other models.
- Specific position, orientation, and zoom scale information displayed.
- Can use existing markers to define position and orientation.

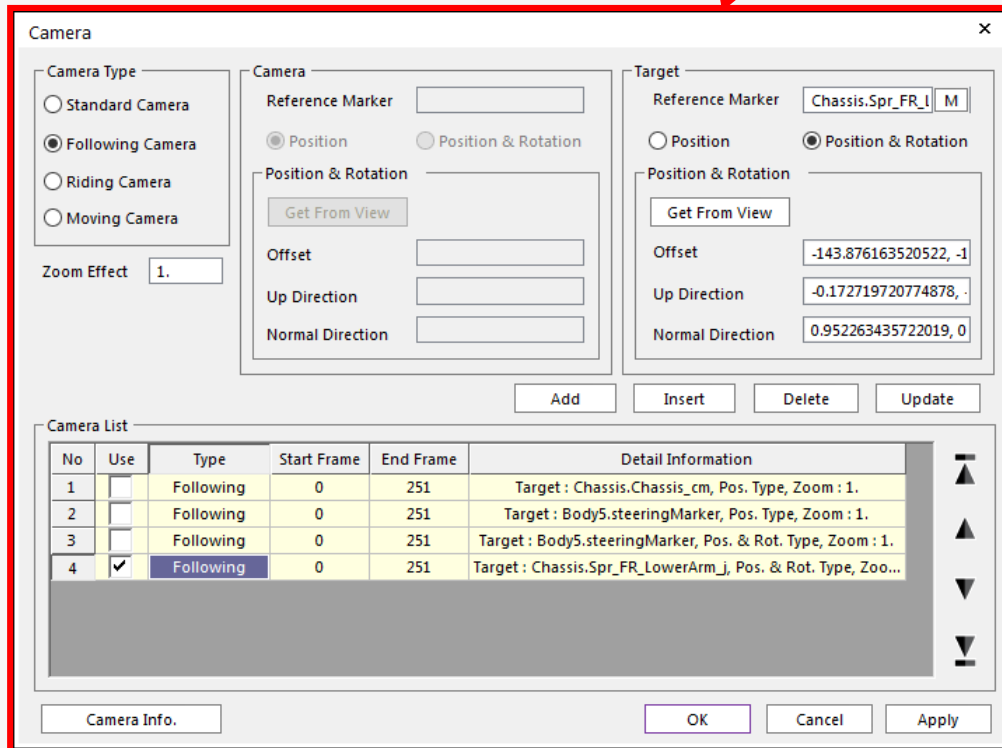
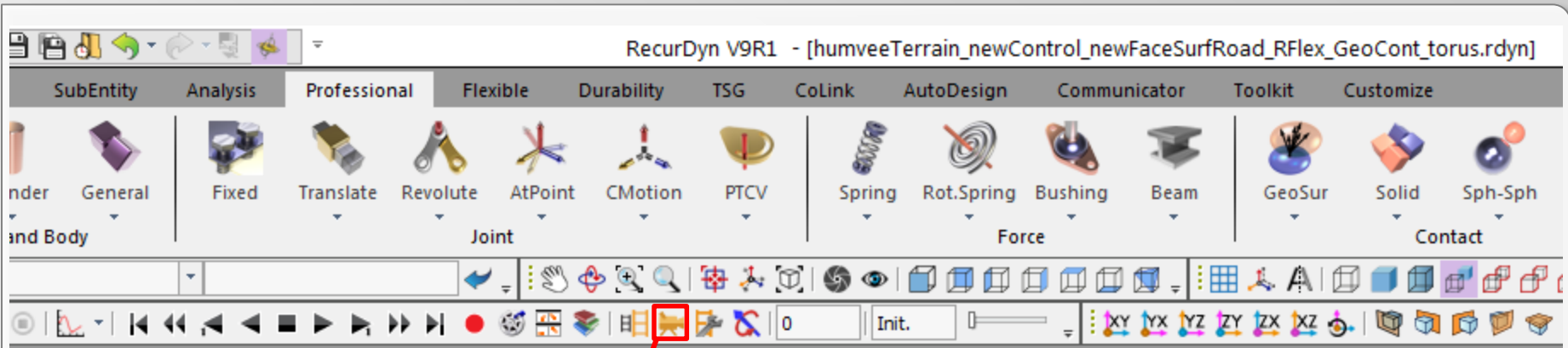
(DEMO)

# Cameras



- During animation, different camera types can be used to view or emphasize different aspects of the results.
- The standard camera remains stationary.
- A following camera can be very useful to focus on moving parts of the model that could be difficult to focus on otherwise.

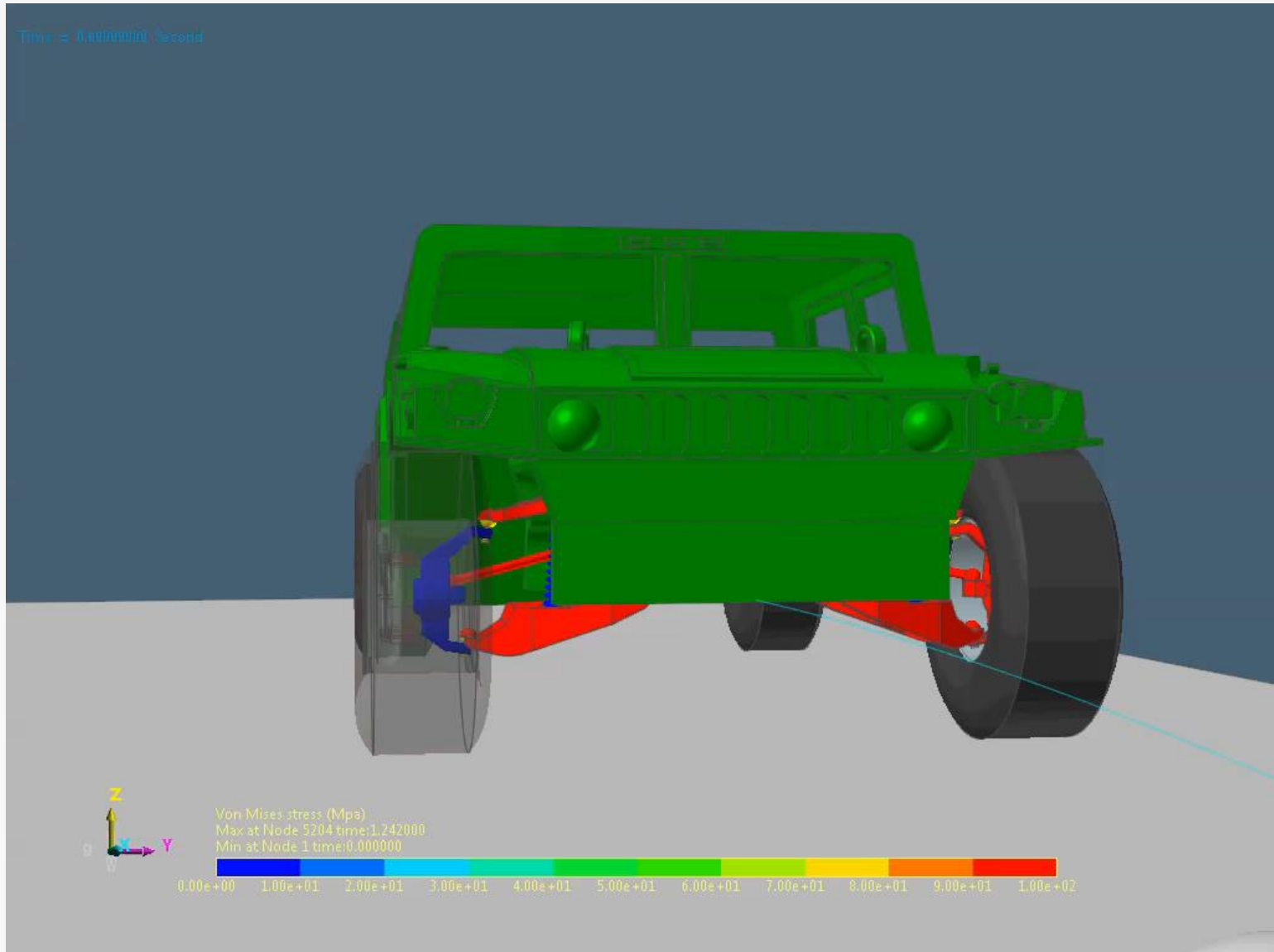
# Cameras



- Multiple cameras can be stored for different purposes.
- Following camera most useful.
- Can constrain camera:
  - Position
  - Position and Rotation

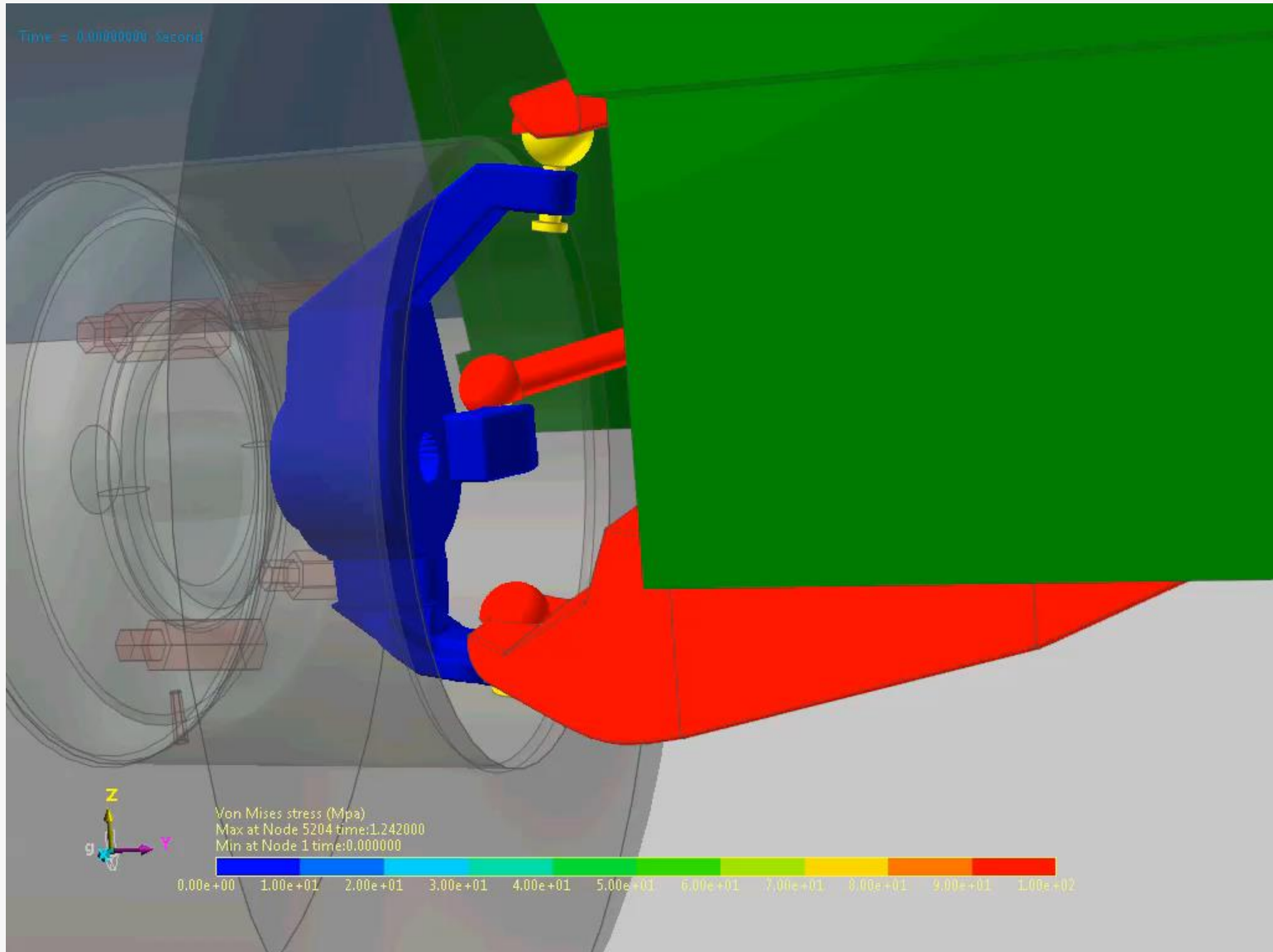
(DEMO)

# Following Camera: Position





# Following Camera: Position & Rotation



# Multi-Animation

The image displays the RecurDyn V9R1 software interface for a pendulum simulation. The main window is divided into four quadrants, each showing a different animation result for a different integral gain ( $K_i$ ):

- Top-left:  $K_i = 50$
- Top-right:  $K_i = 150$
- Bottom-left:  $K_i = 250$
- Bottom-right:  $K_i = 350$

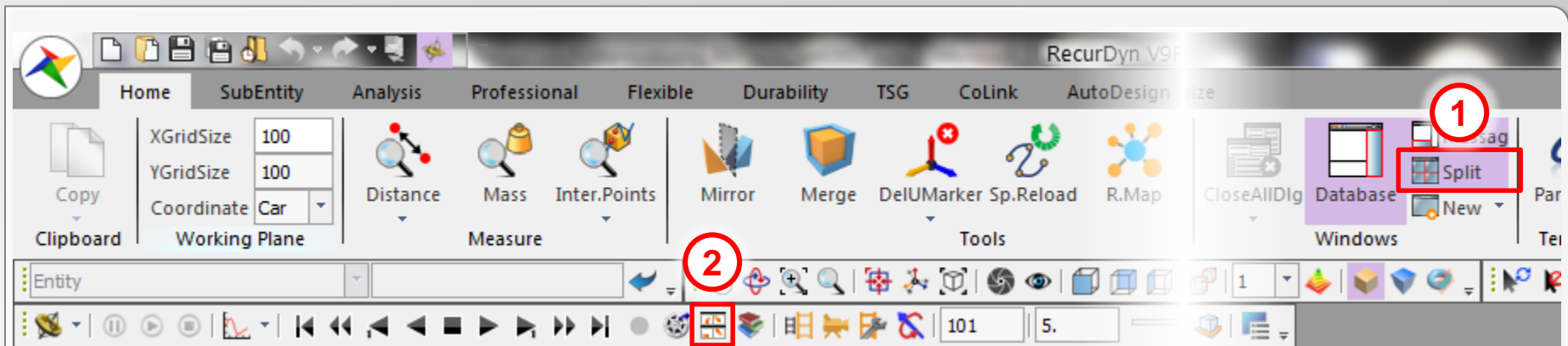
Each quadrant shows a green pendulum bob on a grey base. The control block diagram on the right illustrates the feedback loop:

- The input signal is fed into an **Integrator** block ( $\frac{1}{s}$ ).
- The output of the integrator is multiplied by  $-250$  (the  $K_i$  gain, highlighted with a red box and an arrow).
- The output of the  $K_i$  block is summed with the output of a  $K_p$  block ( $-1000$ ) and a  $K_d$  block ( $-125$ ).
- The summed signal is fed into the **RecurDyn Plant**.
- The plant output is demultiplexed into **Position** and **Velocity** signals.

The software interface includes a menu bar (Home, SubEntity, Analysis, Professional, Flexible, Durability, TSG, CoLink, AutoDesign, Communicator, Toolkit, Customize), a toolbar with simulation controls (Pause, Resume, Stop, Fast Play/Pause), and a status bar at the bottom showing coordinates and units.

Enables user to view different animation results simultaneously in different windows.

