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Siemens PLM Connection

NX Motion Simulation

What's New in NX 6 & Roadmap

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Americas 2008

PLM Software

Answers for industry.

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Siemens PLM Software – Digital Simulation Vision & Objectives

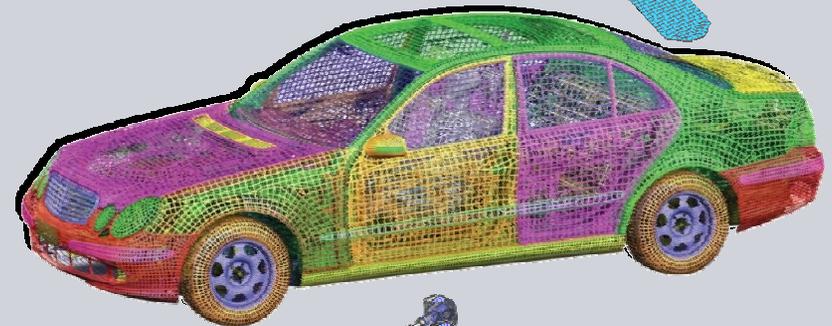
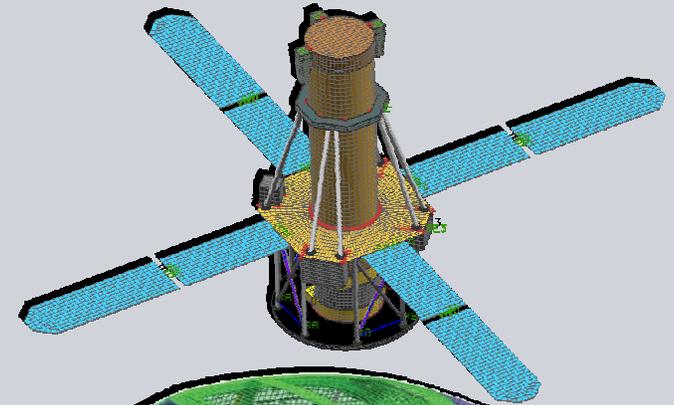
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Vision

- To make simulation pervasive throughout the product lifecycle in order to design in Quality and drive Product Innovation

Key Objectives

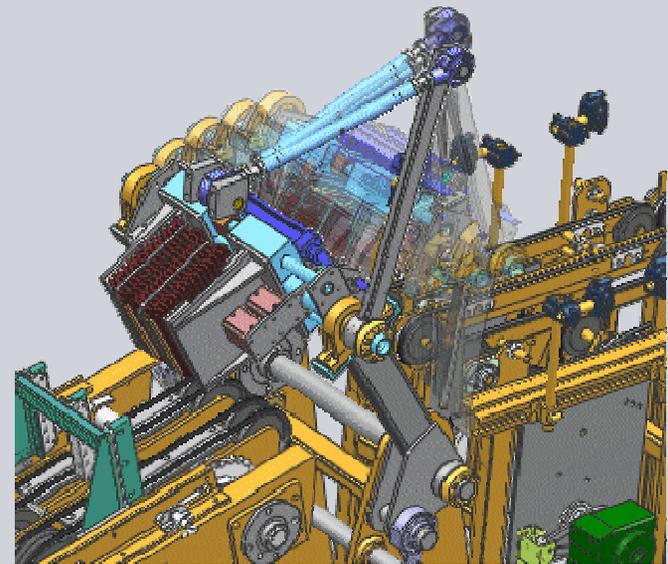
- Best-in-class, scalable CAE pre-post modelers
- Market-leading physics based system solutions
- Integrated system analysis for multi-body motion dynamics
- Data management



NX MOTION SIMULATION AGENDA

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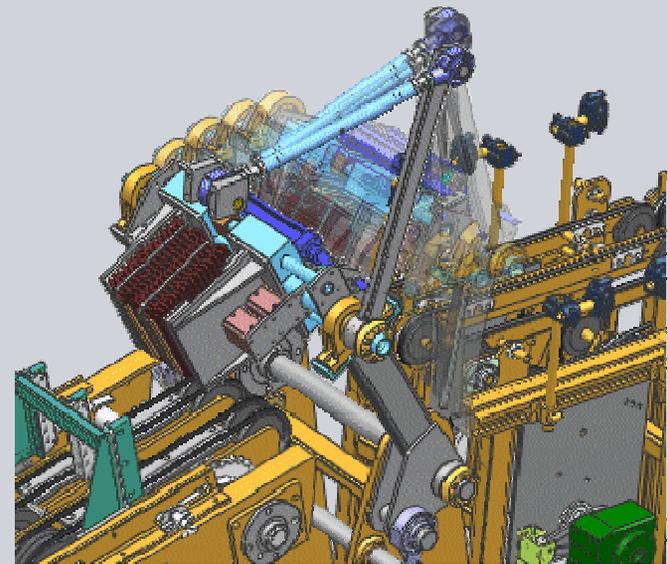
- **Vision & Objectives**
- **What's New in NX 6 Motion**
 - Motion Control
 - Usability & Functionality
- **Roadmap**
 - NX 7 Candidates



