



Innovation Workshop **Online-Sessions**

PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP



Herzlich Willkommen!
Der Workshop beginnt um 09:00 Uhr



Online-Workshop: Simulation - Digital Twin

**Simulationskonzepte für
Maschinenautomatisierung**

Vorstellung



Kurt Zehetleitner
Bereichsleitung Simulation, R&D

B&R Industrial Automation GmbH
Prinz Eugen Center, Linz Austria
Email: kurt.zehetleitner@br-automation.com
www.br-automation.com



Richard Sturm
Marketingleiter Deutschland

B&R Industrie-Elektronik GmbH | TBM
Norsk-Data-Straße 3, 61352 Bad Homburg, Germany
Phone: +49 6172 4019 191
Email: richard.sturm@br-automation.com
www.br-automation.com



Für weitere Fragen oder Informationen erreichen Sie uns unter:

events.de@br-automation.com

Simulationskonzepte für die Maschinenautomatisierung

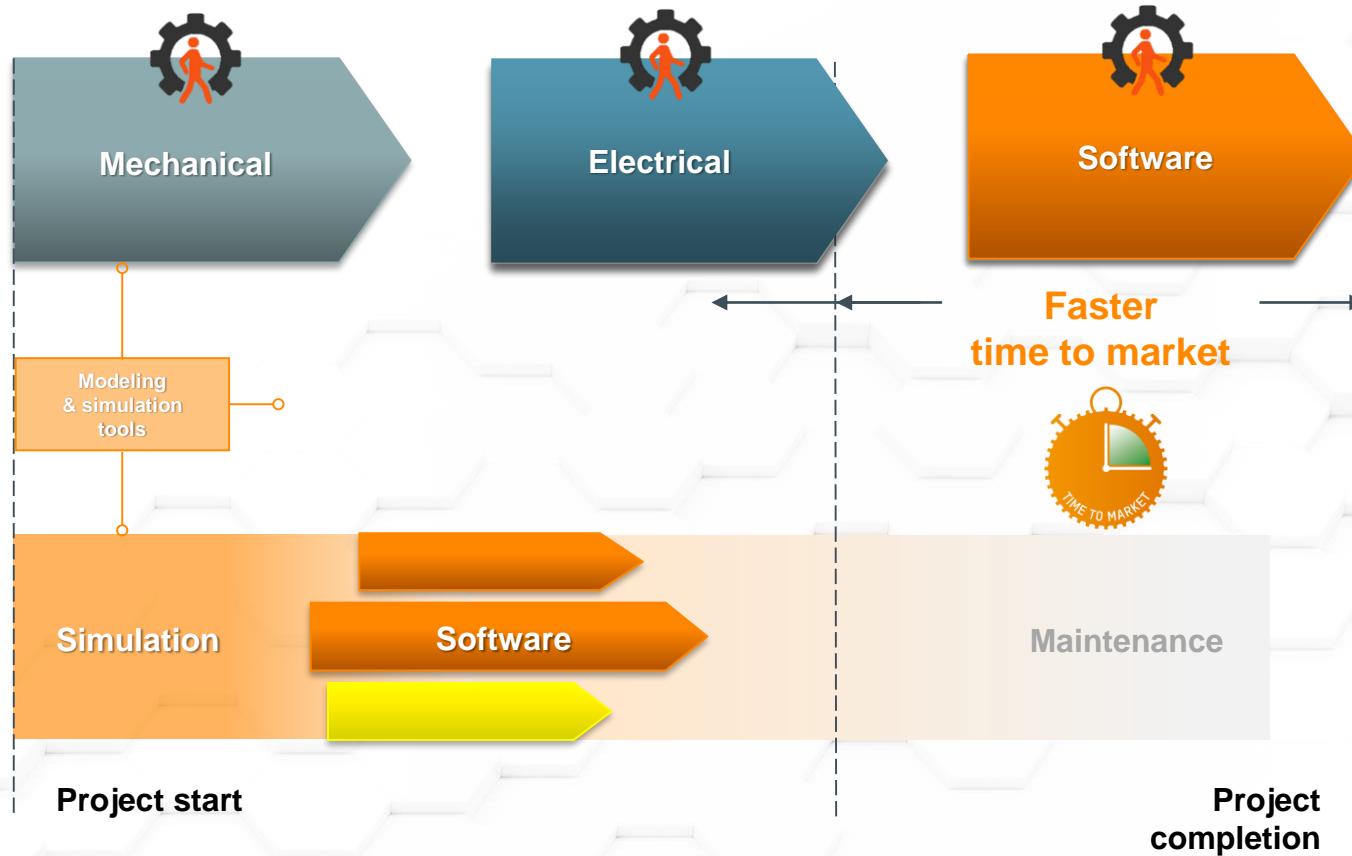
B&R IWOS 2020

Simulationskonzepte für die Maschinenautomatisierung – IWOS 2020 Session

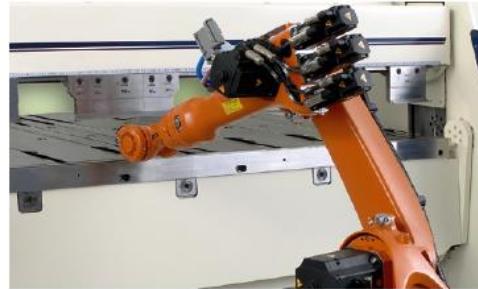
Folgende Themen wollen wir heute behandeln:

1. **Überblick** über Simulationslösungen für B&R Kunden
2. **Projektphasen** und Ziele für die Simulation
3. **Simulationskonzepte** und deren Umsetzung
4. **Anwendungsbeispiele** zu den Konzepten
5. **Zusammenfassungen** der gezeigten Information





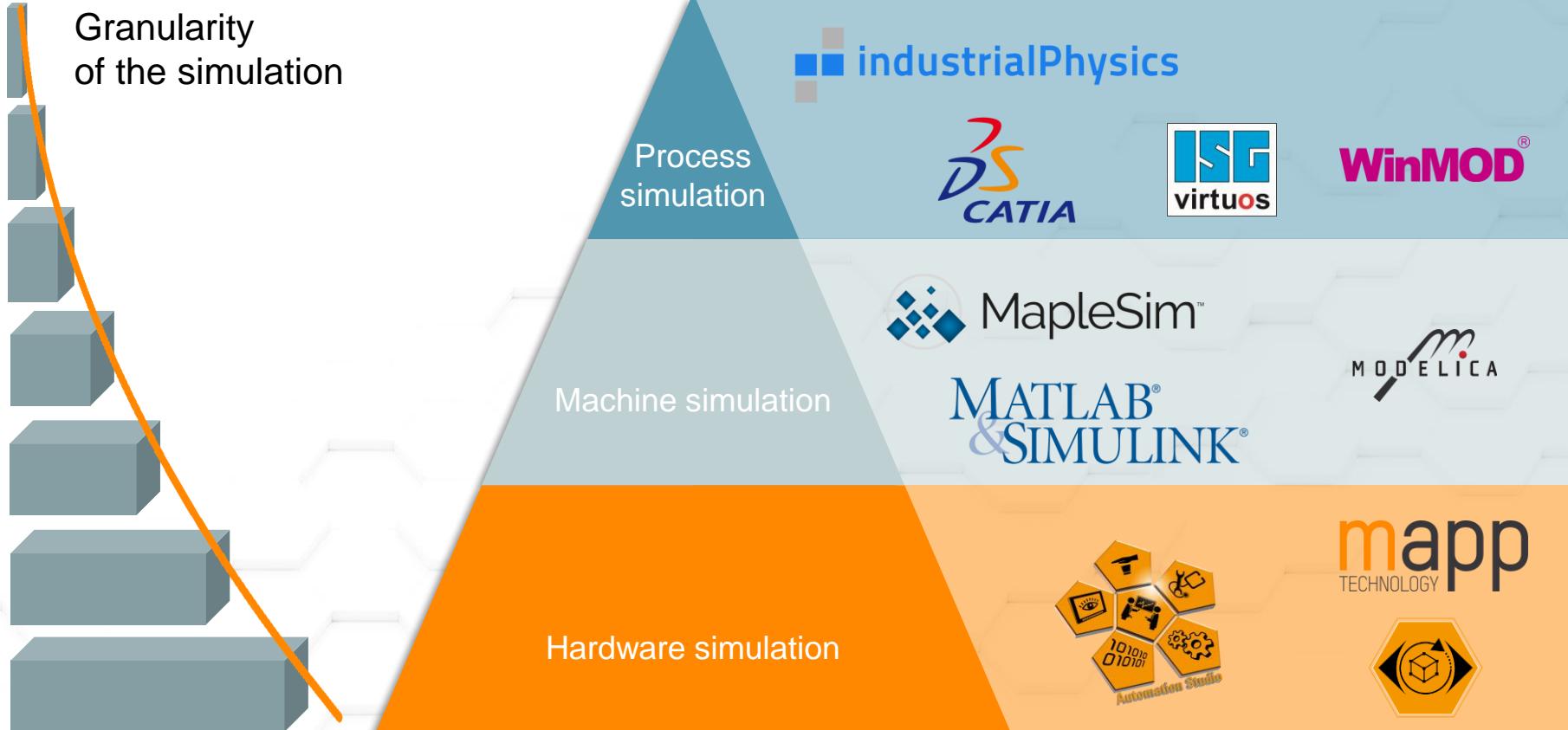
- Reduktion der Projekt Risiken
 - ✓ Proof of concept im Falle von Anpassungen (im gesamten Produkt-Lebenszyklus)