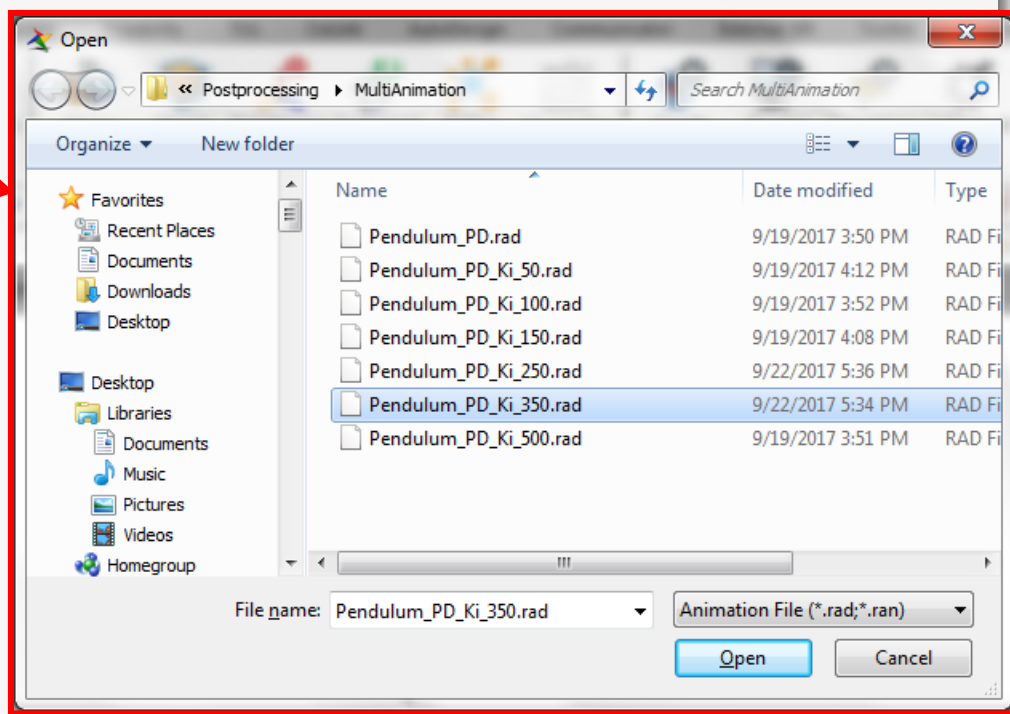
# Multi-Animation



Multi-animation Settings

No	Pos	File	...
1	Left Upper	Pendulum_PD_Ki_50.rad	...
2	Left Lower	Pendulum_PD_Ki_250.rad	...
3	Right Upper	Pendulum_PD_Ki_150.rad	...
4	Right Lower	Pendulum_PD_Ki_350.rad	...

OK Cancel Apply



# Multi-Animation

Time = 0.00000000 Second

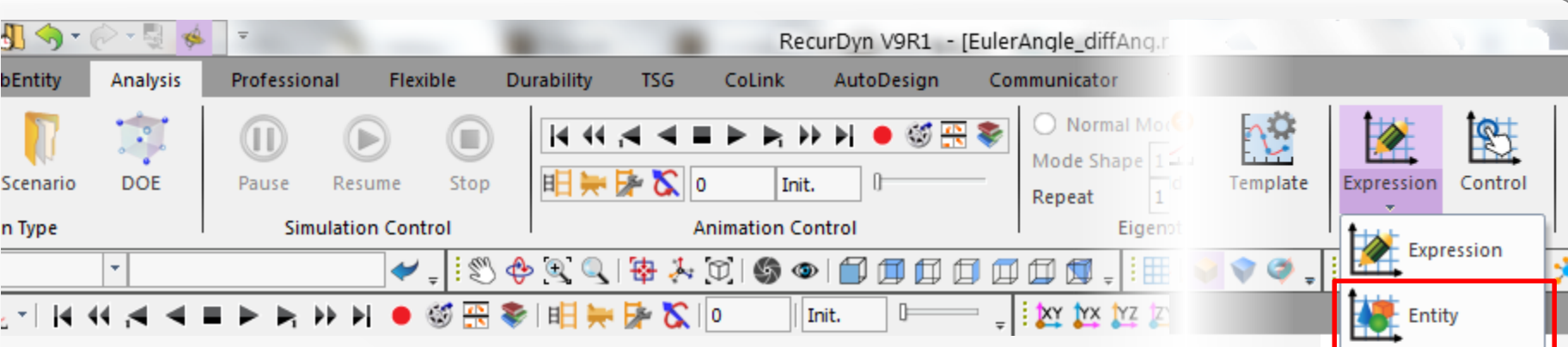


# Scopes

The image displays the RecurDyn V9R1 software interface. The top menu bar includes options like Entity, Analysis, Professional, Flexible, Durability, TSG, CoLink, and AutoDesign. The main toolbar features simulation control buttons (Pause, Resume, Stop) and animation control buttons (Init, Play, Stop). A red box highlights the 'Expression' and 'Control' icons in the toolbar. A dropdown menu is open, showing options: Expression, Entity, Angle, Point-Point, and Gap. Below the main interface, two smaller windows are shown, each displaying a plot of 'Expression#1' over 'Time'. The left window is titled 'Scope\_bearingOrientX' and the right window is titled 'Scope\_bearingOrientY'. Both plots show a sinusoidal wave. The left plot has a peak at approximately 0.25 and a trough at approximately -0.25. The right plot has a peak at approximately 0.30 and a trough at approximately -0.30. The x-axis for both plots ranges from 0.00 to 2.50. The y-axis for both plots ranges from -0.40 to 0.30. The status bar at the bottom of the windows shows coordinates: X: 0.7 and Y: 0.1119710417 for the left window, and X: 0.7 and Y: 0.333256387 for the right window.

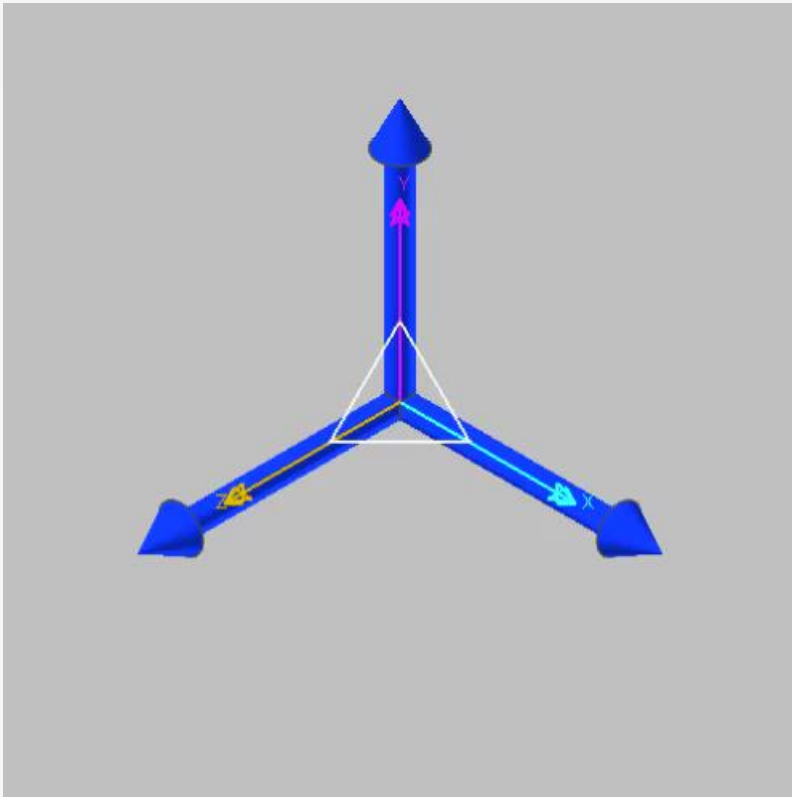
- Displays plots within Modeling Window.
- Convenient, quick way to view results.
- Multiple types available.

# Entity Scope: Orientation



- Entity: If a body selected, scope will plot data related to the CM marker of the body.
- Orientation expressed in Euler Angles.
- Two “modes”:
  - Z-X-Z (3-1-3)
    - Psi, Theta, Phi
  - Z-Y-X (3-2-1)
    - Yaw, Pitch, Roll

# Orientation: Euler Angles

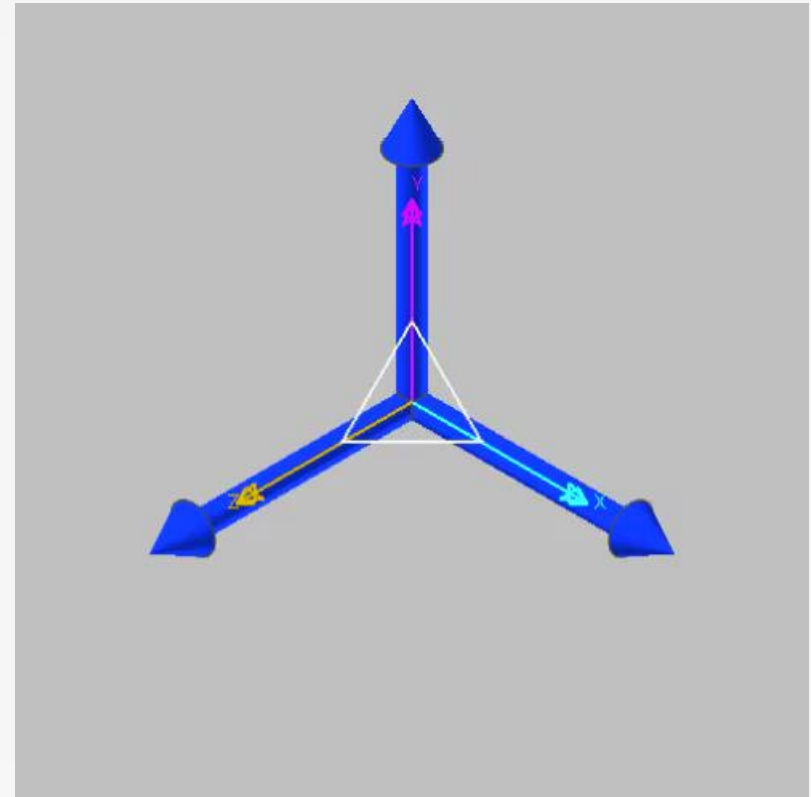


Z-X-Z (3-1-3)

Psi =  $20^\circ$

Theta =  $-45^\circ$

Phi =  $-45^\circ$



Z-Y-X (3-2-1)

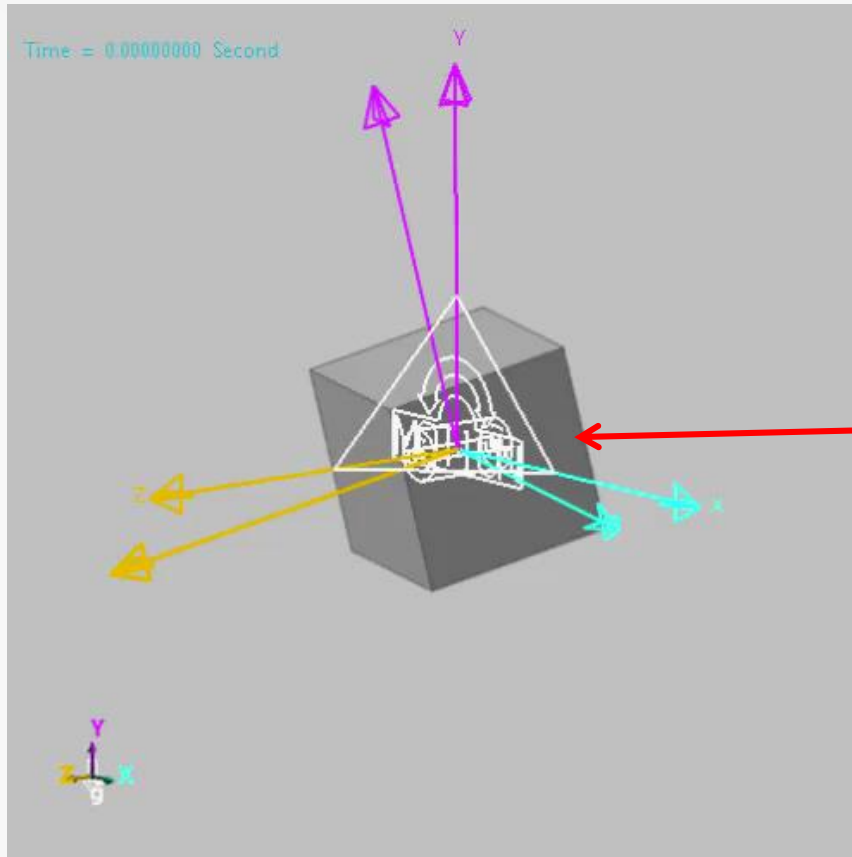
Yaw =  $-15.26^\circ$

Pitch =  $-30^\circ$

Roll =  $-35.26^\circ$

- Intrinsic rotation: axes of rotation attached to moving body.
- In examples above, different Euler Angle types (Z-X-Z and Z-Y-X) can be used to reach the same orientation, but different angle values must be used.

# Orientation Example Model



Properties of DummyBody [ Current Unit : N/kg/mm/s/deg ]

General | Graphic Property | Origin & Orientation | Body

Origin:  Pt

Orientation

Type:

Master Point:

Slave Point:

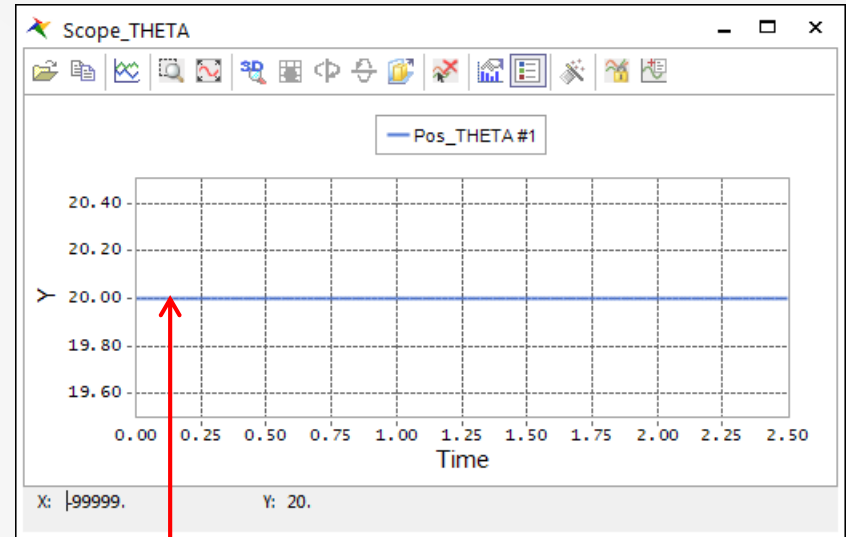
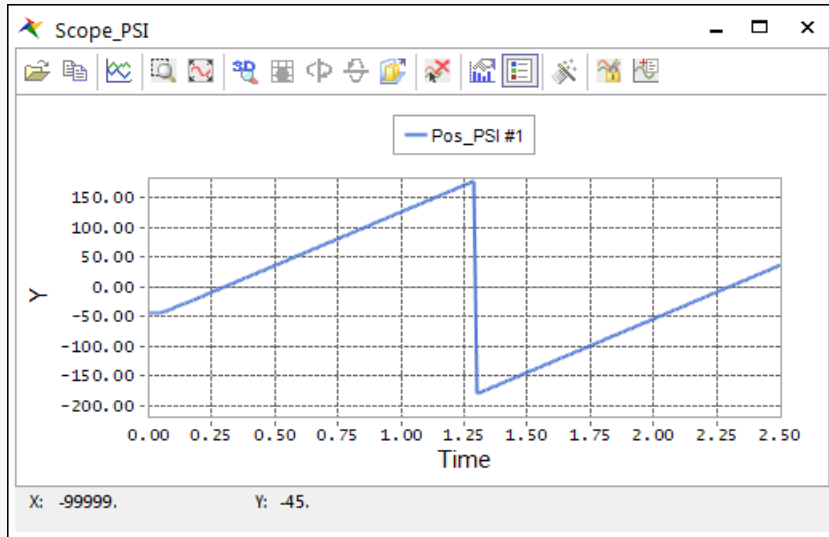
Euler Ang.(PV:R):

Euler Ang.(PV:R):

Body with offset orientation rotates about global Z-axis.