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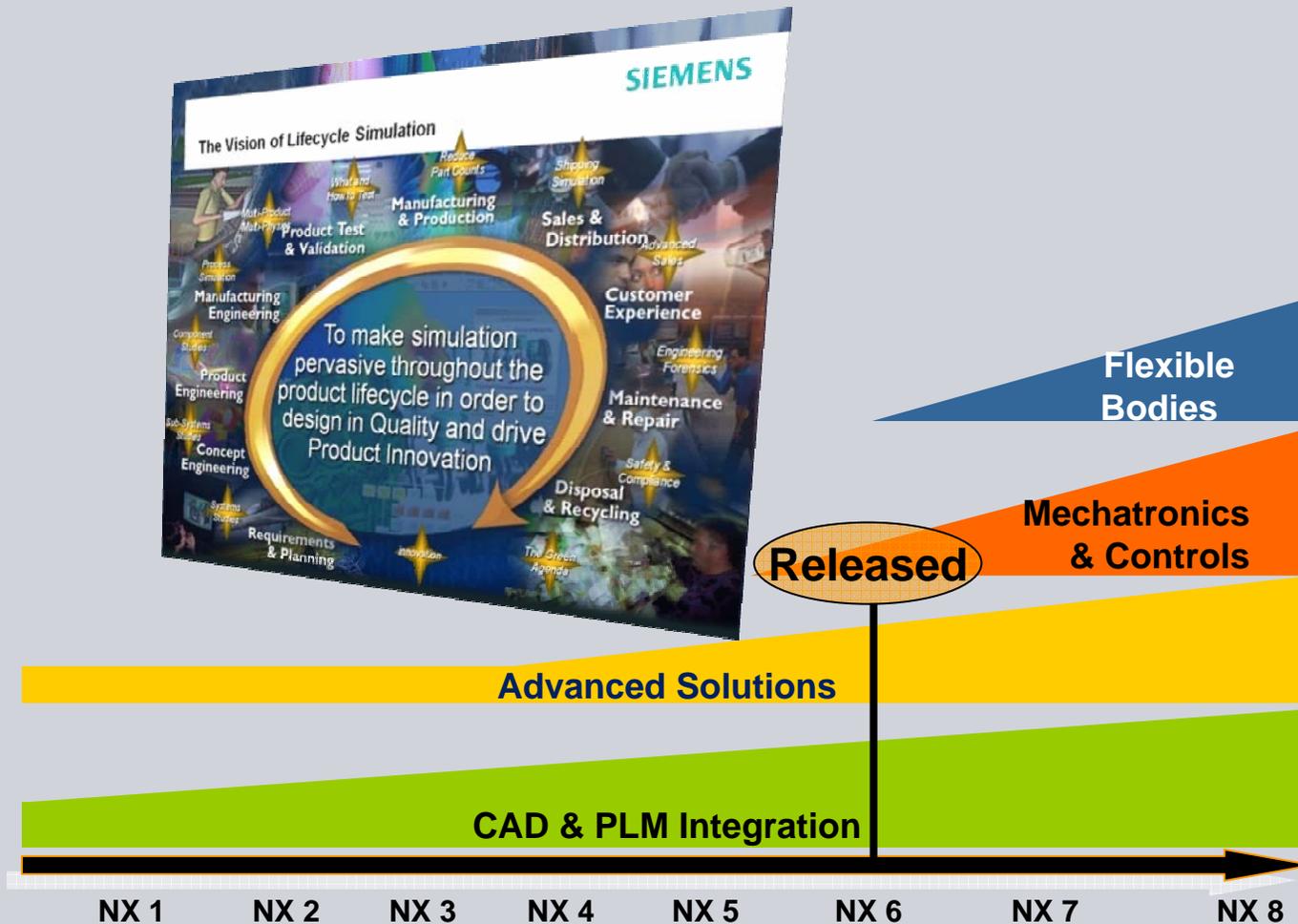
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NX Motion Objectives NX 6 & Beyond

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NX Motion Objectives NX 6 & Beyond - Roadmap



- Motion Simulation for Designers**
 Focus on NX and Teamcenter consistency and integration
- Advanced Solutions**
 Expand advanced functionalities for Pre/Post/Solver
- Control Systems and Mechatronics**
 Support sensor, motor driver, electric circuit, software,...
- Flexible Multi-Body Dynamics**
 Fully integrate structural behavior

Advanced Post-Processor
 Lightweight support
 Joint Primitive & Friction
 Imp/Exp mechanisms
 Load transfer enhancement

Motion Control/MATLAB
 PMDC motor & signal
 Direct open of Motion
 Non-linear Spring/Damper
 UI improvement & .NET

Conference attendees only

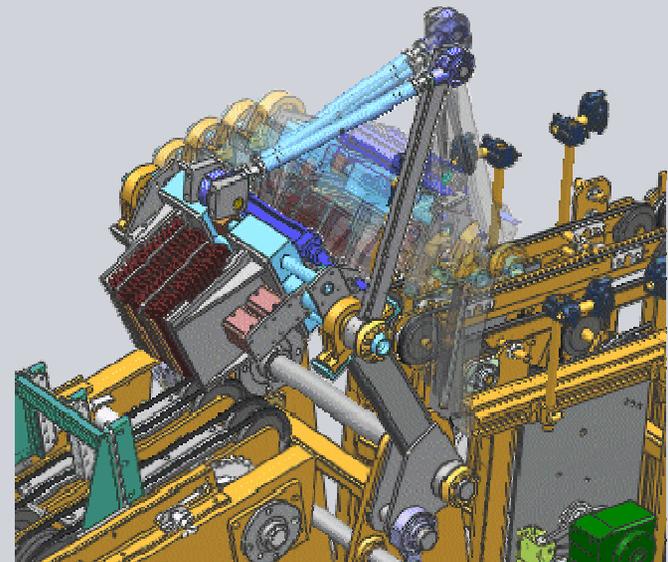


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NX MOTION SIMULATION AGENDA

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- **Vision & Objectives**
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NX Motion Control Simulation Released at NX 6.0

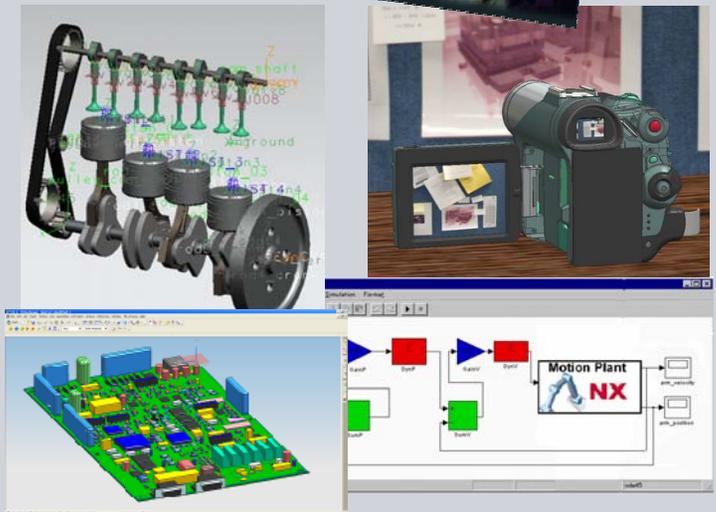
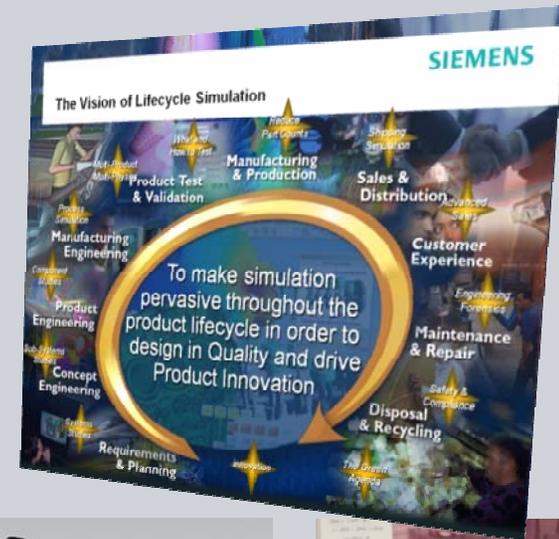
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Objectives