- Vereinfachtes Engineering und Entwicklung
 - ✓ Mechatronischer Zugang
 - ✓ Schnelle Anpassungen
 - ✓ Geschützte Entwicklungsumgebung
 - ✓ Optimierung, etc.
 - ✓ Schnellere Inbetriebnahme der realen Maschine
- Schneller und planbarer auf den Markt



Granularity
of the simulation



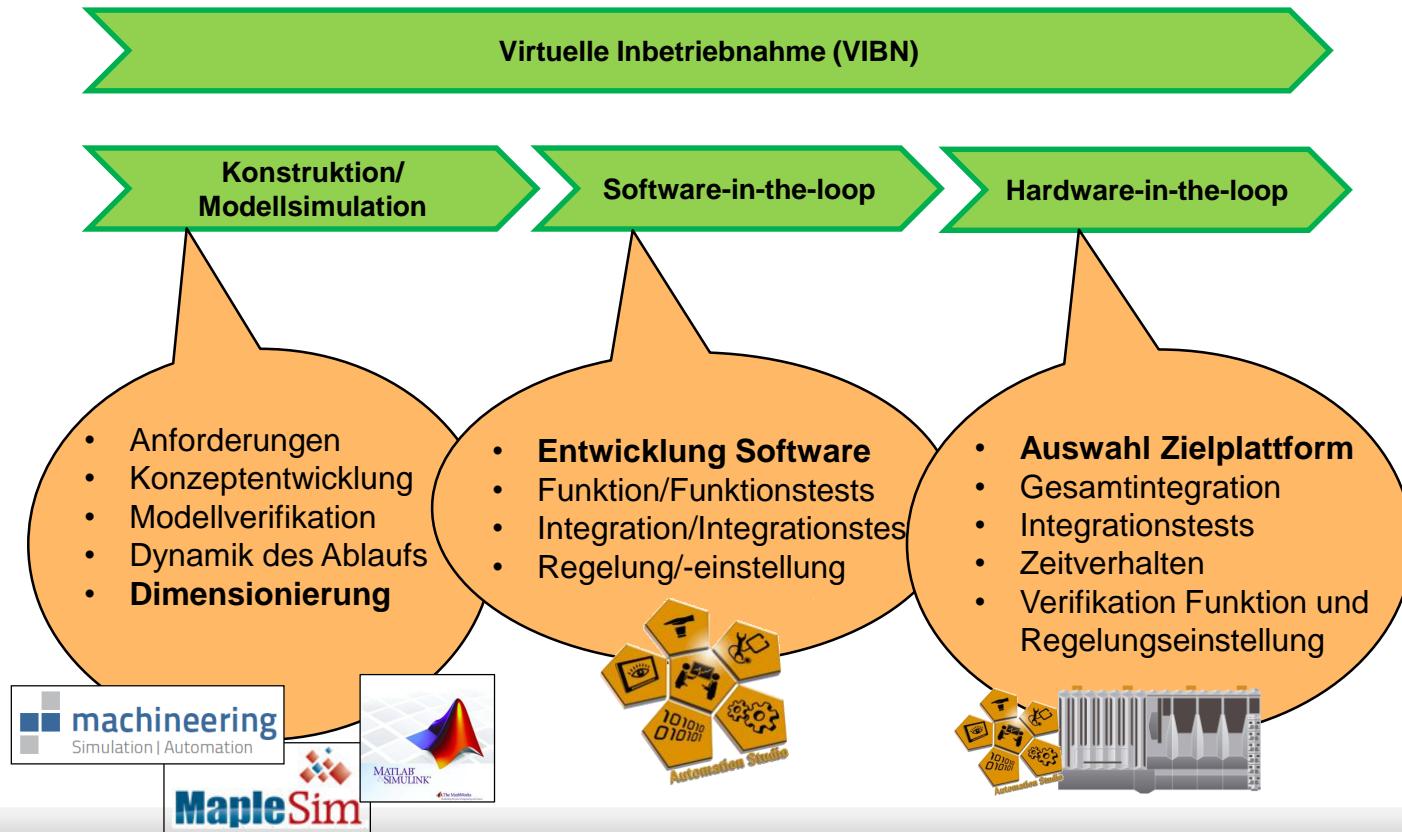


PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP

Phasen

Virtuelle Inbetriebnahme

Wiederverwendung virtueller Maschinen





PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP

