Mechatronics Concept Designer

Realize innovation.
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NX: Breaking down the barriers to innovation

- Electro-Mechanical Design
- Most Productive Modeling Environment
- Generative Design & Integrated Validation
- Industrialized Additive Manufacturing
- Collaborative Design Management
- Immersive Design with VR
NX: Breaking down the barriers to innovation

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The current machinery challenges
Master increasing product complexity

Is this “just” a loading door?

Solutions are never only about mechanics!

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Advanced Machine Engineering reduces the time from the first idea to the delivered machine.

Siemens products are supporting already today advanced engineering methods.
Mechatronics Concept Designer

- Mechatronic Concept
- Mechanics
- Electrics
- Automation
- Virtual Commissioning
Mechatronics Concept Designer

Mechatronic Concept

Mechanics Electrics Automation

Virtual Commissioning

Concept Design
Multi-disciplinary Concept
Capturing relevant multi-disciplinary aspect from the beginning

How should the machine work?

- Operations
- Mechanics
- Motion Control
- Reuse of existing Components
- Drives & Actors
- Sensors
Mechatronics concept design using MCD
Modeling concepts – Mechanics and Kinematics

• Easily create machine concepts in the NX modeling environment

• Interaction with other CAD systems

• Taking physical properties into account, e.g. Inertia, collision and gravity

• Presentation and evaluation of machine concepts

+ Easily create and display complex machine concepts
Mechatronic concept design using MCD
Sensors, Actuators, Sequence of Operations and Interaction

- Extension of the kinematics with logical functions
- Definition of actuators and sensors
- Creation of machine sequences with consideration of acceleration, jerk etc.
- Evaluation of different concepts
- Discussing machine concepts with ...
  ... other departments and colleagues
  ... technical and non-technical customers

Early validation and communication in between the different eng. disciplines
Multi disciplinary design
Mechatronics Concept as Basis for multi-domain Engineering
Generation of information for successive engineering disciplines

Which Data is provided by a mechatronics concept design?

- Sequence of Operations
- 3D Geometry
- Cam Discs
- Sensor-Actor Lists
- Path-Time diagrams
- Resource classification
- Control Signals
- Force / Loadprofiles
Mechatronics Concept as a data source
Creating timing diagrams / sequence descriptions

Timing chart
Automatic export & charting in MS Excel inc. Consideration of axis values such as acceleration, jerk etc.
‡ Better communication of machine processes

Simple cycle time calculation and evaluation of complex machine sequences
Knowledge Reuse with Mechatronic Concepts
Interactive, Real Time Kinematics Data for Design Analysis

Analyze dynamic behavior of concept interactively during simulation.
- Different concepts can be tested rapidly.
- Reusing result gained in analysis for further design process

Interactive, Real Time Kinematics Data for Design Analysis

Rapid iteration of concept validation

Utilization of analysis results
Knowledge Reuse with Mechatronic Concepts: Dimensioning of Drives

NX/MCD – SIZER Interface

Transfer of 3D CAD Data with CAD-Creator

3D-CAD

Drive Library

Load Curve

Continuous use of knowledge in the design process
Knowledge Reuse with Mechatronic Concepts:
Dimensioning of Drives with NX Motion and Wittenstein Cymex

- Export the motor load profile in the MCD or NX Motion
- Convert the points from the MCD table to a Cymex® standard ascii file
- Loading the data points according to Wittenstein Cymex® 3 or 5
Knowledge Reuse with Mechatronic Concepts

Cam Curve Design

Integrated tool to design, simulate and edit cam curves. Cam curves can be exported to be used for further design process.

+ Faster way to produce draft concept for cam curves

+ Easily compute cycle time of complex machine sequences
Mechatronics Concept Designer

Virtual Commissioning

Virtual Commissioning
Virtual Commissioning with MCD
Characteristics and Advantages

- Integrated Solution for Design and Automation
- Test and code the control software on the physical CAD-Data
- Reusing information of existing mechatronic modules or machines
- Train machine operators to operate on virtual machines instead of real machines
- Store virtual machines for further developments or on-site engineering change

 Avoid machine issues from mechanical designs or automation via risk free virtual tests

 Reduce time needed for commissioning up to 70%
Mechatronics Concept Designer supports throughout the complete automation engineering process

**Idea**

Concept to detailed design and evaluation: 3D based automation engineering

**Virtual Commissioning Offering**

<table>
<thead>
<tr>
<th>Software-In-the-Loop (SIL)</th>
<th>Hardware-In-the-Loop (HIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept to detailed design and evaluation: 3D based automation engineering</td>
<td>Virtual Commissioning</td>
</tr>
</tbody>
</table>