- Interaction between control devices and mechanical systems
- Motion simulation will embed signal logic and electronic components

Users Benefits

- Electro-mechanical products simulation:
 - Optimize control system design a.k.a. sensor settings, input gain, along with mechanical mass/Inertia...
- Unified environment:
 - Same user interface thus better team work
 - Share data, revise, configure



NX 6 Motion Control Simulation

Mechatronics & Control Systems

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Mechatronics & Controls

Co-Simulation w/ Simulink® (from MathWorks)

Control with the most popular Math Software

- Control loop system in Simulink
- Mechanical Plant in NX Motion
- Controls Torque, Force, Velocity...
- Monitors any Motion output
- Sampling time
- Post-Process in NX

PMDC motor and voltage signal

Mechatronics and Mechanical Design

- Fully integrated modeling
- Open or closed loop signal
- Customizable and re-usable
- Post-Process current, torque, velocity...

PMDC: Permanent Magnetic Direct Current

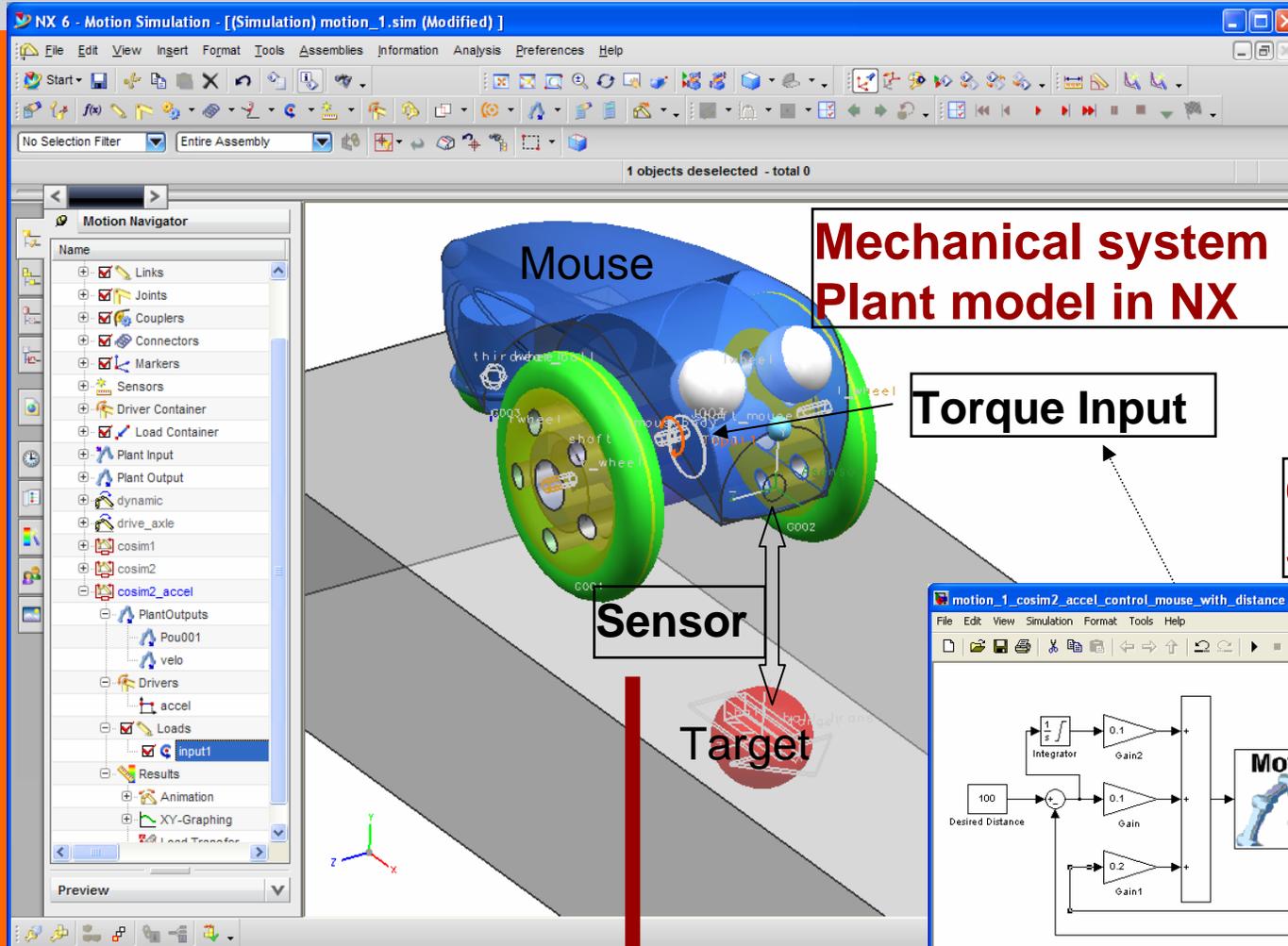


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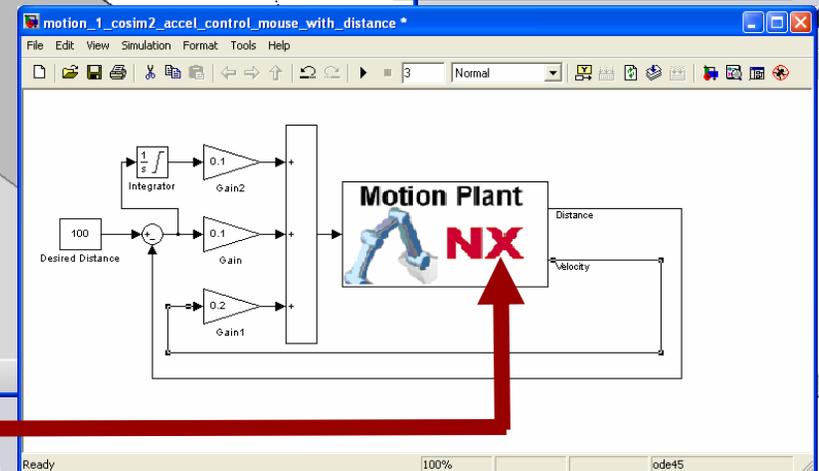
NX 6 Motion Control Simulation Co-Simulation with MATLAB®, Simulink®