Virtuelle Maschinen 1
Konstruktion / Modellsimulation

Konstruktion/Modellsimulation

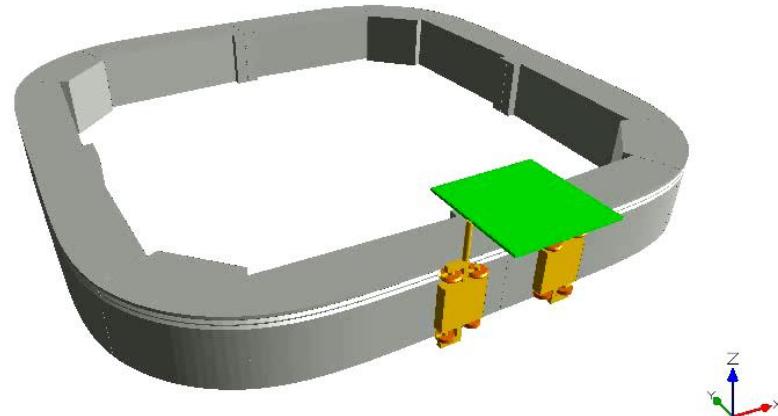


- Import der Geometriedaten aus CAD Konstruktion
- Festlegung des groben Ablaufes
- Abstimmung der Komponenten (Mechanik, Getriebe, Antrieb, Elektrik)
- Festlegung des Regelungszugangs

Anwendungsbeispiele



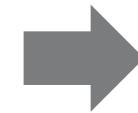
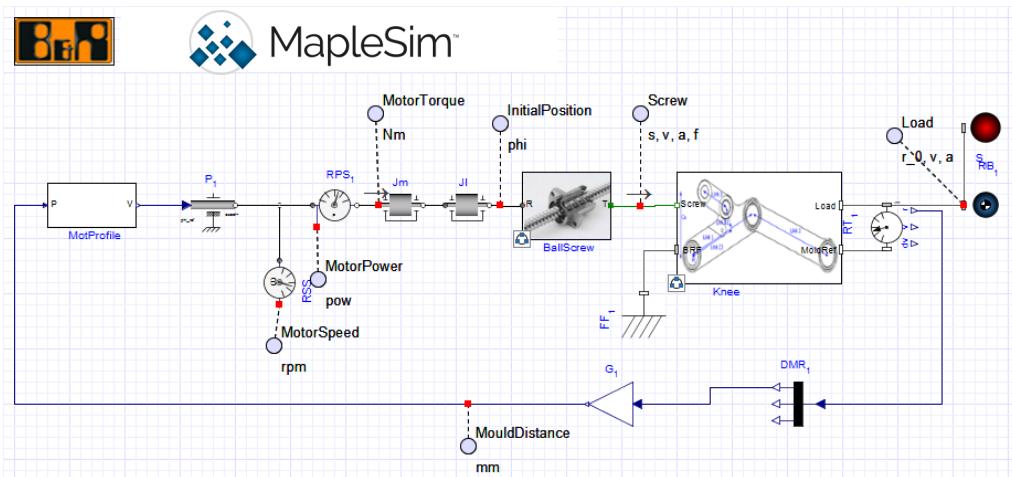
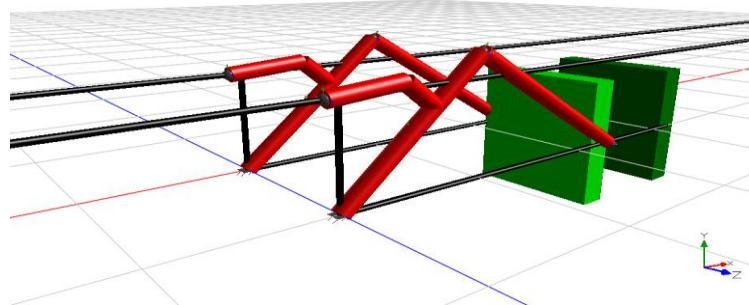
t = 0