# Psi, Theta, Phi (3-1-3 Angles)



Properties of DummyBody [ Current Unit : N/kg/mm/s/deg ]

General | Graphic Property | Origin & Orientation | Body

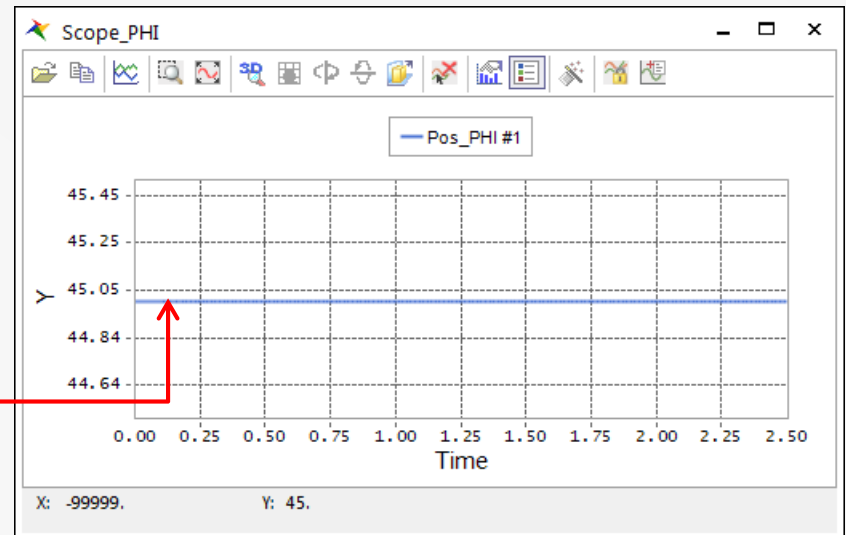
Origin: 0, 0, 0 Pt

Orientation Type: Angles

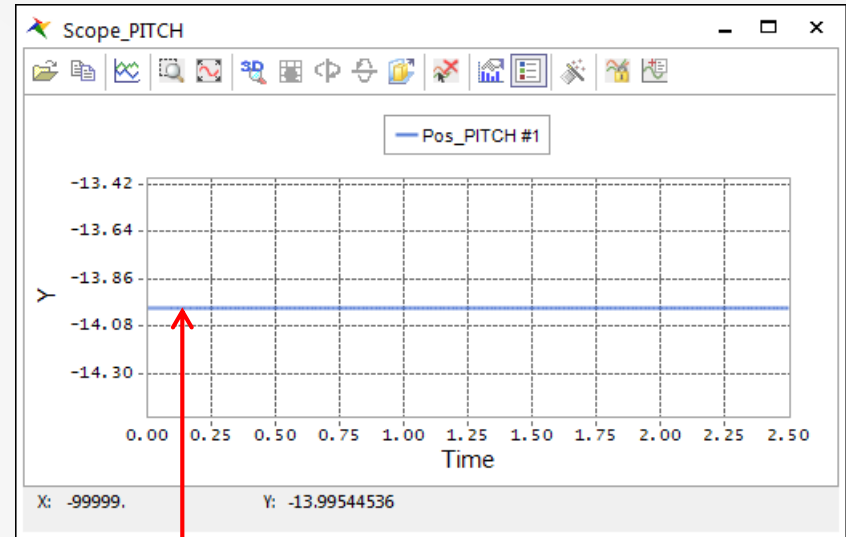
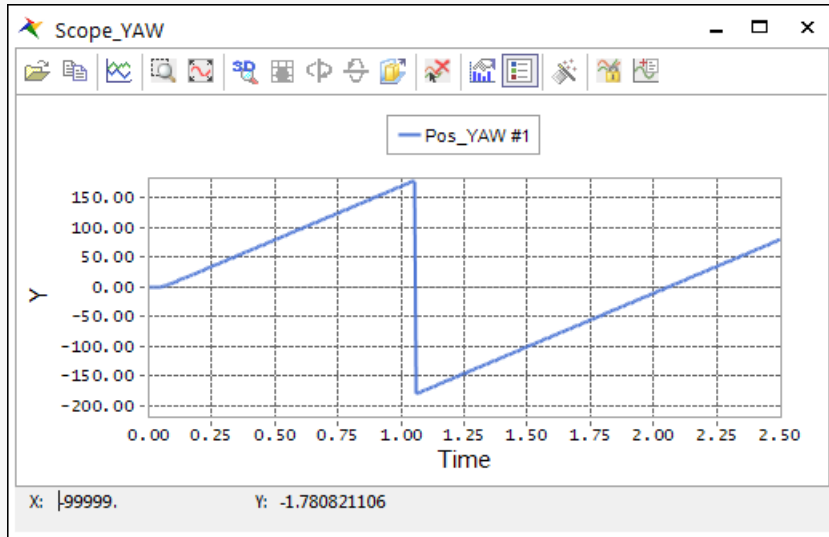
Master Point: +Z -0.241844762647975, -0.241844

Slave Point: +X 0.969846310392954, -3.0153689

Euler Ang.(PV:R): Angle313 -45, 20, 45



# Yaw, Pitch, Roll (3-2-1 Angles)



Properties of DummyBody [ Current Unit : N/kg/mm/s/deg ]

General Graphic Property Origin & Orientation Body

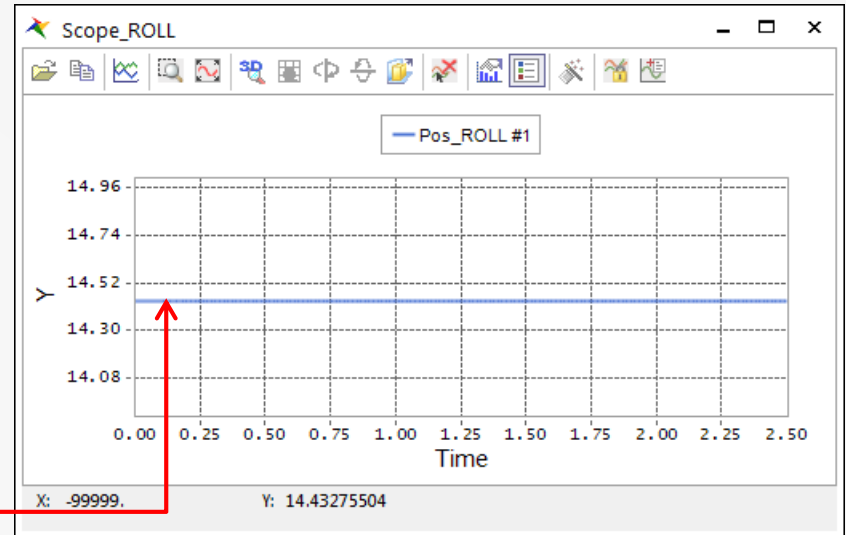
Origin 0, 0, 0 Pt

Orientation Type Angles

Master Point +Z -0.241844762647975, -0.241844

Slave Point +X 0.969846310392954, -3.0153689

Euler Ang.(PV:R) Angle321 -1.78082110628583, -13.9954453588914, 14.4327550432674



-1.78082110628583, -13.9954453588914, 14.4327550432674

# Projected Angle of Rotation

The screenshot displays the RecurDyn V9R1 software interface. The main window title is "RecurDyn V9R1 - [EulerAngle\_diffAng.r". The interface includes a menu bar with options like "bEntity", "Analysis", "Professional", "Flexible", "Durability", "TSG", "CoLink", "AutoDesign", and "Communicator". A toolbar with various icons is visible below the menu bar. Two dialog boxes are open, both highlighted with red boxes. The left dialog box is titled "Expression" and has a "Name" field containing "Ex\_orientX" and an "Expression" field containing "AX(1, 2)". Below this dialog is an "Available" list of function expressions and an "Argument List" table. The right dialog box is titled "Scope Expression" and has a "Name" field containing "Scope\_bearingOrientX" and an "Expression" field containing "Ex\_orientX". Below this dialog is a "Display" checkbox which is checked. A red arrow points from the "Expression" dialog to the "Scope Expression" dialog. Another red arrow points from the "Scope Expression" dialog to the "Expression" button in the software's toolbar.

Expression

Name: Ex\_orientX

Expression: AX(1, 2)

Available:

- Function expressions
- Fortran 77 Functions
- Simulation constants
- Displacement
- Velocity
- Acceleration
- Generic force
- Specific force
- System element

ID	Entity
1	DummyBody.CM
2	Ground.InertiaMarker

Argument List

Scope Expression

Name: Scope\_bearingOrientX

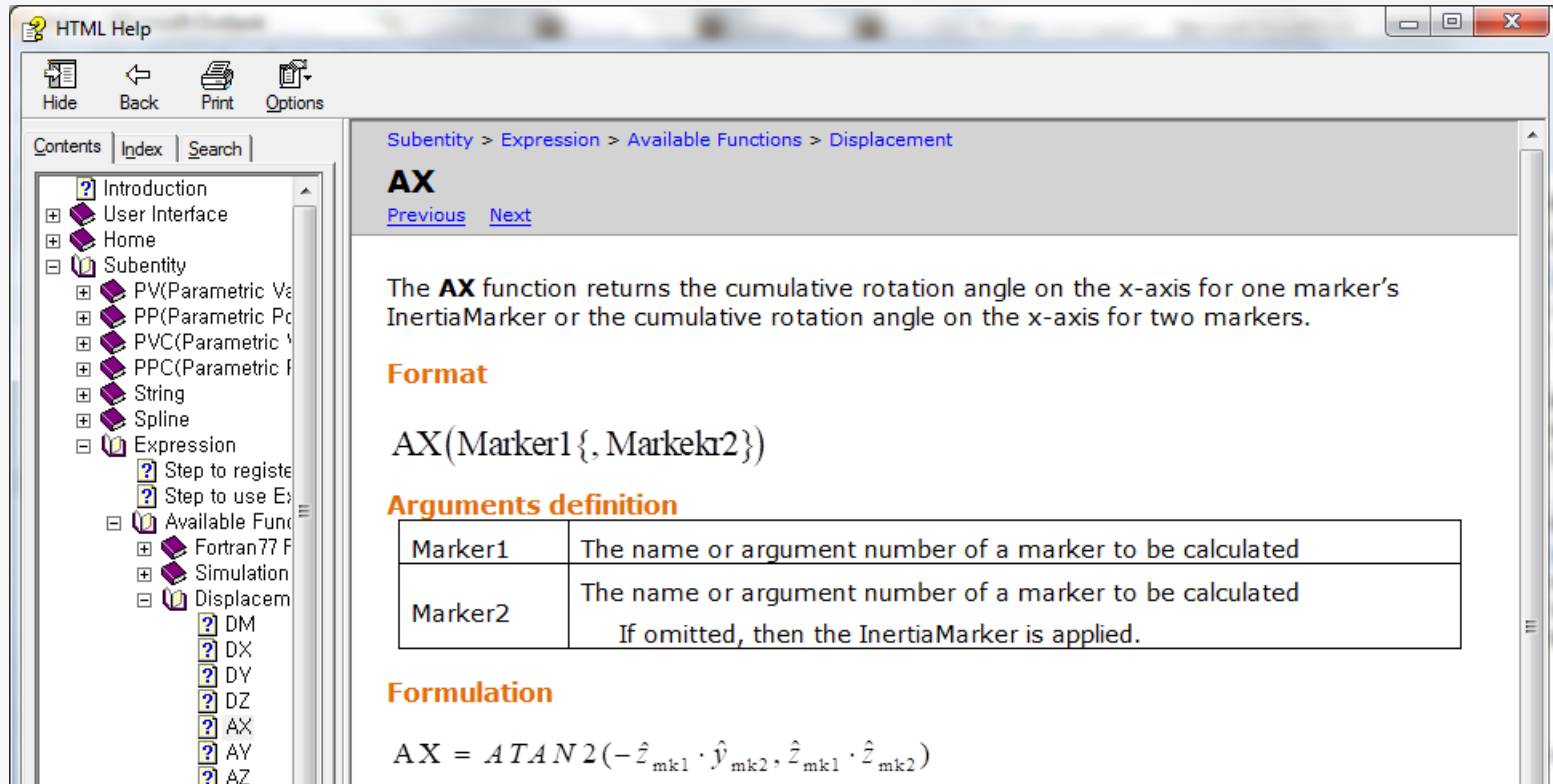
Expression Name: Ex\_orientX

Expression: AX(1, 2)

Display:

- An alternative to the Euler Angles is to get the projected angle of rotation.
- Use expression functions AX(), AY(), and AZ().
- Can then create Expression Scope (or Expression Request for plot output).

# Projected Angle of Rotation



The screenshot shows a web browser window titled "HTML Help" with a navigation toolbar (Hide, Back, Print, Options) and a breadcrumb trail: "Subentity > Expression > Available Functions > Displacement". The left sidebar contains a tree view with categories like "Introduction", "User Interface", "Home", "Subentity", "Expression", and "Available Functions". The main content area displays the "AX" function documentation, including its description, format, argument definitions, and mathematical formulation.

**AX**  
[Previous](#) [Next](#)

The **AX** function returns the cumulative rotation angle on the x-axis for one marker's InertiaMarker or the cumulative rotation angle on the x-axis for two markers.

**Format**

$$AX(\text{Marker1}\{, \text{Marker2}\})$$

**Arguments definition**

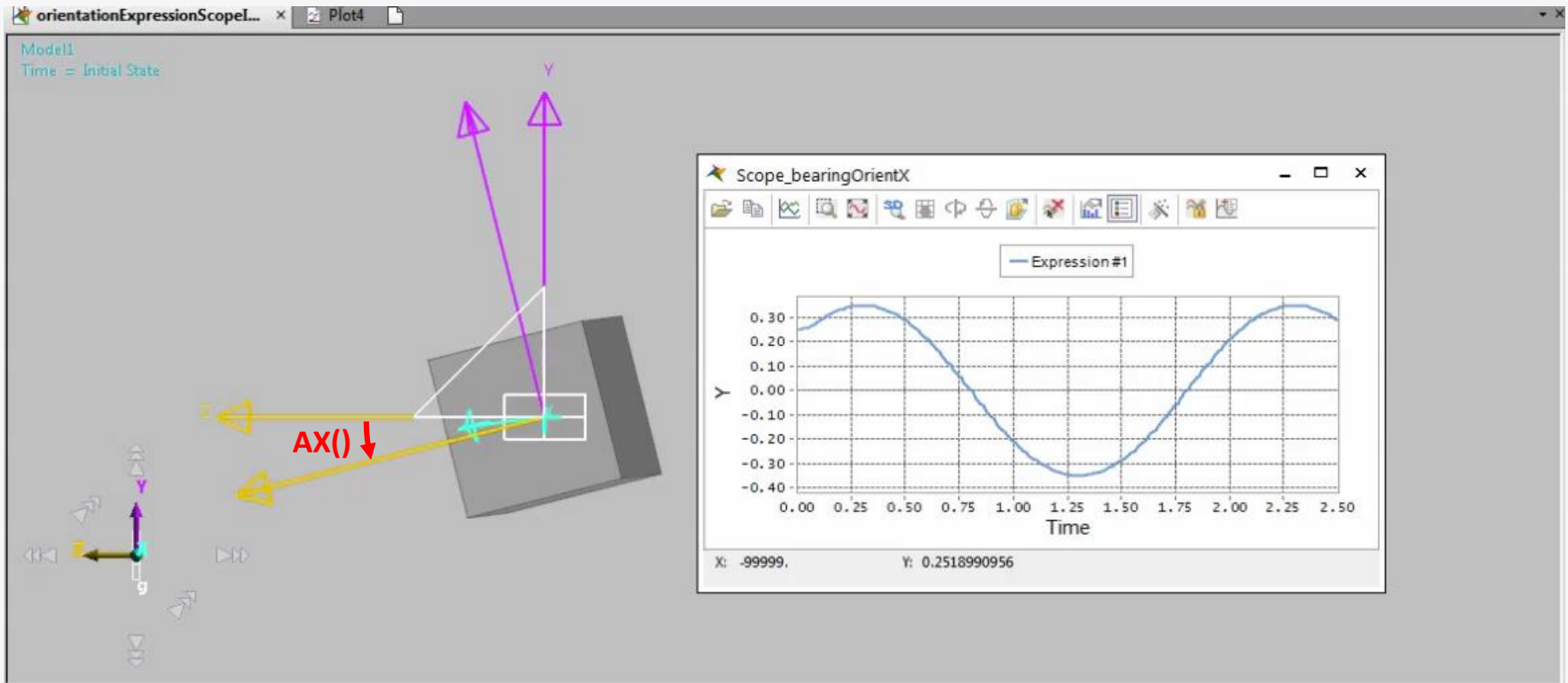
Marker1	The name or argument number of a marker to be calculated
Marker2	The name or argument number of a marker to be calculated If omitted, then the InertiaMarker is applied.