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Mechatronics & Controls



Control System
Simulink



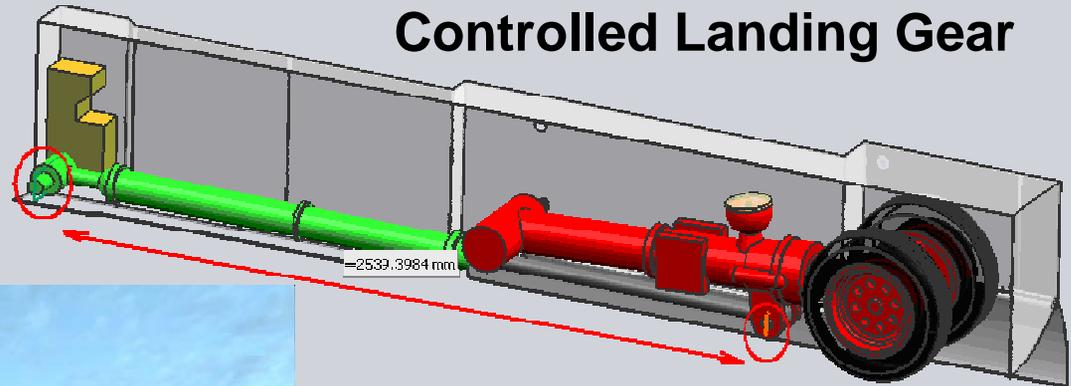
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NX 6 Motion Control Simulation

Co-Simulation with MATLAB®, Simulink®

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Goal: Smooth closing
Validate under realistic
aircraft operating conditions



Controlled Landing Gear

Mechatronics & Controls



- **Plant Input:** Hydraulic force pushing the piston
- **Plant Output:** Displacement and velocity of the piston relative to the cylinder. Includes goal setting from a Design Parameter.

NX 6 Motion Control Simulation

Co-Simulation with MATLAB®, Simulink®

Control Solution type

- Control system file
- Control sampling time

Mechanical system control input

- Load control: torque, force
- Driver control: velocity, acceleration

Mechanical system control output

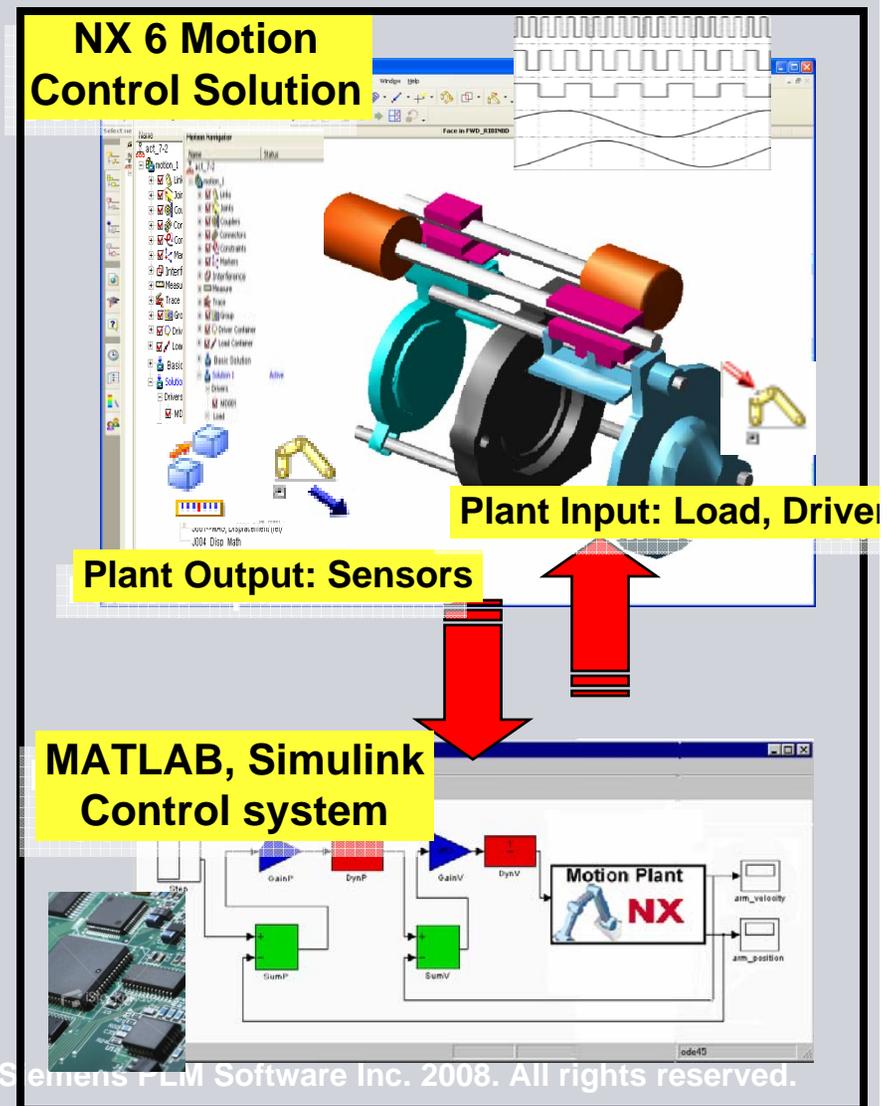
- Sensors - absolute or relative
- Functions - complex operations