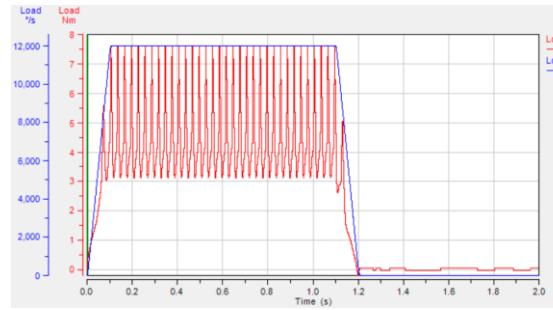
Spritzgießmaschine

Neues Design

Neues elektrisches Antriebskonzept

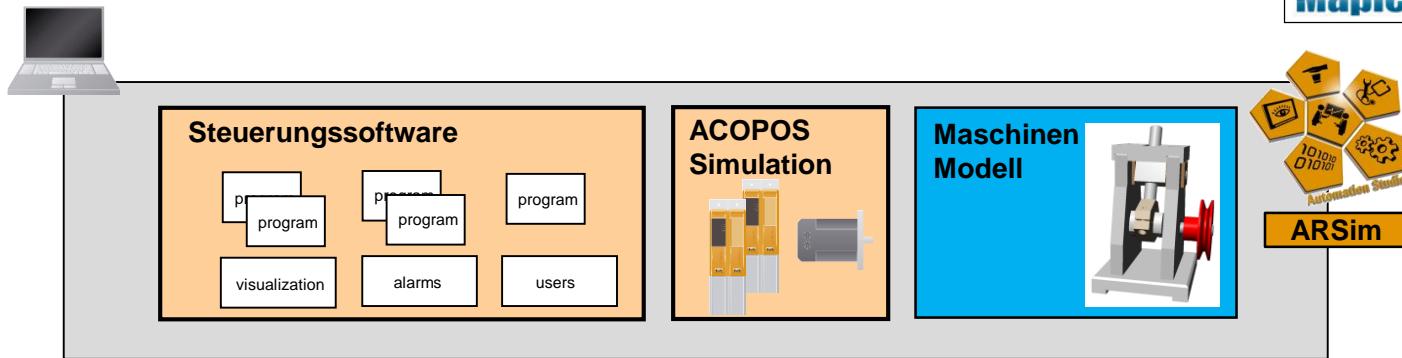


SERVOsoft Drive Sizing



Virtuelle Maschinen 2
Software-in-the-Loop

Software in the Loop Simulation



- Entwicklung der Automatisierungssoftware an der virtuelle Maschine
- Funktionsprüfung, -tests
- Integrationstests
- **Virtuelle Inbetriebnahme**

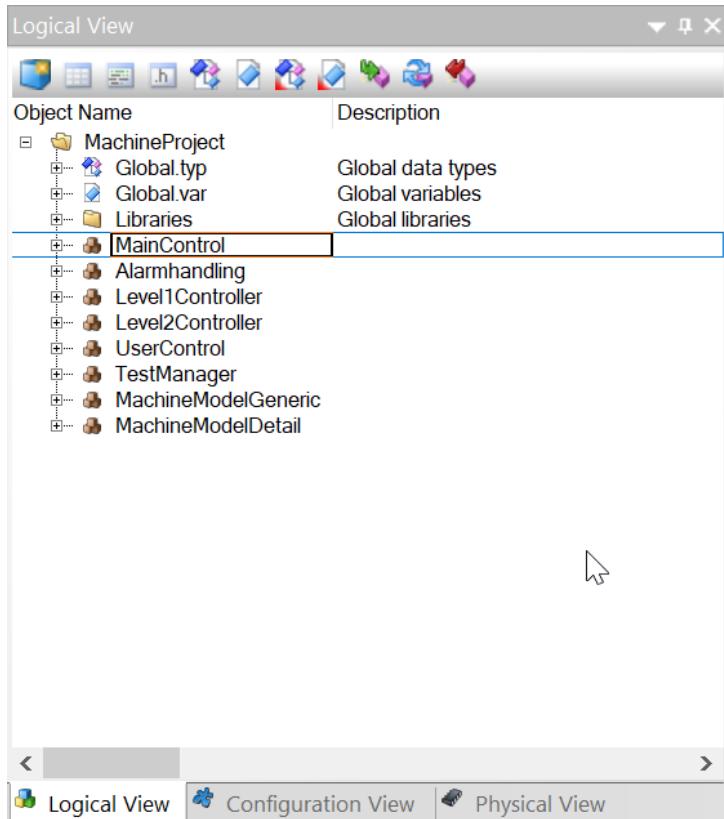
- **Exakte Simulation der ACOPOS Regelkreise**
- Temperaturverhalten des Leistungsteils und des Motors