**Formulation**

$$AX = ATAN2(-\hat{z}_{mk1} \cdot \hat{y}_{mk2}, \hat{z}_{mk1} \cdot \hat{z}_{mk2})$$

Formulation from Help documentation

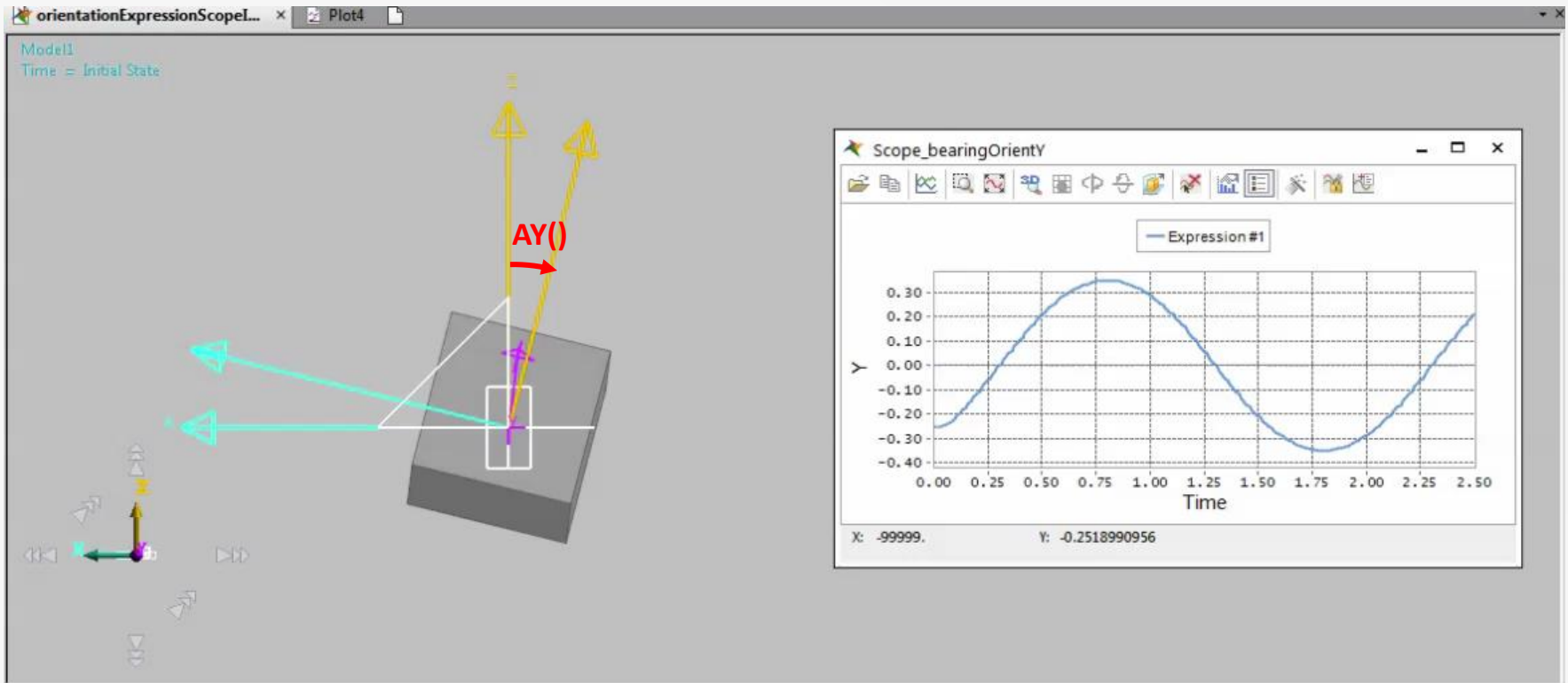
# AX() Function



$$AX( ) = \tan^{-1}(-\hat{z}_1 \cdot \hat{y}_2, \hat{z}_1 \cdot \hat{z}_2)$$

→ AX() measures rotational deviation of Z-axis about X-axis.

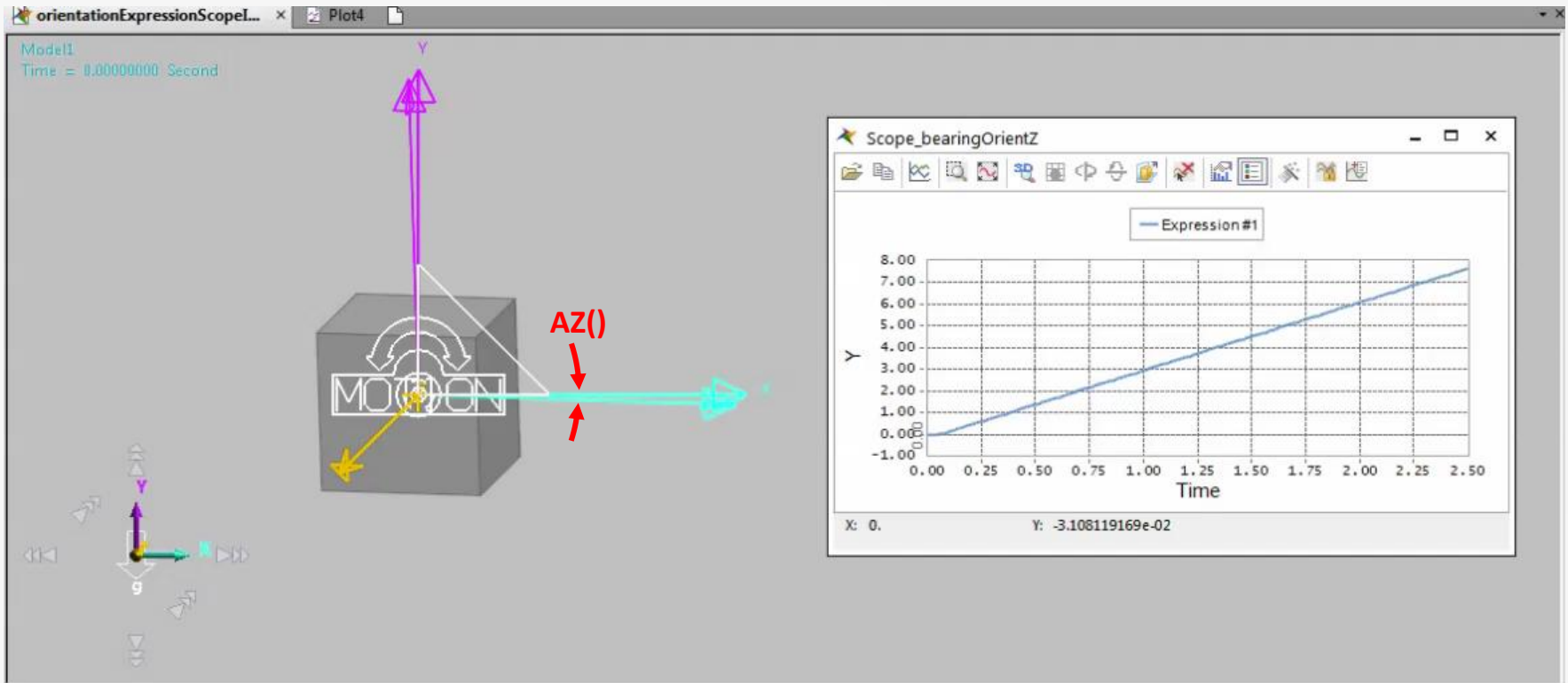
# AY() Function



$$AY( ) = \tan^{-1}(\hat{z}_1 \cdot \hat{x}_2, \hat{z}_1 \cdot \hat{z}_2)$$

→ AY() measures rotational deviation of Z-axis about Y-axis.

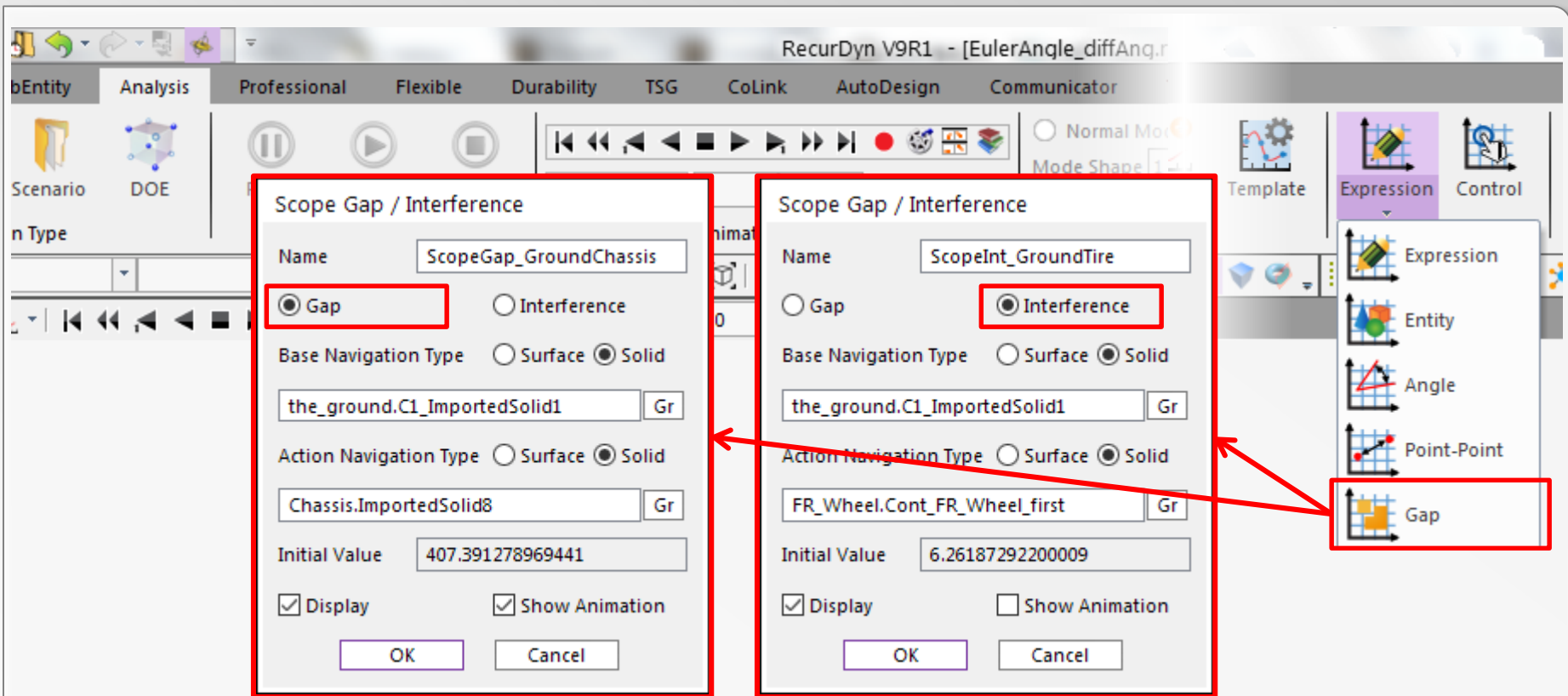
# AZ() Function



$$AZ( ) = \tan^{-1}(\hat{x}_1 \cdot \hat{y}_2, \hat{x}_1 \cdot \hat{x}_2)$$

→ AZ() measures rotational deviation of X-axis about Z-axis.

# Gap/Interference Scope



- **Gap Scope** measures minimum 3D distance between two geometries.
- **Interference Scope** displays whether two geometries are intersecting each other or not.



# Gap/Interference Scope

RecurDyn V9R1 - [humveeTerrain\_newControl\_newFaceSurfRoad\_RFlex\_GeoCont\_torus\_GapSensor.rdyn]

Home SubEntity Analysis Professional Flexible Durability TSG CoLink AutoDesign Communicator Toolkit Customize

Dyn/Kin Eigen Scenario DOE Simulation Type

Pause Resume Stop Simulation Control

Animation Control

Normal Mode Frequency Response Mode Shape 1 Freq. (Hz) Repeat 1

Eigenvalue & FRA Animation

Result Add Template Expression Control Scope

Trace Display Post Tool

Entity

humveeTerrain\_newControl\_...

Database

- GeoSurContact2
- GeoSurContact3
- GeoSurContact4
- Requests
- Splines
- PP
- PV
- PV\_targetLinVel
- PPC
- PVC
- Ex
- Exp\_Torq\_EngineTorque
- MOTION\_Trans\_SteeringRac
- Func\_Braking
- Func\_Steering
- Func\_0
- Func\_EngineTorque
- Ex1
- Ex2
- USUB
- Diff.Eq
- Var.Eq
- Scopes
- ScopeExpression1
- ScopeGap\_GroundChassis
- ScopeInt\_GroundTire
- Sensors
- BCs
- PI
- DP
- AR
- Subsystems
- PIN

ScopeGap\_GroundChassis

Y

400.00

350.00

300.00

250.00

200.00

150.00

100.00

0.00

0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50

Time

Gap / Interference #1

ScopeInt\_GroundTire

Y

1.10

1.00

0.90

0.80

0.70

0.60

0.50

0.40

0.30

0.20

0.10

0.00

-0.10

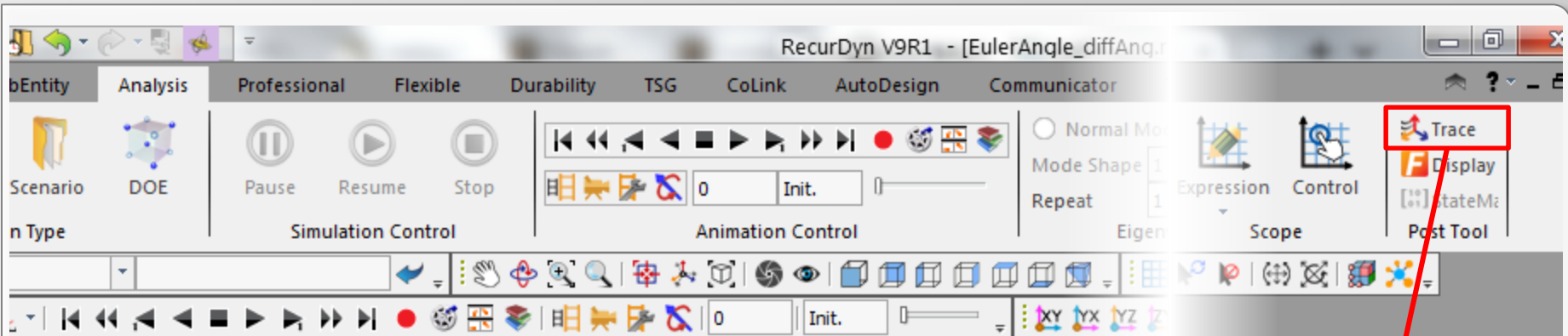
0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50

Time

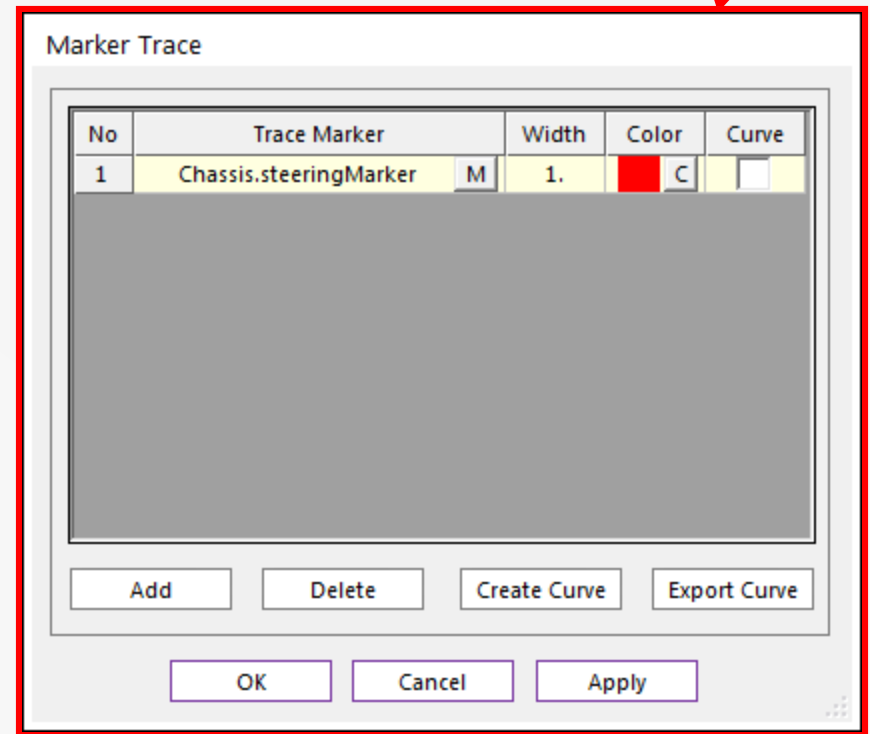
Gap / Interference #1

Local X:-1200 Y:-2.147484e+1 N/kg/mm/s

# Marker Trace



- Displays path that a marker goes through during the simulation.
- Helps to visualize path that bodies take.
- **New for V9R1:**
  - Create Curve
  - Export Curve



# Marker Trace

The screenshot displays the RecurDyn V9R1 software interface. The main window shows a 3D model of a green car on a grey ground plane. The interface includes a top menu bar with options like Home, SubEntity, Analysis, Professional, Flexible, Durability, TSG, CoLink, AutoDesign, Communicator, Toolkit, and Customize. Below the menu is a toolbar with simulation controls (Pause, Resume, Stop) and animation controls (Play, Stop, Step). The main workspace shows the car model with a coordinate system at the bottom left. A ScopeEx window titled "ScopeEx\_steeringPositionError" is open in the top right, displaying a line graph of "Expression #1" over "Time". The graph shows a blue line oscillating between approximately -150 and 200 over a time range of 0.00 to 4.50. The Y-axis ranges from -200.00 to 200.00. The X-axis ranges from 0.00 to 4.50. The ScopeEx window also shows a tree view on the right with various simulation elements like Exp\_Torq\_EngineTorque, MOTION\_Trans\_SteeringRate, Func\_Braking, Func\_Steering, Func\_0, Func\_EngineTorque, Ex\_steeringPositionError, Ex2, USUB, Diff.Eq, Var.Eq, Scopes, Sensors, BCs, PI, DP, AR, Subsystems, PIN, PlantInput1, POUT, PlantOutput1, and PlantOutput2. The status bar at the bottom indicates "Car Global X:-3900 Y:2600 Z:0 Local X:-3900 Y:2600 N/kg/mm/s".