NX Interface with Simulink

- Integration within the control system
- Run co-simulation

Solve and Post-Process

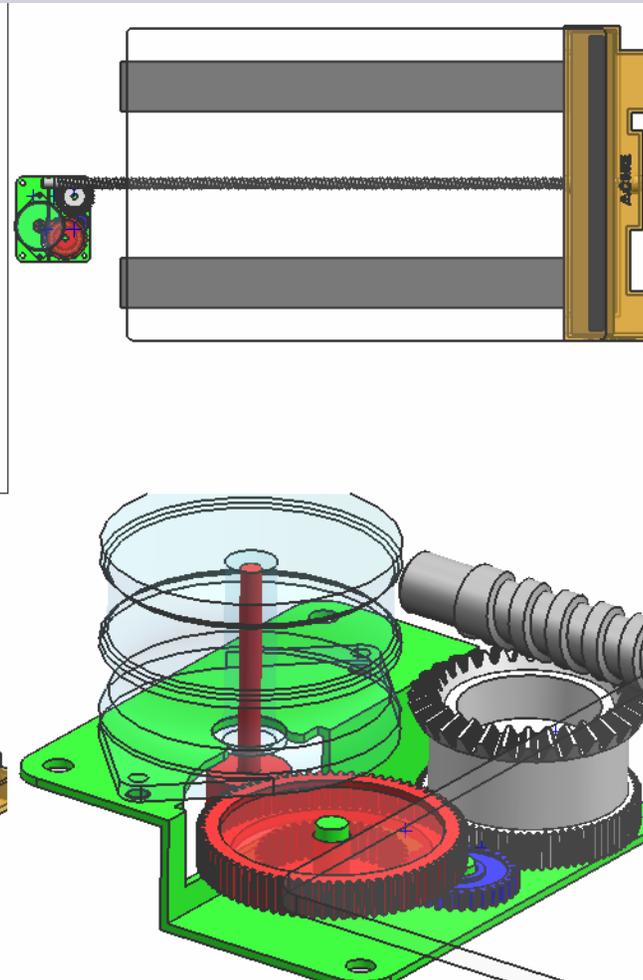
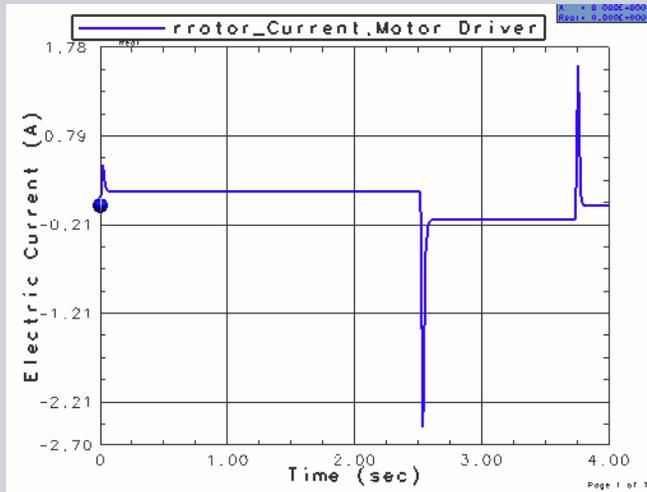
Compare different control systems and validate using Animation, XY Plot, Clearance, Trace...



NX 6 Motion - Control Systems

Integrated PMDC motors and signal input

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NX 6 Motion Control Simulation

Integrated PMDC motors and signal input



Electrical Motor Object

- Input parameters as electrical properties
- Re-usable via PLMXML
- Input voltage as a signal

Signal Chart

- Input for motor as ratio of nominal voltage (more likely to be 0, +1 or -1)
- Open loop – time dependant only
- Uses Function Manager: afu, preview...
- Closed loop
- Sequence of events following sensor triggers
- Allow timer (countdown)
- Includes time dependant (absolute)

The screenshot displays the Siemens NX software interface for configuring a PMDC motor. Key elements include:

- Environment Panel:** Shows 'Control Solution Options' with 'Motor Driver' checked and 'Co-Simulation' unchecked.
- PMDC Motor Dialog:** Configures electrical parameters:

Nominal Voltage (V)	24.0000
Voltage Constant (V/rpm)	0.0539
Inductance (H)	0.0017
Resistance (Ohm)	0.4080
Initial Current (A)	0.0000

 The name 'DC001' is entered in the Name field.
- Signal Chart:** Shows a 'Closed Loop' configuration with an 'Origin' sensor. The 'Event Setting' table is as follows:

Sensor	Condition	Time Delay	Signal	Event
Return	< 12.000...	0.000000	-1.000...	FAI
Origin	> 0.0000...	0.000000	0.0000...	FAI
- Signal Chart Plot:** A graph showing 'rotor_Current, Motor Driver' (solid blue line) and 'rotor_Voltage, Motor Driver' (dashed red line) over time. The voltage signal is a step function that transitions from 0 to 24V at a specific time point.