- Nutzung des Maschinenmodells
- Einfache, einmalige Kopplung
- **Synchronisiert mit Steuerungssoftware**

mapp

Konfiguration in Automation Studio

Logical View

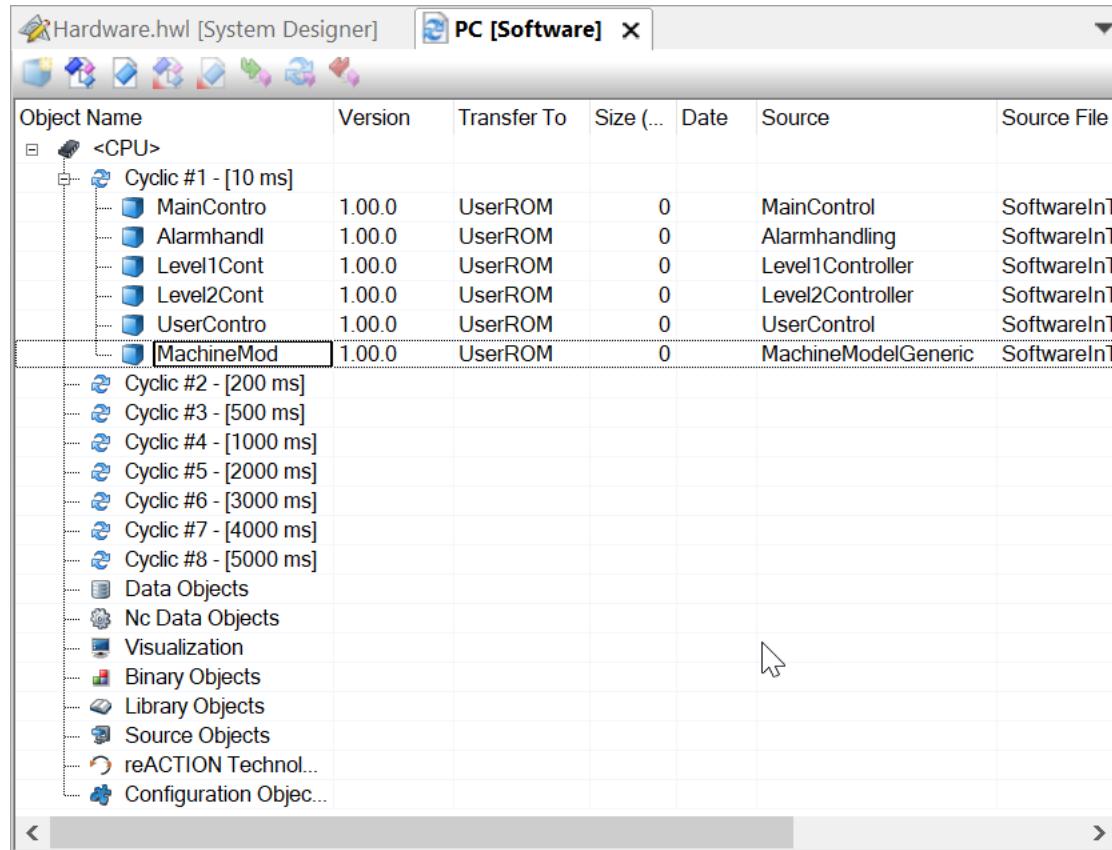


Object Name Description

- MachineProject
 - Global.typ Global data types
 - Global.var Global variables
 - Libraries Global libraries
 - MainControl
- Alarmhandling
- Level1Controller
- Level2Controller
- UserControl
- TestManager
- MachineModelGeneric
- MachineModelDetail

Logical View Configuration View Physical View

Hardware.hwl [System Designer] PC [Software]



Object Name	Version	Transfer To	Size (...	Date	Source	Source File
<CPU>						
Cyclic #1 - [10 ms]						
MainContro	1.00.0	UserROM	0		MainControl	SoftwareInT
Alarmhandl	1.00.0	UserROM	0		Alarmhandling	SoftwareInT
Level1Cont	1.00.0	UserROM	0		Level1Controller	SoftwareInT
Level2Cont	1.00.0	UserROM	0		Level2Controller	SoftwareInT
UserContro	1.00.0	UserROM	0		UserControl	SoftwareInT
MachineMod	1.00.0	UserROM	0		MachineModelGeneric	SoftwareInT
Cyclic #2 - [200 ms]						
Cyclic #3 - [500 ms]						
Cyclic #4 - [1000 ms]						
Cyclic #5 - [2000 ms]						
Cyclic #6 - [3000 ms]						
Cyclic #7 - [4000 ms]						
Cyclic #8 - [5000 ms]						
Data Objects						
No Data Objects						
Visualization						
Binary Objects						
Library Objects						
Source Objects						
reACTION Technol...						
Configuration Objec...						