RecurDyn V9R1 - [humveeTerrain\_newControl\_newFaceSurfRoad\_RFlex\_GeoCont\_torus.rdyn]

Home SubEntity Analysis Professional Flexible Durability TSG CoLink AutoDesign Communicator Toolkit Customize

Dyn/Kin Eigen Scenario DOE Simulation Type

Pause Resume Stop Simulation Control

Animation Control

Entity

humveeTerrain\_newControl\_... Plot1

RecurDyn Model  
Time = Initial State

ScopeEx\_steeringPositionError

Expression #1

Y

Time

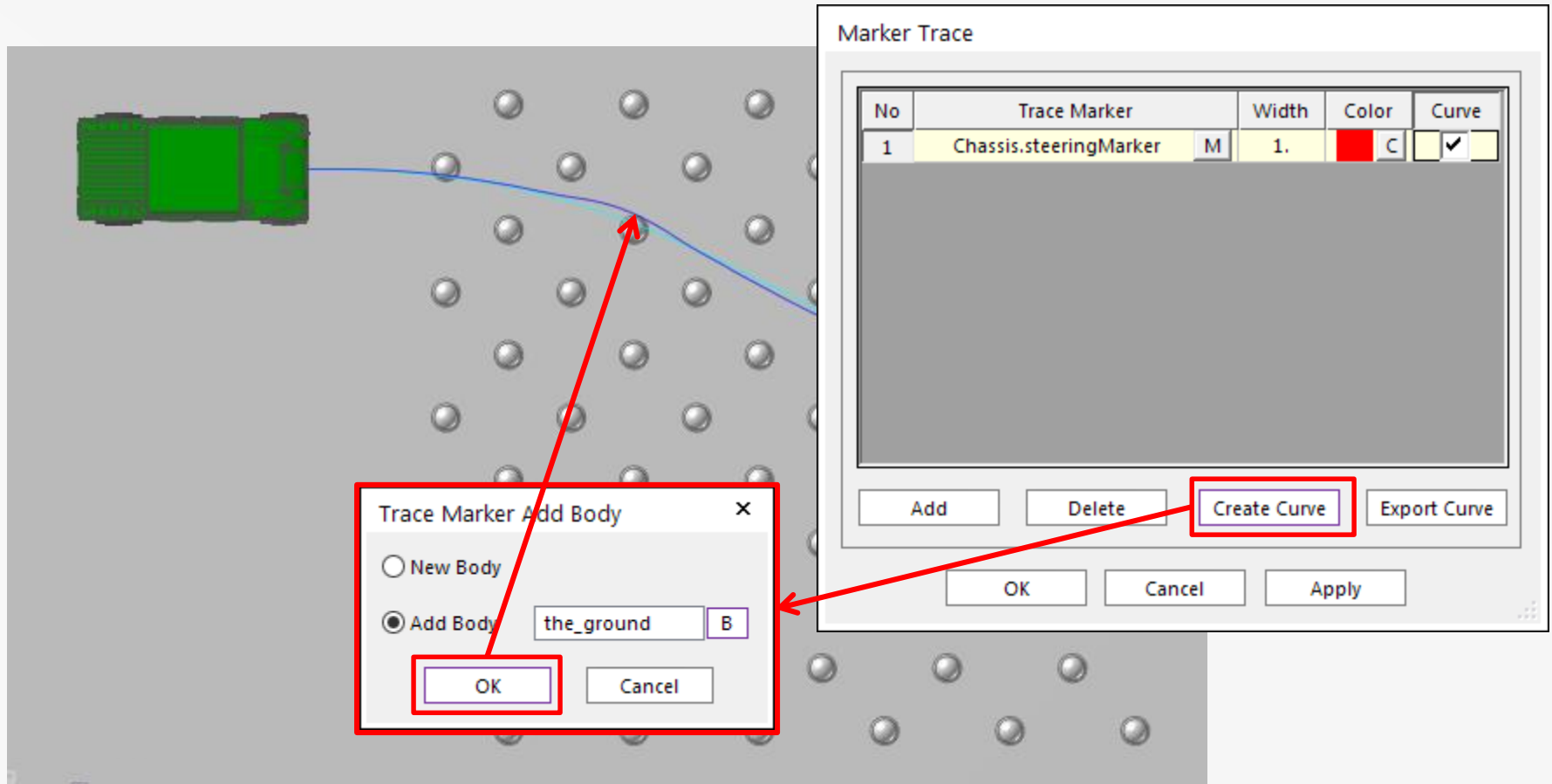
X: -99999. Y: -1.51869602e-11

Exp\_Torq\_EngineTorque  
MOTION\_Trans\_SteeringRate  
Func\_Braking  
Func\_Steering  
Func\_0  
Func\_EngineTorque  
Ex\_steeringPositionError  
Ex2  
(..) USUB  
Diff.Eq  
Var.Eq  
Scopes  
ScopeEx\_steeringPositionError  
Sensors  
BCs  
PI  
DP  
AR  
Subsystems  
PIN  
PlantInput1  
POUT  
PlantOutput1  
PlantOutput2

Message  
For Help, press F1

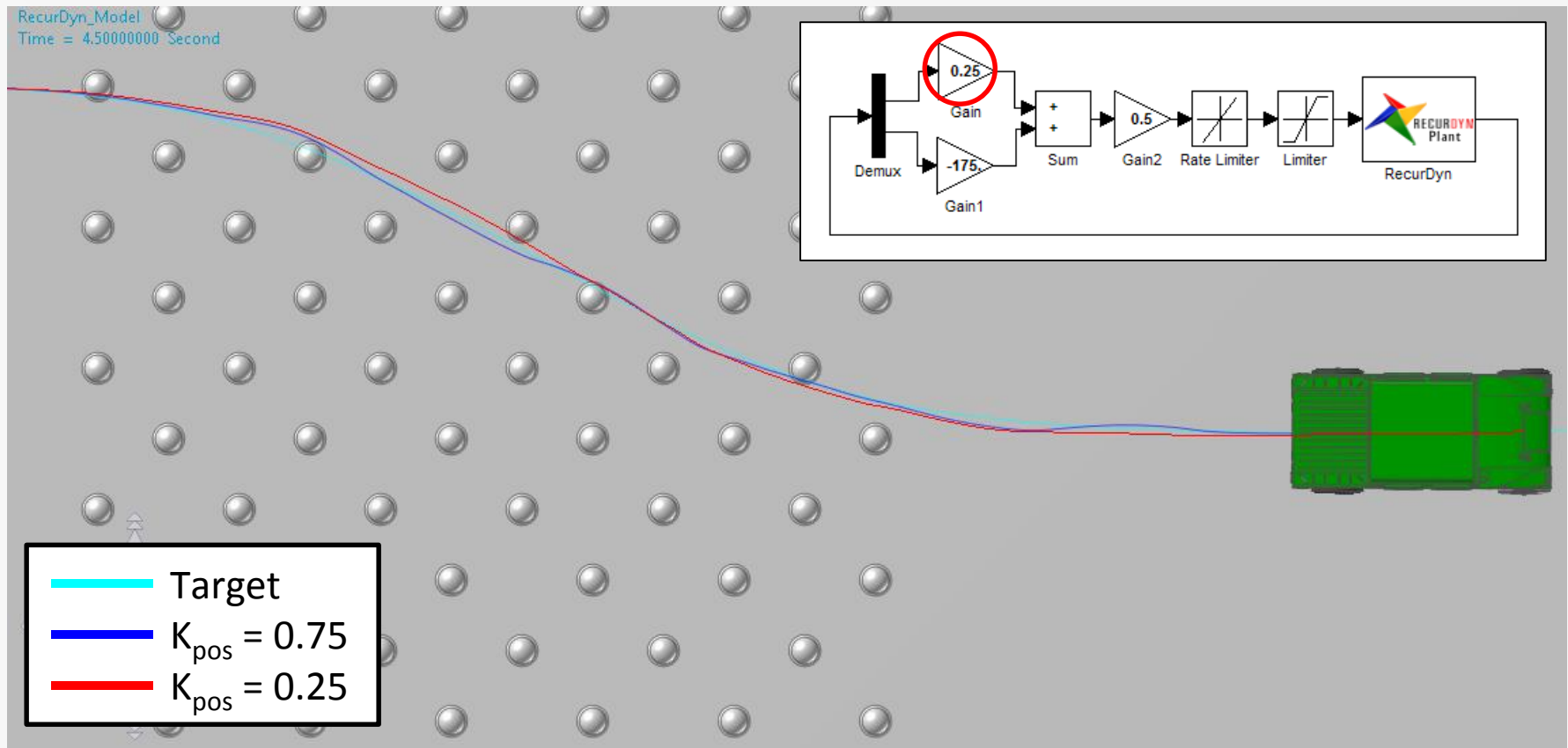
Car Global X:-3900 Y:2600 Z:0 Local X:-3900 Y:2600 N/kg/mm/s

# Marker Trace – Create Curve



- Can create curve on new or existing body.
- Can be used to compare results.

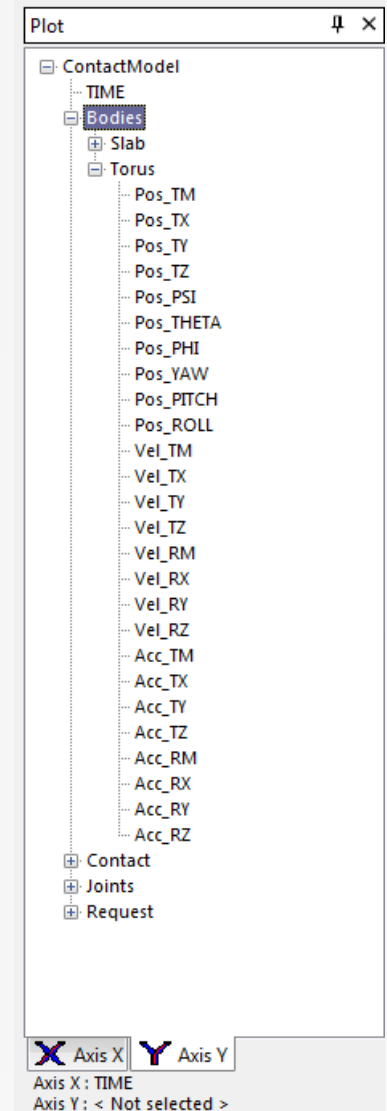
# Marker Trace – Create Curve



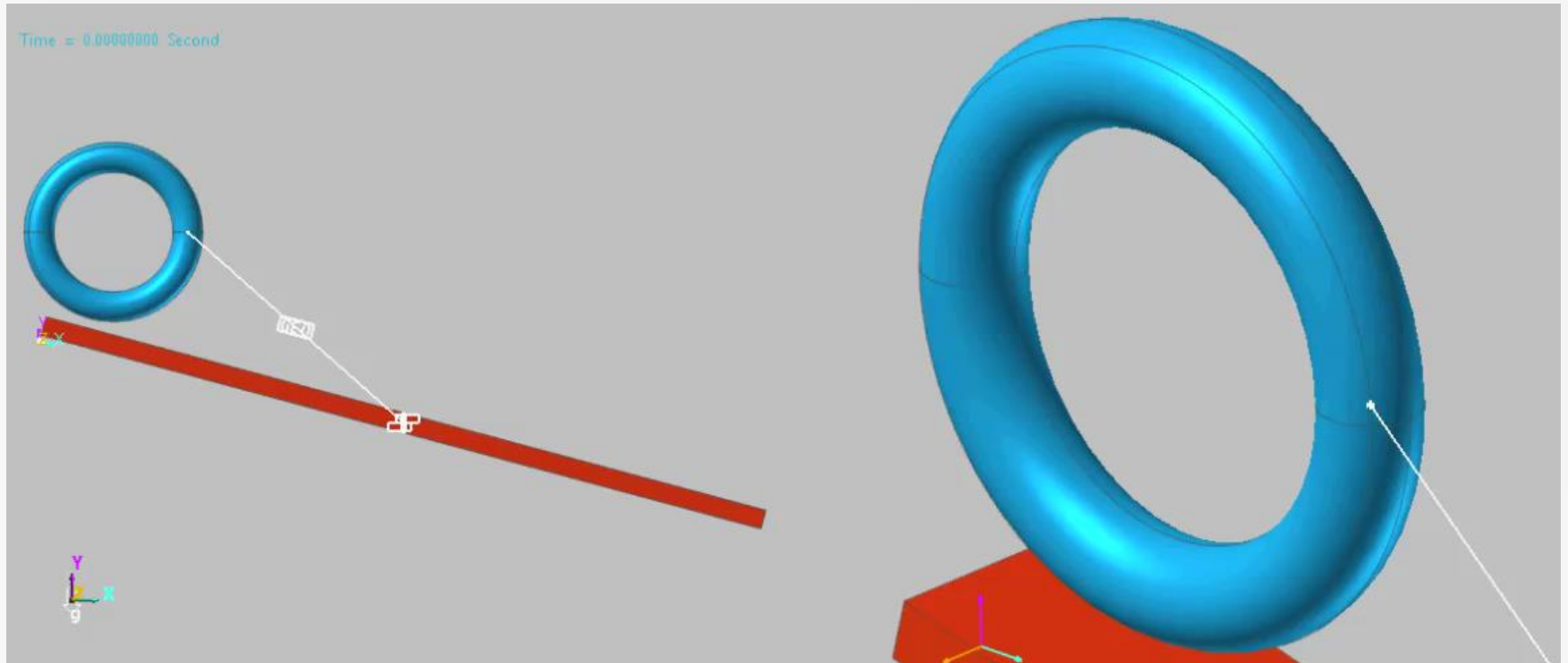
- Change made to model and model simulated again.
- In steering control system, reduced  $k_{pos}$  from 0.75 to 0.25.

# Plot Output - Bodies

- Results in global reference frame.
- Rotational position results defined as described earlier (Pos\_THETA, Pos\_THETA, Pos\_PHI, Pos\_YAW, Pos\_PITCH, Pos\_ROLL).