PMDC: Permanent Magnetic Direct Current

Motion Simulation for Design *Usability, NX and Teamcenter integration*

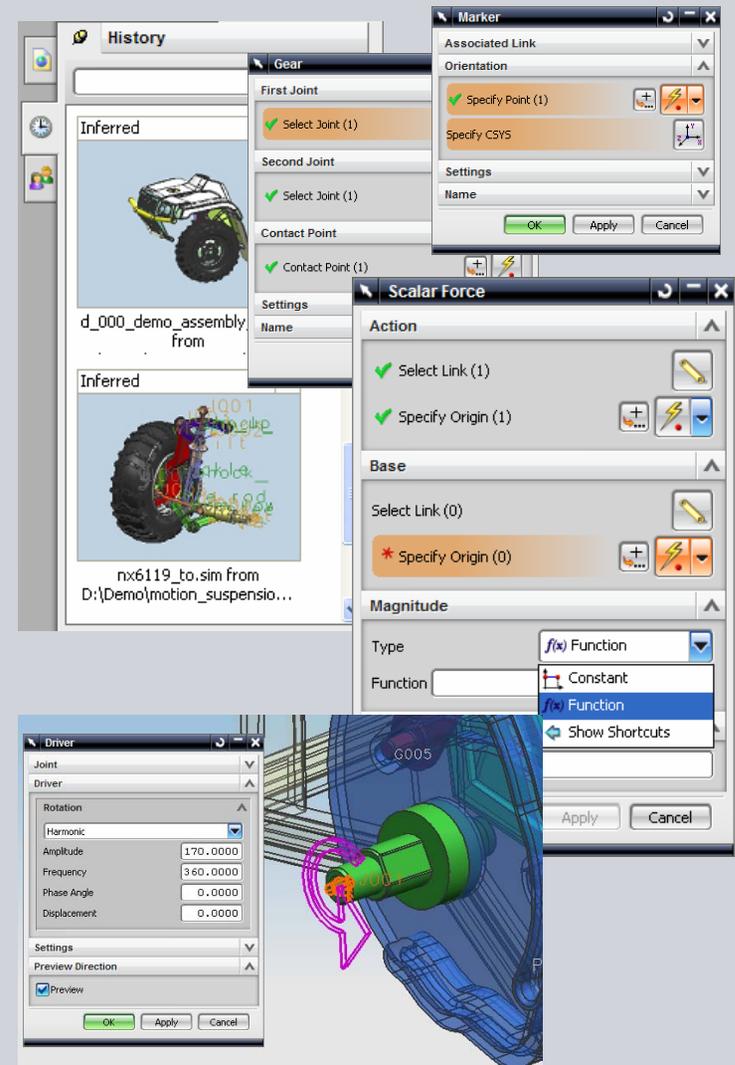
CAD-PLM

Direct opening of the Motion File

- Rapid access to simulation data
- Follows Assembly load options
- Allows minimum geometry loading
- Supported in Teamcenter 2007.1

User Interface improvements

- 15 improved dialogs for consistency and Journal support extension
- Constant/Function types for Forces
- Default inherited Free Length for spring
- Marker position and orientation options
- New Graphic Display with local XYZ
- Preview of direction for standalone drivers



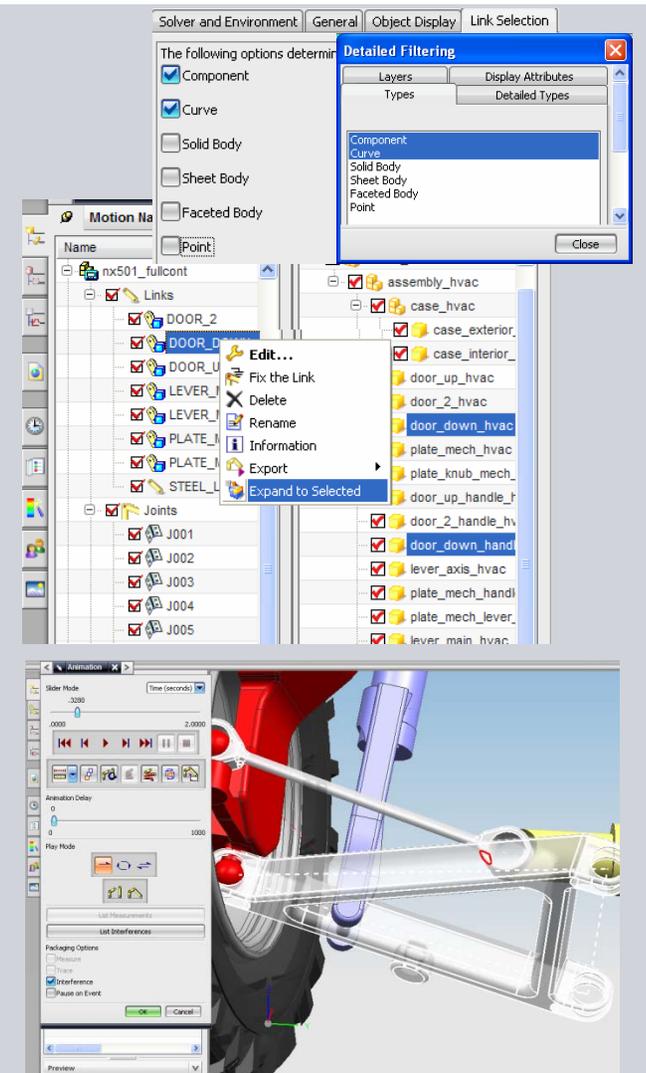
Motion Simulation for Design Workflow Improvements for Designers

Improved Assembly workflow

- List the geometry used for a Link for the detailed content
- “Expand Selected” for identifying the components in the Navigator
- Filter the Link geometry selection in Customer Default for Best practice

Show Intersection curves

- Displays the contour of Interference on the body faces with a warning sign
- Trace for further usage (i.e. modeling)
- Allow to measure how much penetration
- Available with Lightweight reference sets



Motion Simulation Openness Comprehensive Automation support

CAD-PLM

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Mechatronics & Controls

Existing Objects complete support

- Couplers: cable, gear, rack-pinion
- Constraints: point-curve, curve-curve
point-surface
- Forces: Scalar Force and Torque
Vector Force and Torque

Support for new Features

- Direct Opening
- Sensor
- PMDC motor, motor driver, signal chart
- Plant Input and Output

Motion Objects	NX 3		NX 4		NX 5		NX 6	
	KF	KF	KF	JA	KF	JA	KF	JA
Link								
Revolute Joint								
Slider Joint								
Cylindrical Joint								
Universal Joint								
Planar Joint								
Spherical Joint								
Screw Joint								
Fixed Joint								
Primitive Joints (7)								
Marker								
Gear								
Rack-Pinion								
Cable								
Spring								
Damper								
Bushing								
S Force/Torque								
V Force/Torque								
2D contact								
3D contact								
Interference								
Trace								
Measure								
Function Manager								
Solution								
Driver								
XY Graphing								
Sensor								
PMDC motor								
Signal Chart								
Plant I/O								

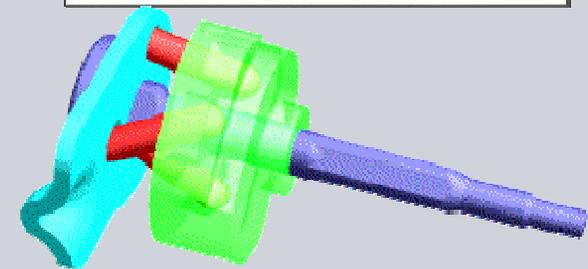
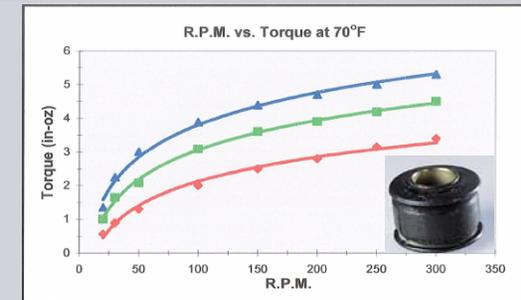
Advanced Motion Solutions