**Concurrent improvement of design and automation**
### Virtual Commissioning with MCD

**A scalable offering to support the automation engineering process**

<table>
<thead>
<tr>
<th>Virtual Machine Validation</th>
<th>Virtual Commissioning (Software-in-the-loop)</th>
<th>Virtual Commissioning (Hardware-in-the-loop)</th>
<th>Real Machine Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechatronics Concept Designer</td>
<td>SIMIT</td>
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<td>e.g. Simatic S7-1500 Control</td>
</tr>
<tr>
<td>Machine Concept</td>
<td>Virtual Machine Validation</td>
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<td>Automation System</td>
</tr>
<tr>
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<td>Simulation of the automation behaviour</td>
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<td>Profibus or Profinet</td>
</tr>
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<td></td>
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<td>IO Devices / Actuators / Sensors / …</td>
</tr>
<tr>
<td></td>
<td>Virtual machine</td>
<td>Virtual machine</td>
<td>Real Machines</td>
</tr>
</tbody>
</table>

**Simulation of the automation behaviour**

- **Virtual Machine Validation**
  - PLCSIM Advanced
- **Virtual Commissioning (Software-in-the-loop)**
  - PLCSIM Advanced
- **Virtual Commissioning (Hardware-in-the-loop)**
  - e.g. Simatic S7-1500
  - Simit UNIT (PN / PB)
- **Real Machine Commissioning**
  - e.g. Simatic S7-1500 Control
  - Automation System
  - Profibus or Profinet
  - IO Devices / Actuators / Sensors / …
  - Real Machines
Variation 1: 3D based automation engineering with direct Coupling of Control or CO-Simulation Signals in MCD

- PLCSIM Advanced
- Simcenter Amesim
- OPC DA & UA
- TCP / UDP
- Server & Client
- SHM
- Profinet iDevice
- Matlab
- Open API (.NET)
- ...

Digital Model

Control

NX / MCD
Variation 2: Virtual Commissioning setups with MCD and SIMIT for Software- and Hardware-in-the-loop scenarios
Mechatronics Concept Designer

- Mechatronic Concept
- Mechanics
  - Electrics
  - Automation
- Virtual Commissioning

Outlook

- MCD & Automation Designer
- Co-Simulation with AMESIM
- MCD & HEEDS
What is Automation Designer?

What?

- **Central Design Application** for Electrics and Automation Software
- Enables functional, mechatronic engineering of **production systems and machines**
- Integrates Electrical and Automation data, with system design and mechanical data
- Provides **rule-based engineering** support with connection to downstream ECAD & Automation tools
How does it fit into the Siemens PLM Portfolio?
Automation Designer integrates PLM with Automation

How?

- Application within NX
- Teamcenter as backbone
- Strong integration with TIA Portal
- EPLAN integration
Scalable Siemens portfolio – Machine Virtual Commissioning

- Machine structure, Components, sensors and actuators
- E-CAD Generation
- TIA Portal
- HW and Code Generation
- Behavior models
- SIZER
- NX, Mechatronics Concept Designer
- Automation Designer
- NX Platform
- Teamcenter
- Machine design
- Automation design
- Automation engineering
- Virtual commissioning

Reusable components within mechatronics library
Mechatronics Concept Designer

- Mechatronic Concept
- Mechanic Elektric Automation
- Virtual Commissioning

Outlook

- MCD & Automation Designer
- Co-Simulation with AMESIM
- MCD & HEEDS
Physical process behavior can be simulated with AMESIM. This can be used to enhance the filling process.

**Application**
- Optimization of filling machines performance
- Improvement of the filling valves design

**Benefit**
- Higher performance
- Reduced number of prototypes by 20 percent
- Shorter-time-to-market

**Filling machine of Ronchi Mario**

"If you are interested in the global parameters of the system, a 1D simulation tool, such as LMS Imagine.Lab Amesim, is the best option, because it is fast, reliable and easy-to-use.", Gabriele Pastrello, R&D Engineering at RONCHI MARIO
Mechatronics Concept Designer

Outlook

- MCD & Automation Designer
- Co-Simulation with AMESIM
- MCD & HEEDS
Discover Better Designs, *Faster!*
Innovative Products and Technologies

HEEDS
Multidisciplinary Design Exploration Platform

BUILD > TEST > EXPLORE > ASSESS

Motion & Stress
Drag

CAD
Hydraulics
Control

Hydraulics

CFD
Conclusion: Mechatronics Concept Designer
Starting from the idea to the virtual commissioning

Overview:
- Create and simulate machine concepts in the shortest time directly in NX
- Connect the CAD data with real or virtual controls e.g. with Siemens S7-1500

Avoid risks during planning and commissioning to fulfill requirements
Better coordination in projects between mechanical, electrical and automation teams via a unified data model
Substantial reduction of time while increasing safety during commissioning
Thank you.