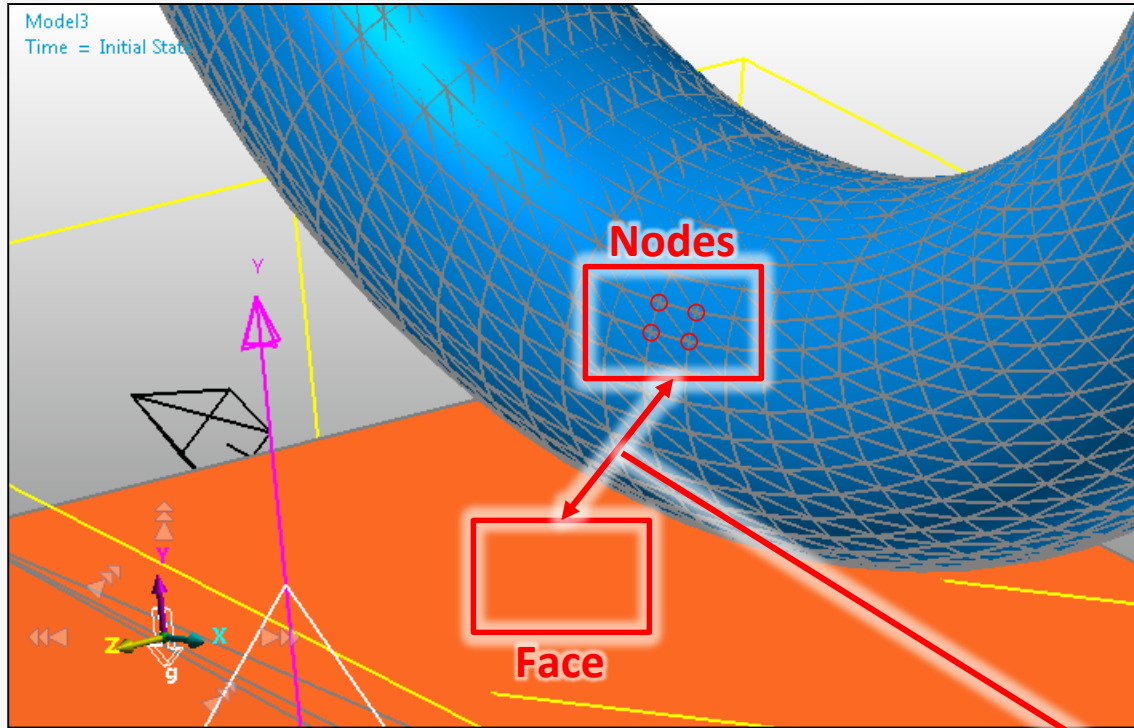
# Plot Output - Geo Surface Contacts



Sample model:

- Simple torus rolling down inclined slab.
- Geo Surface Contact used.

# Plot Output - Geo Surface Contacts



Properties of GeoSurContact1 [ Current Unit : N/kg/mm/s/deg ]

General Characteristic Geo Contact

Definition of the Base Geometry

Name Slab.Box1 Gr

Normal Direction  Up  Down  Node Contact

Preview Contact Geometry Contact Geometry

Definition of the Action Geometry

Name Torus.Torus1 Gr

Geometry Type Surface

Normal Direction  Up  Down  Node Contact

Preview Contact Geometry Contact Geometry

Edge Contact Advanced Setting

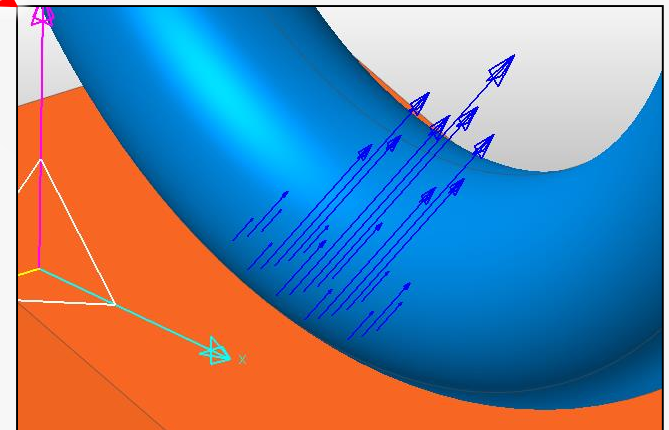
No. of Max Contact Points 100

Generate the contact output file. (\*.com) Torus.CM

Force Display Action

Scope OK Cancel Apply

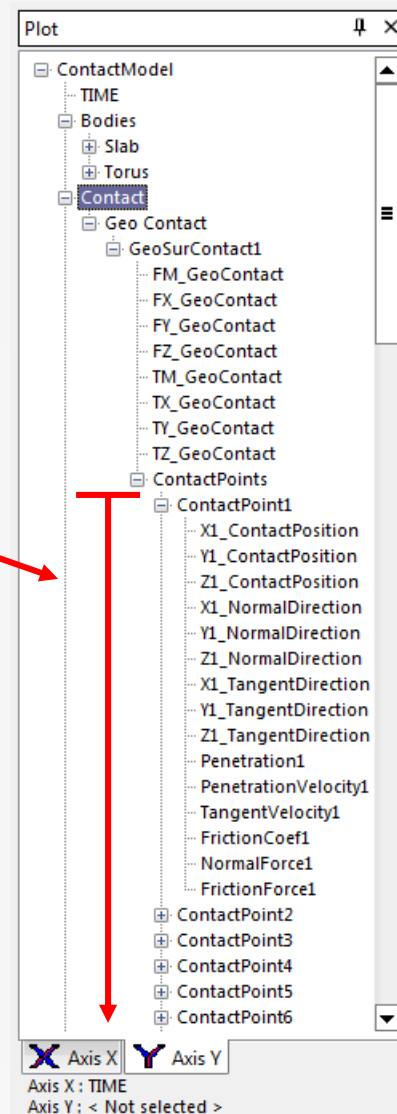
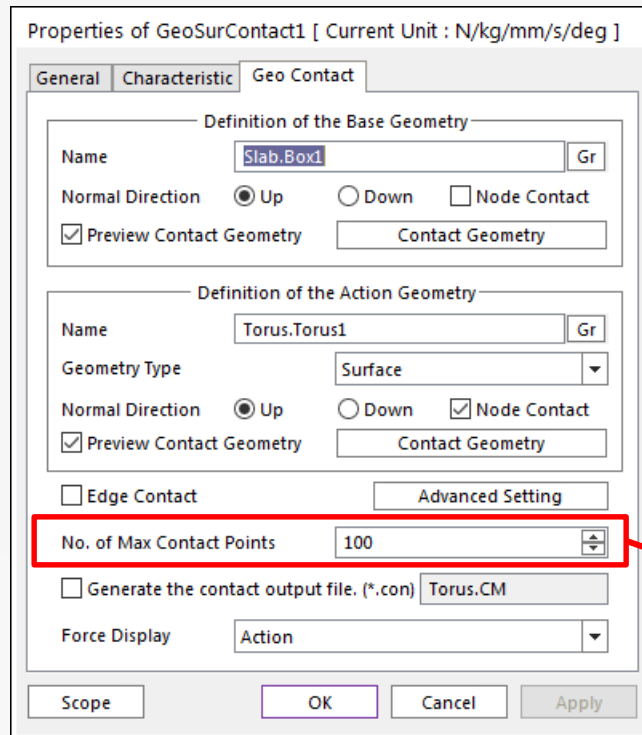
- Geo Surface Contacts based on Node-to-Face algorithm.
- Contact surfaces tessellated using triangular or rectangular patches.
- Nodes defined at corners of patches.
- Faces are the faces of patches.
- **Node Contact** option should only be selected for one body, whichever has more closely-spaced nodes.



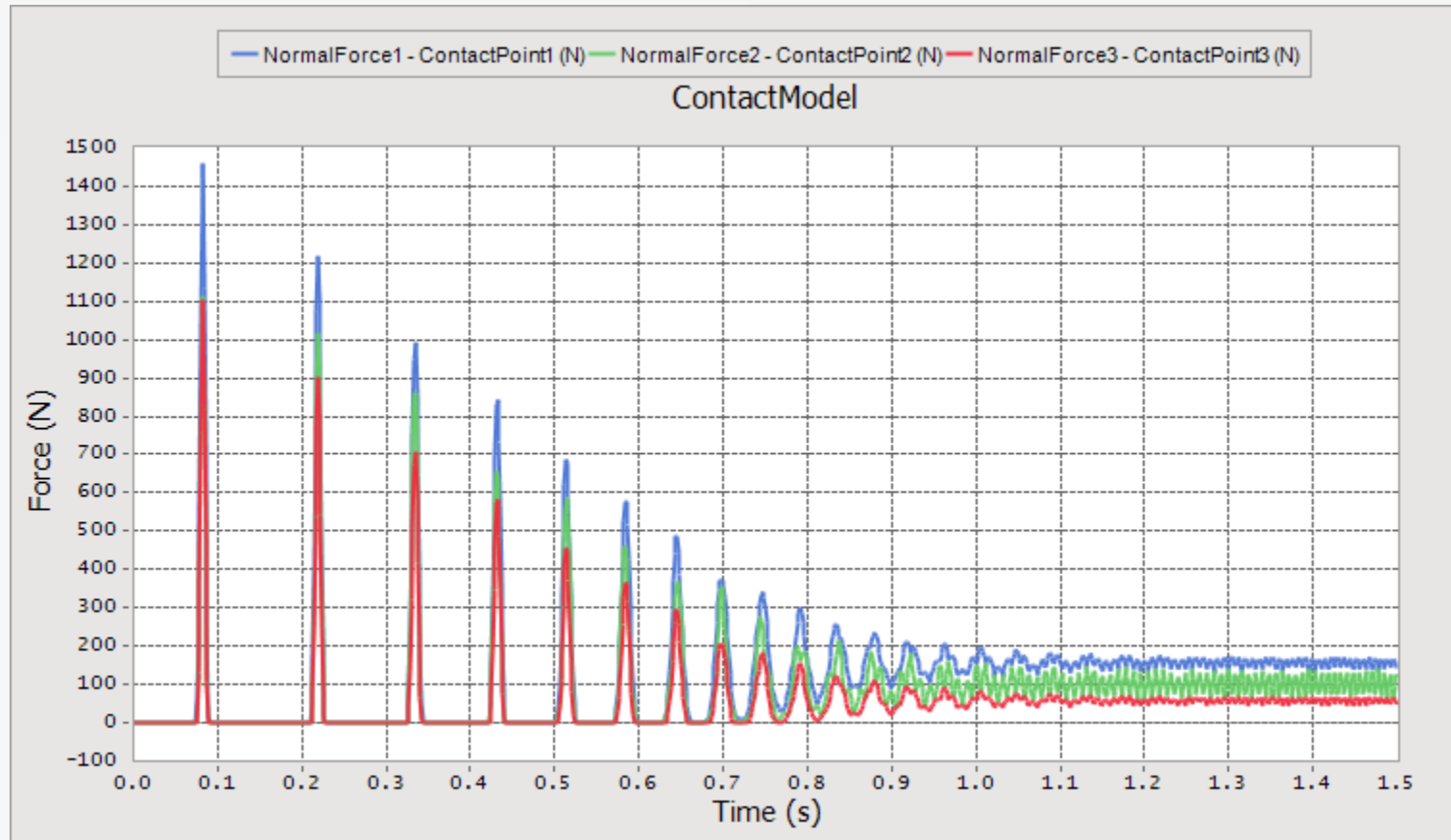


# Plot Output - Geo Surface Contacts

- In Properties of Geo Surface Contact, **No. of Max Contact Points**:
  - Sets number of points output is generated for.
  - Does not affect contact behavior.
- Results are in global reference frame.
- Contact points ordered by normal force magnitude at any given time during the simulation.