Adding more functionality

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Non linear connections

- Bushing, spring and damper
- Tabulated values input with Spline approximation
 - Allow import from spreadsheet
 - Enable re-use with AFU file

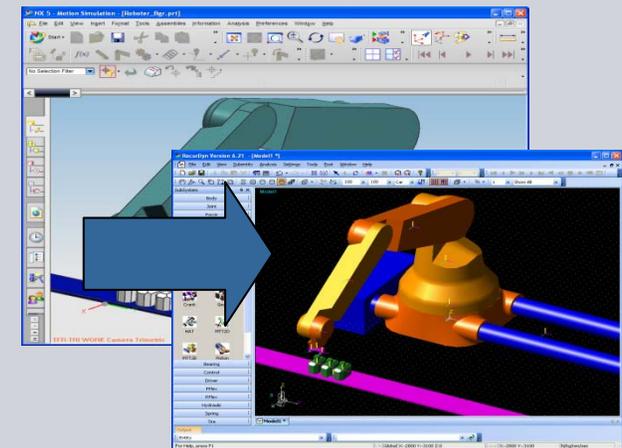


Cylindrical Joint Driver

- Independent translation vs. rotation drivers
- Supports Motor driver from Mechatronics

Scalability: Export to standalone solutions

- Export to Adams/View
- Export to RecurDyn/Pro 7



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Advanced Motion Solutions

Adding more functionality

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Advanced

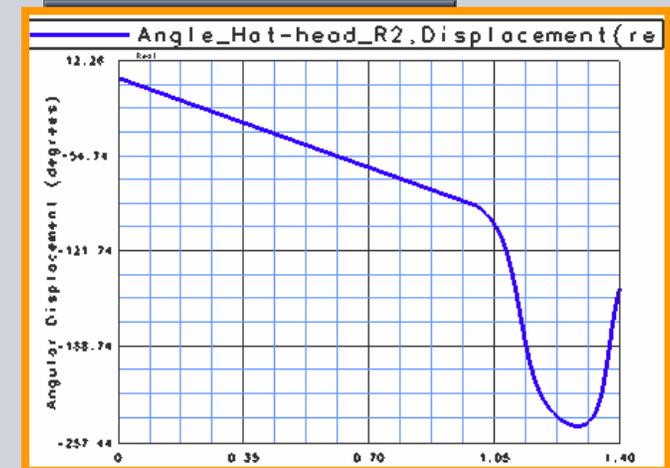
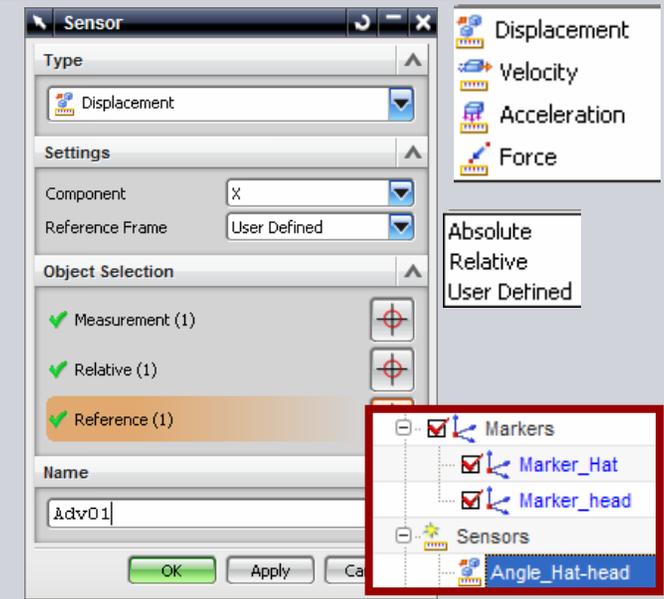
Mechatronics & Controls

Motion Sensors

- Absolute or relative Motion results
- Monitor displacement, velocity, acceleration and forces on Markers or Joints in time
 - Absolute in Global Coordinate System
 - Relative to another Marker (moving or fixed)
 - Using the Marker's Coordinate System
 - Expressed in any 3rd Coordinate System
- Directly graph the sensor result
- Available for combining in Functions

Control Solution usage

- Co-Simulation for Plant output
- Motor Driver for signal chart in closed loop



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Assembly Constraints - Joint Wizard NX 6.0.1

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CAD-PLM

WHAT IS IT?

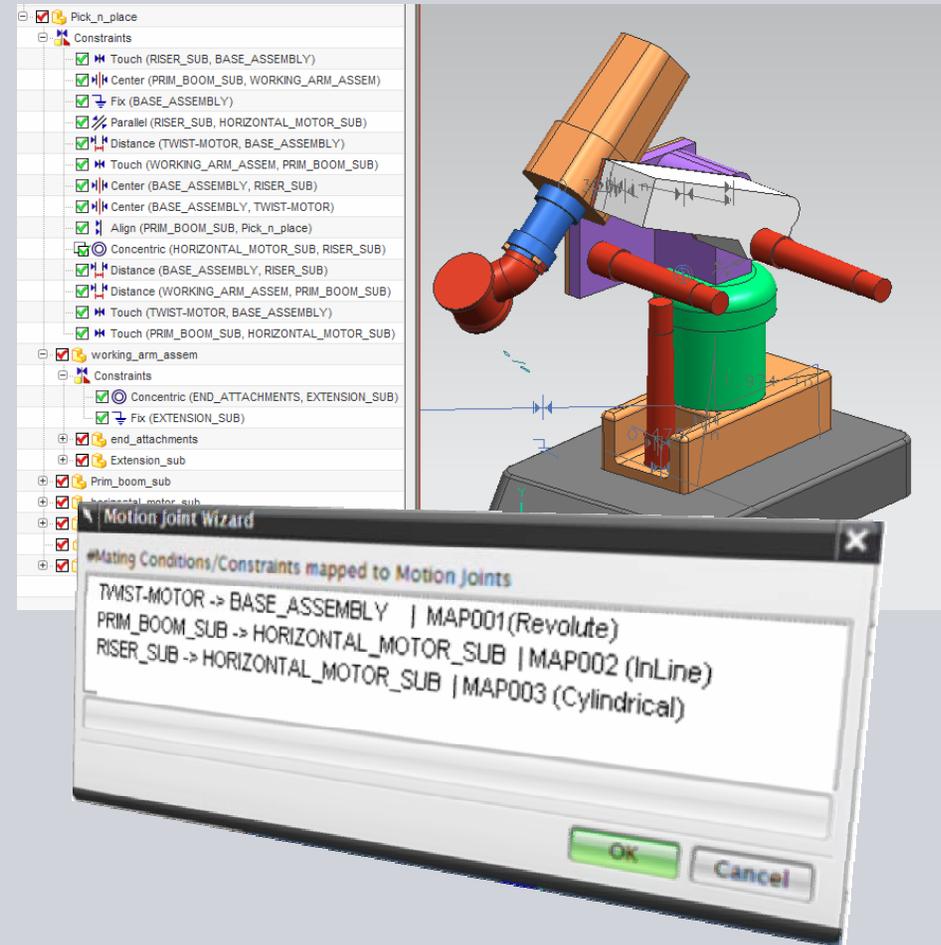
- Map the components with Links
- Map the Assembly constraints and mating conditions with Joints

BENEFITS

- Capture the Assembly Intent
- Re-use the Assembly construction

CONTENT

- Inherit and associative positions and orientation
- Leverage the Joint Primitives



Display Measure in Animation NX 6.0.1

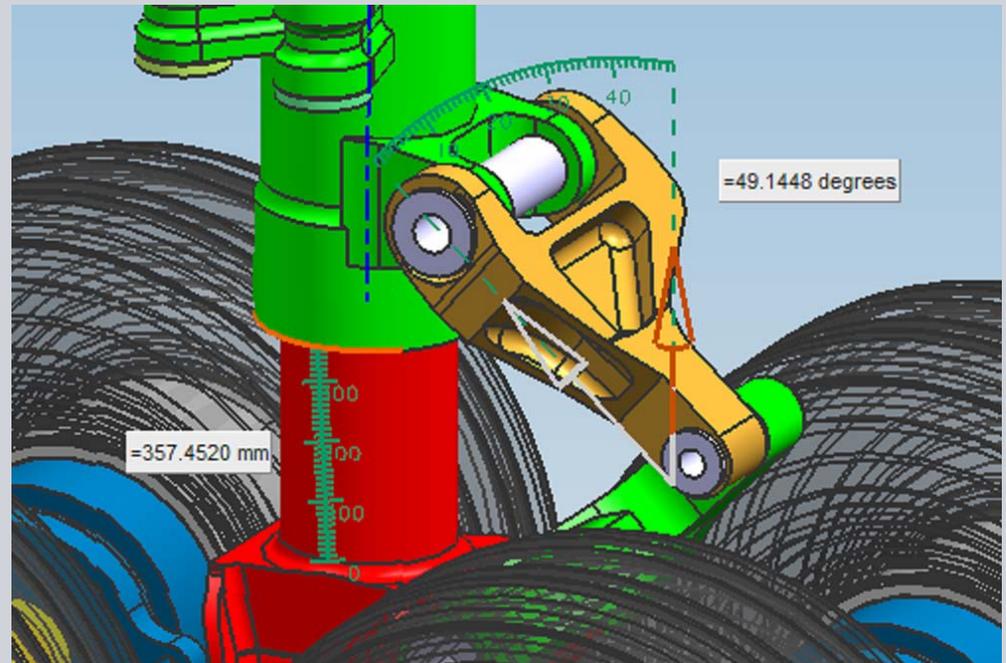
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WHAT IS IT?

- Display distance and angle updated with Animation
- Consistent with NX analysis measure

BENEFITS

- Validate the packaging requirements
- Monitor the clearance



Point on Curve Driver NX 6.0.1

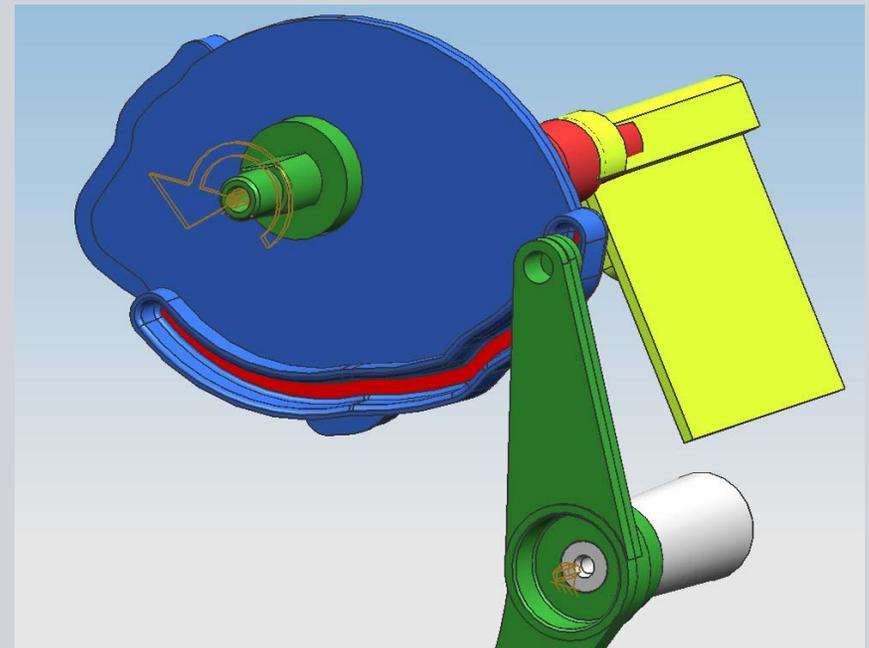
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WHAT IS IT?

- Movement following a curve
- Driver as constant, harmonic or Motion general function

BENEFITS

- Concept analysis for cable or chain
- Enable reverse kinematics:
Find a driver time profile in order to
achieve a constant velocity
following a trajectory



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**Conference
attendees only**

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Thank You!

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