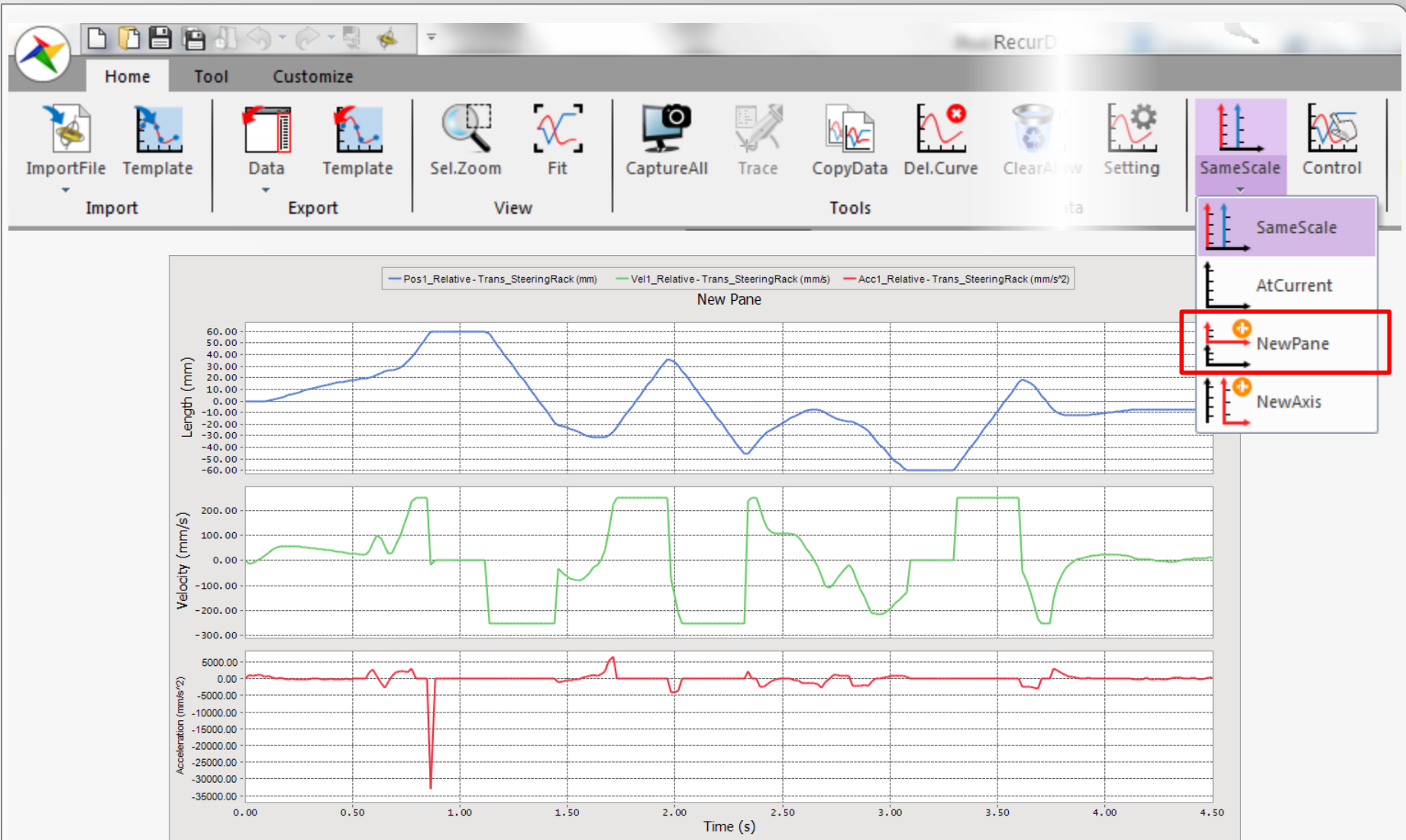


# Plot Output - Geo Surface Contacts



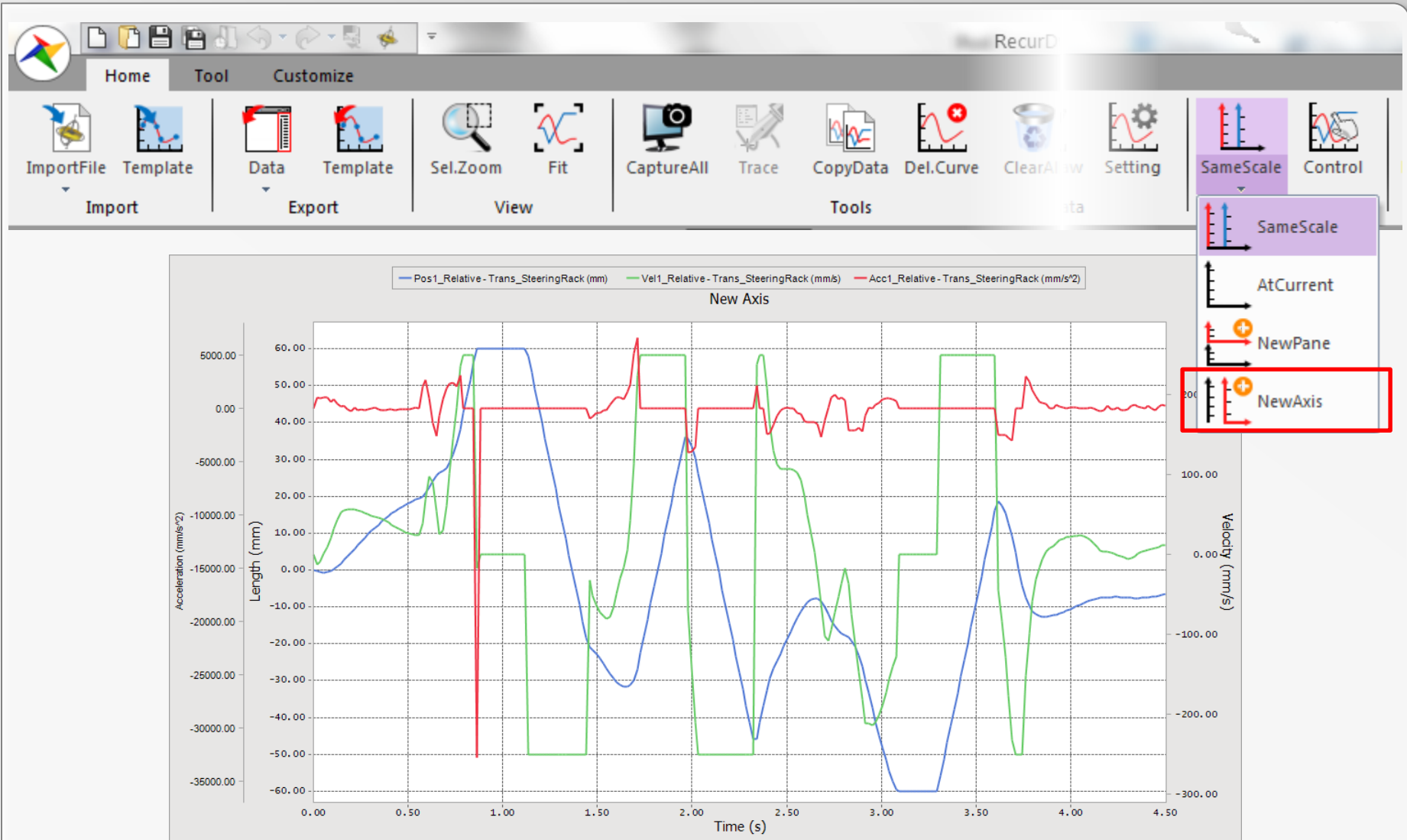
**New for V9R1:** Contact points ordered by normal force magnitude at any given time during the simulation.

# Plot Output - Multi-Axis Control



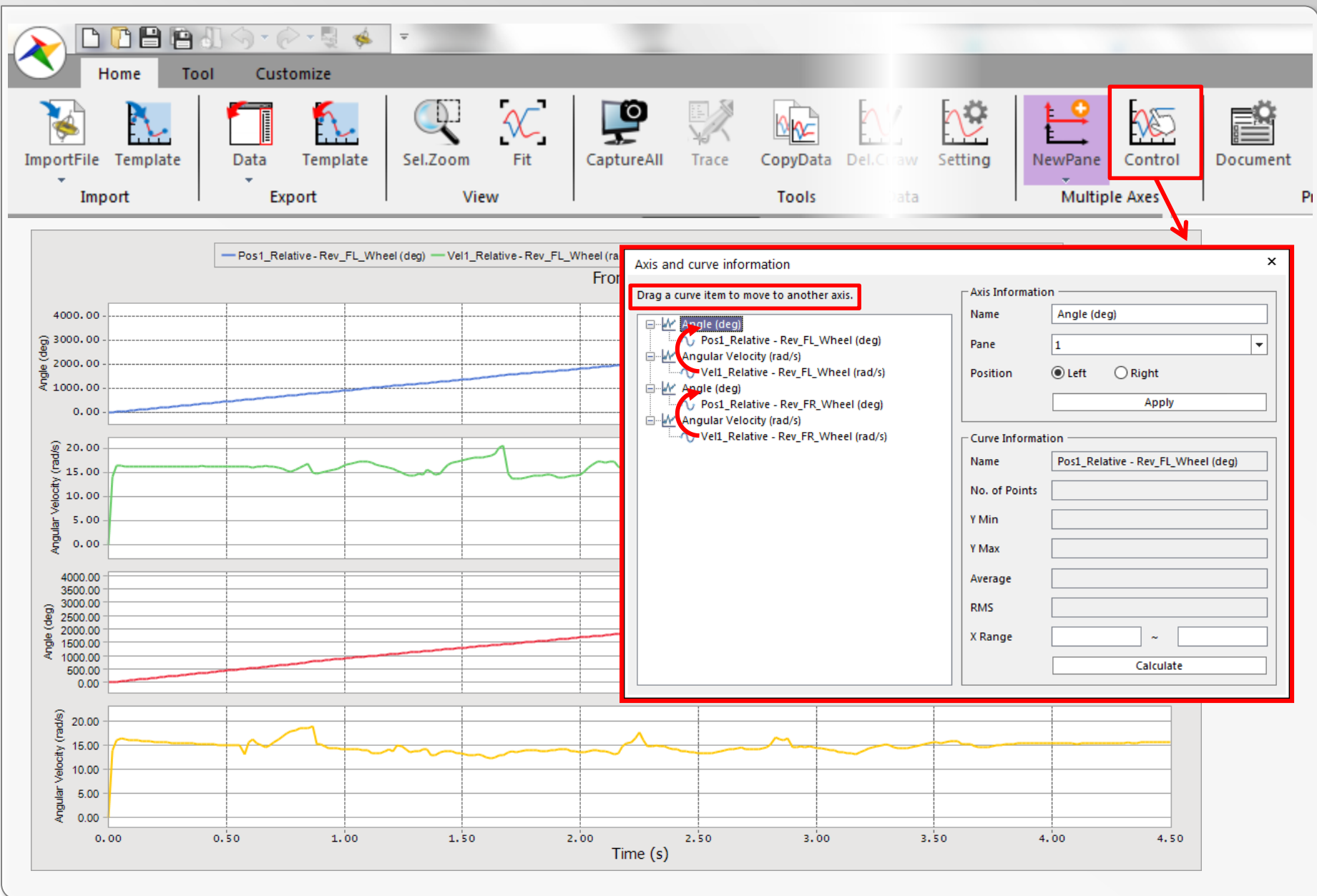
NewPane: Each new curve drawn in a new pane.

# Plot Output - Multi-Axis Control

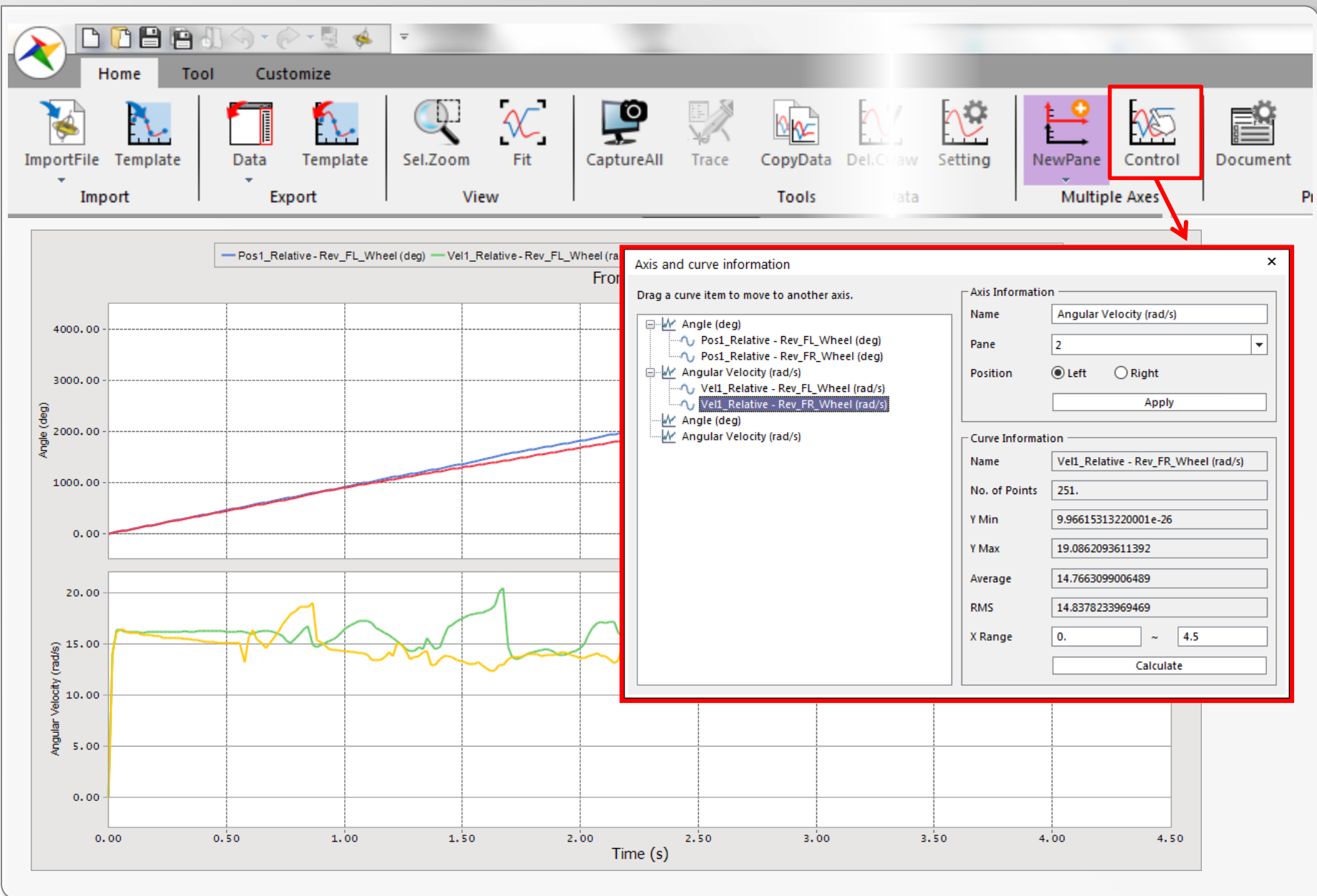


**NewAxis:** Each new curve drawn with a new axis.

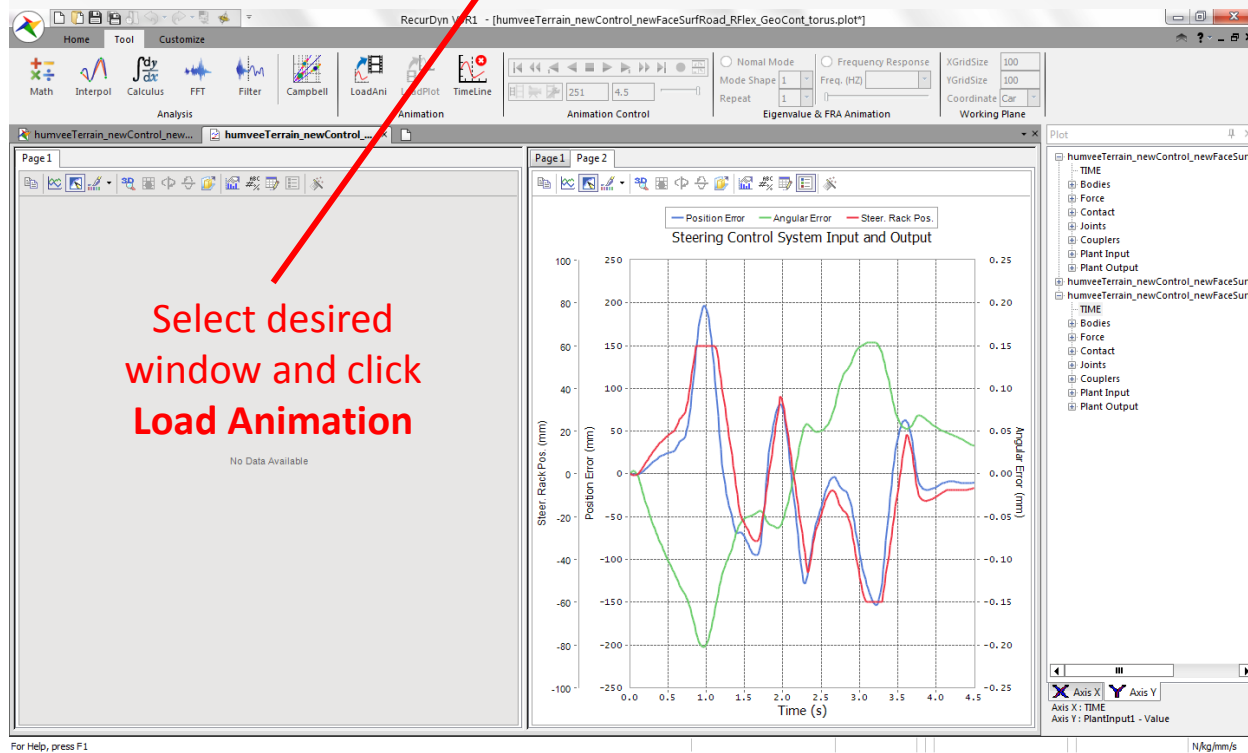
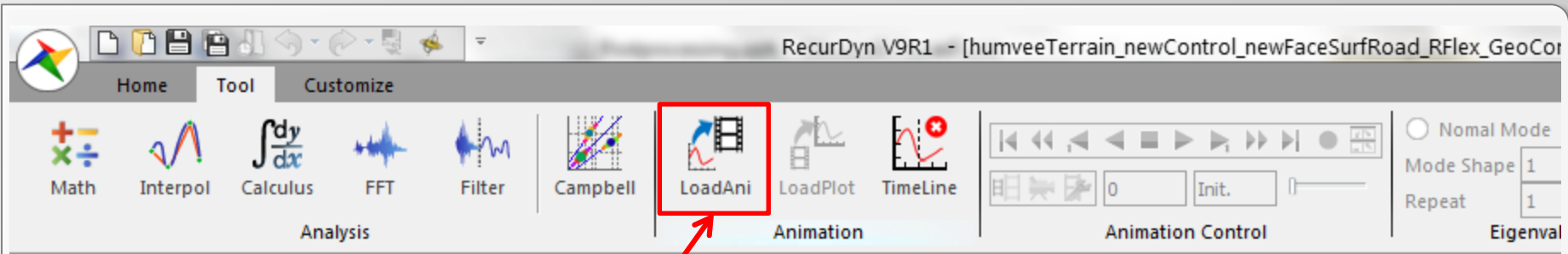
# Plot: Multiple Axis Control



# Plot: Multiple Axis Control

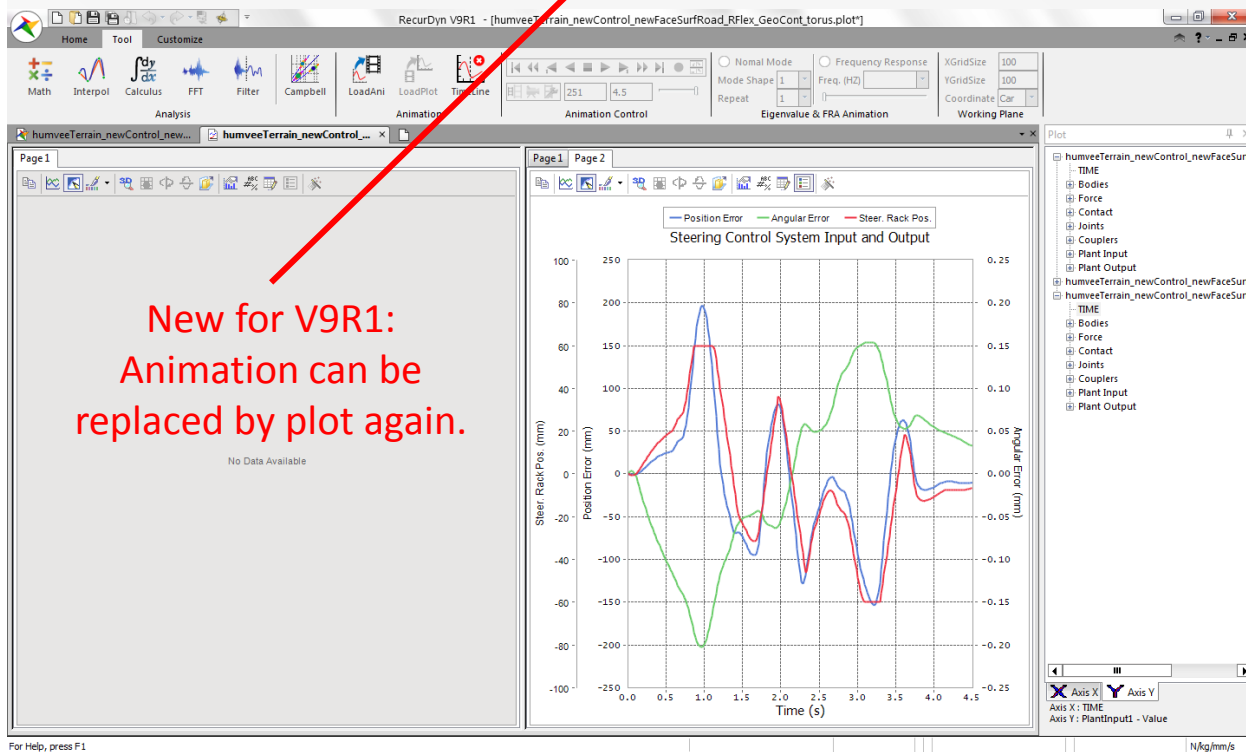
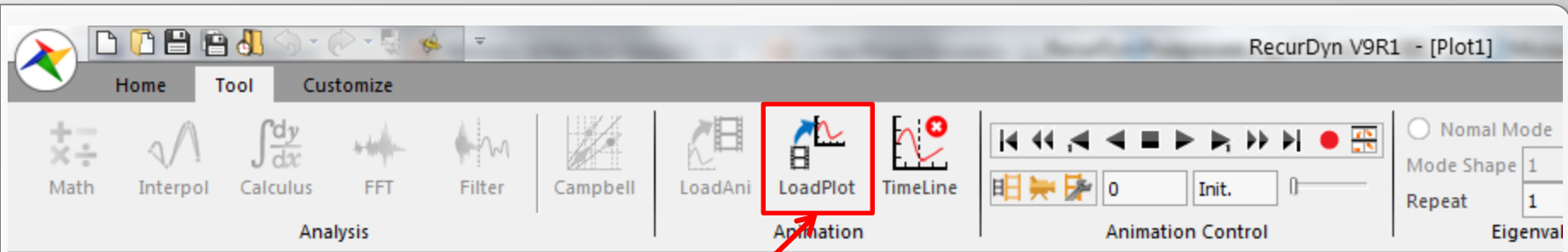


# Plot with Animation



Select desired window and click **Load Animation**

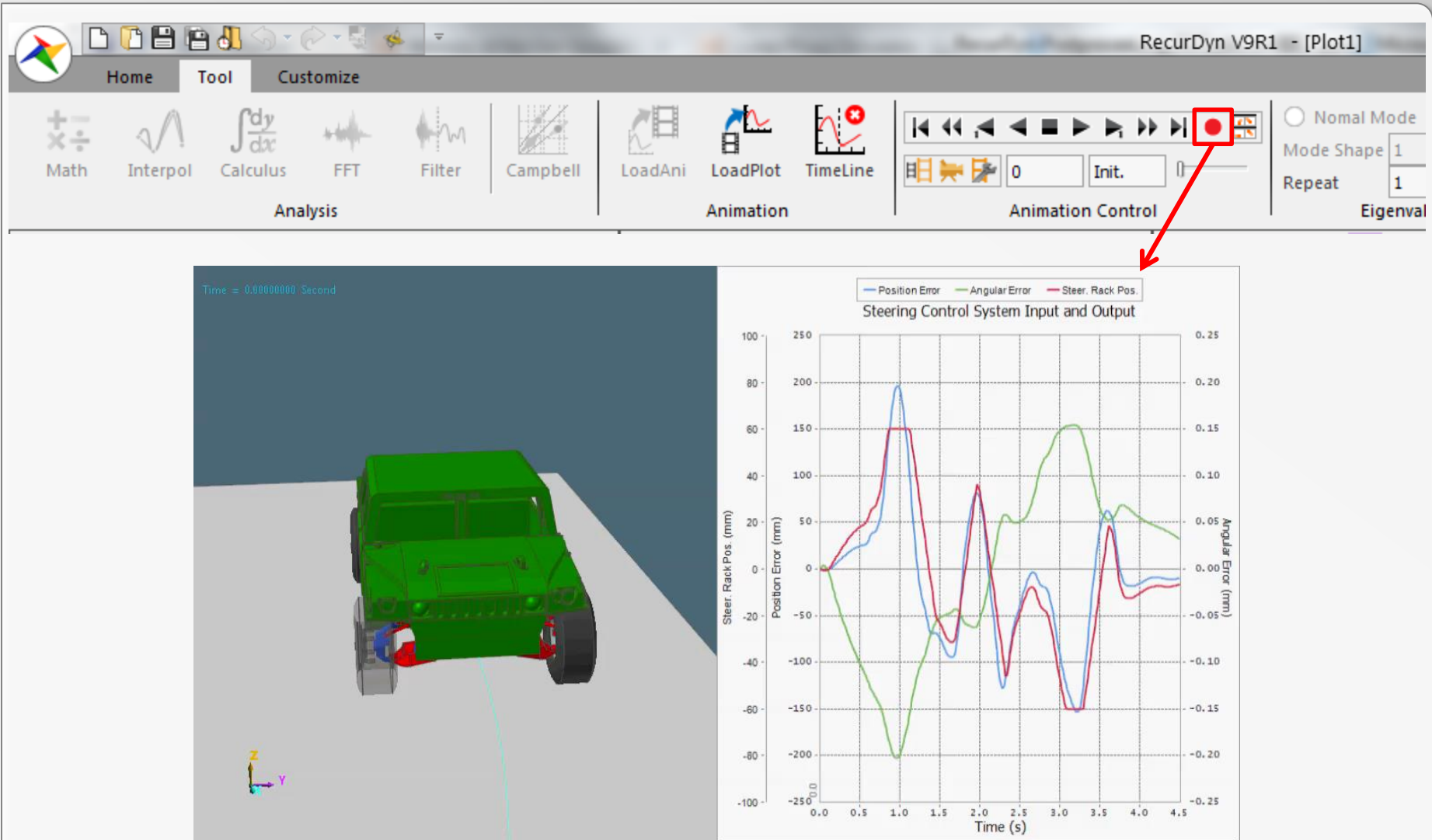
# Plot with Animation



New for V9R1:  
Animation can be  
replaced by plot again.



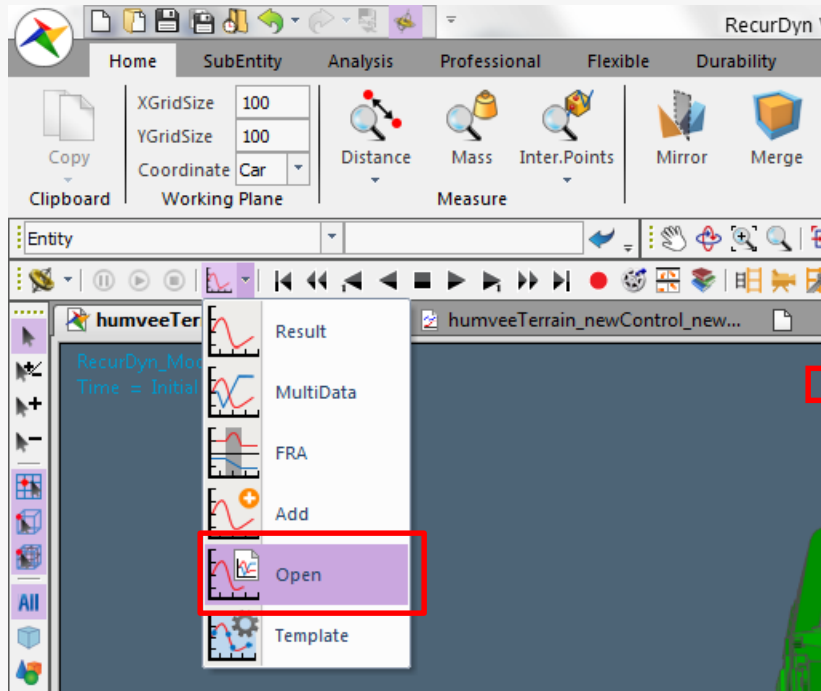
# Plot with Animation: AVI Creation



Quality of AVIs higher than earlier versions of RecurDyn.

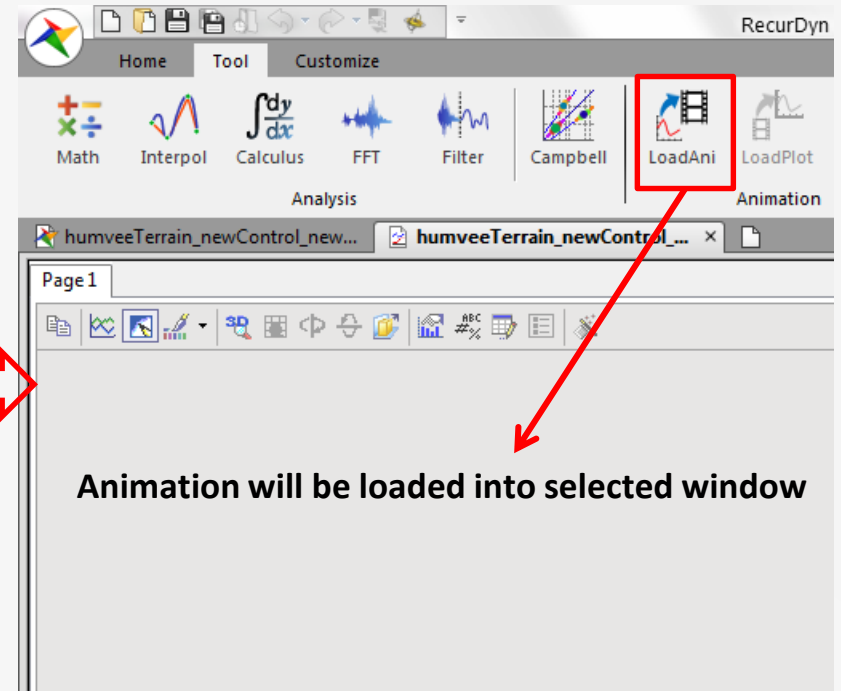
# Reloading Animation into Existing Plot

## Modeling Window with animation results loaded



Select existing plot

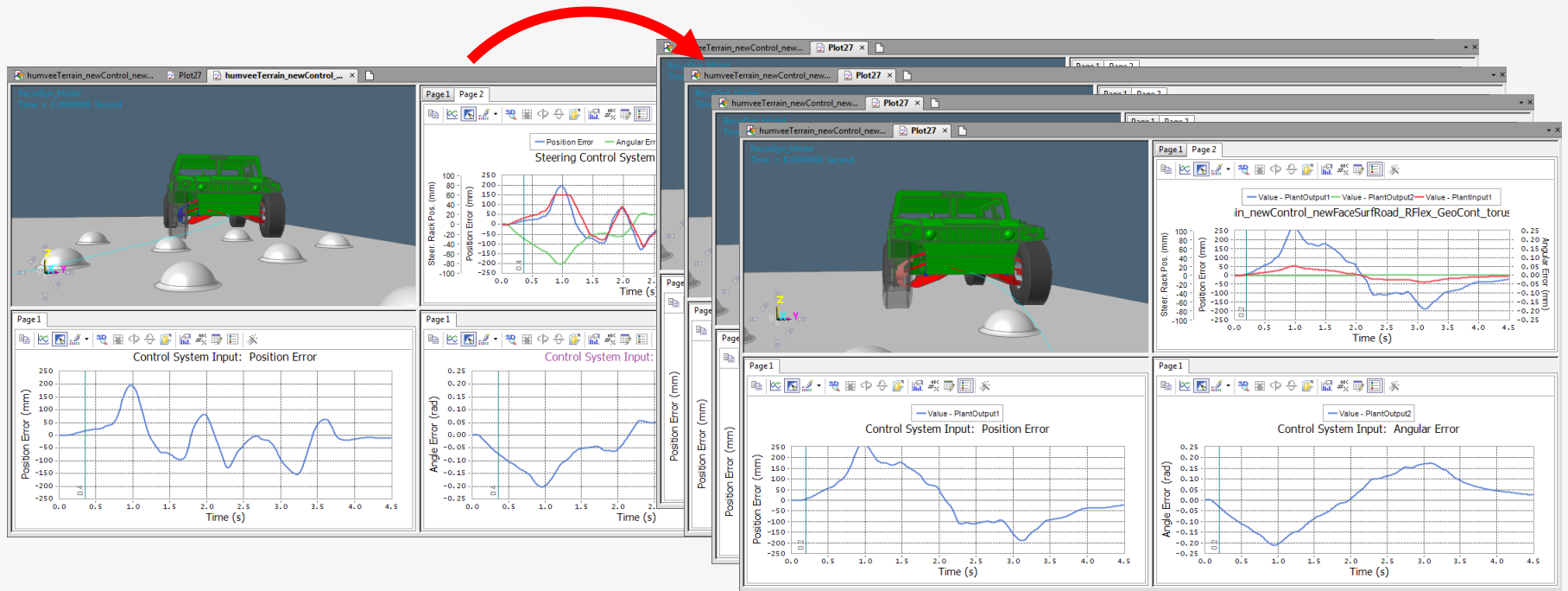
## In Plotting Window, click Load Animation.



Animation will be loaded into selected window

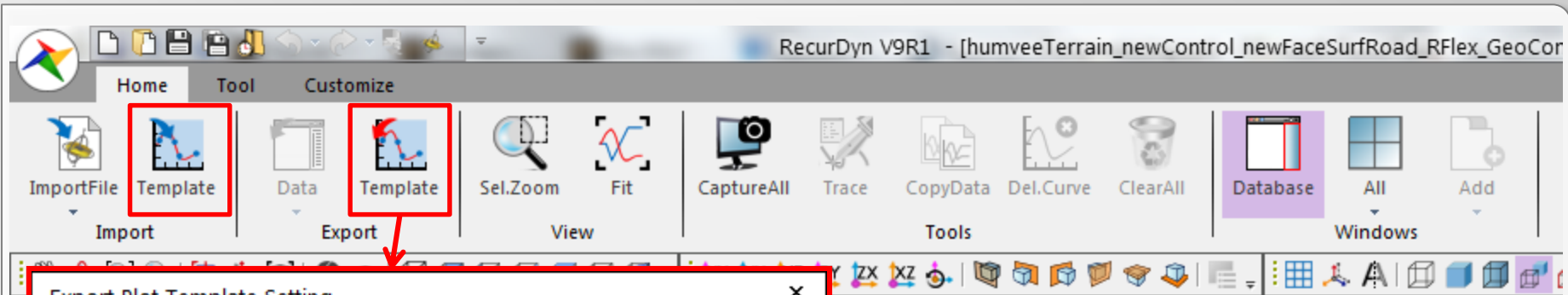
- In previous versions, after a plot with animation results is closed, the animation could no longer be associated with the animation file.
- In RecurDyn V9R1, the new Open Plot button now allows this.

# Plot Templates



- Quick way to automate plot creation.
- Transfers many plot settings such as plot title, axis scale and title, window and page layout, imported animation, curve appearance, etc.
- Plot Template files are in XML format.

# Plot Templates



All these settings are saved in plot templates

1. Create plot.
2. Export plot template.
3. Run another simulation.
4. Open new plot using plot template / import plot template.
5. New plot is formatted the same as the original plot.

(DEMO)

# Conclusion

Thank You!  
Questions?