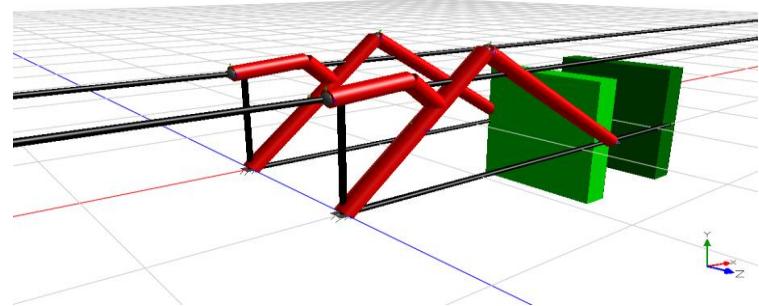
Spritzgießmaschine

Neues Design

Neues elektrisches Antriebskonzept

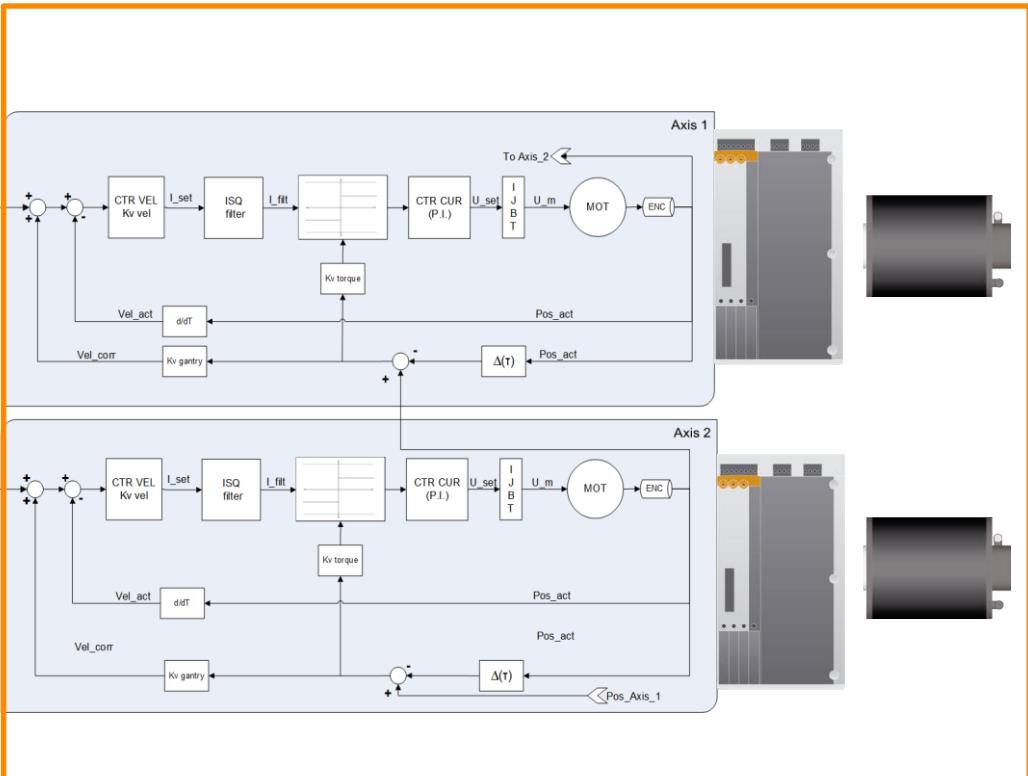
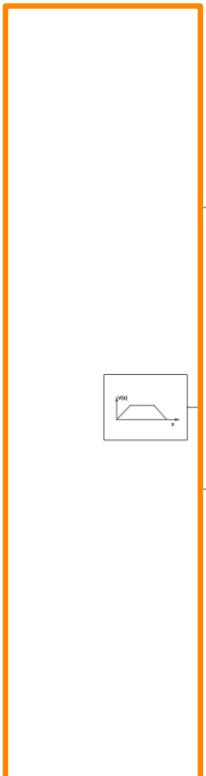
Ziel:

Test des Softwarekonzepts zur Gleichlaufregelung der beiden Achsen



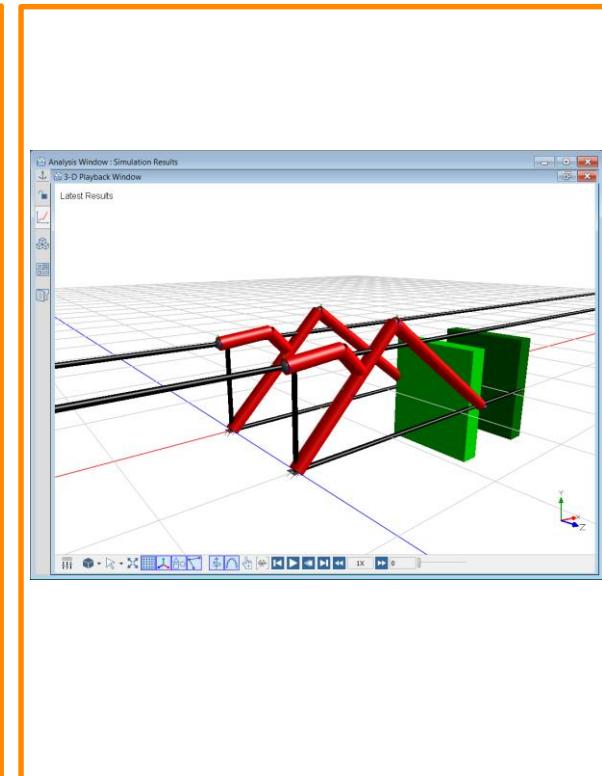
Test des Software Konzepts mittels SiL in Automation Studio

PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP



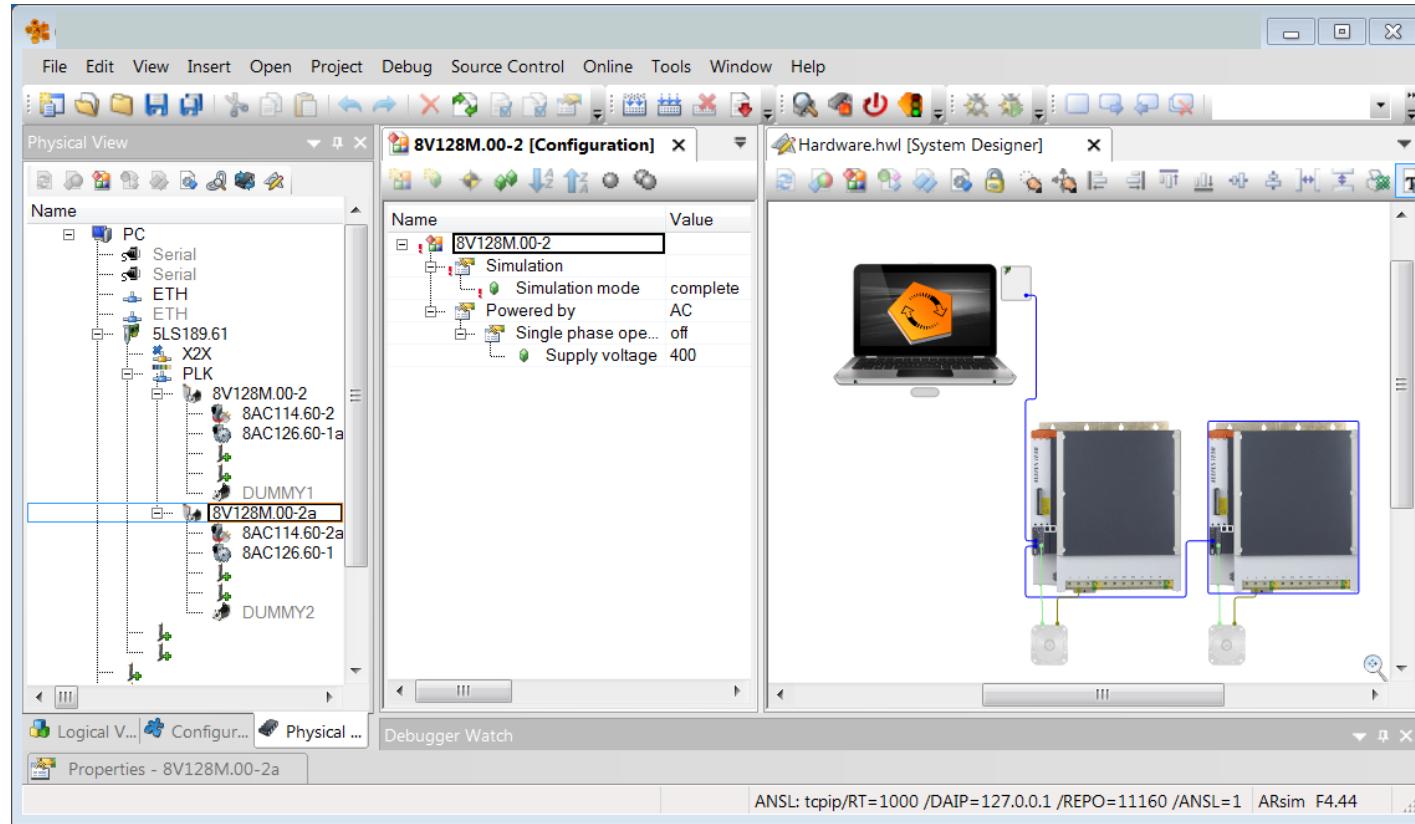
mapp

ACOPOS Simulation

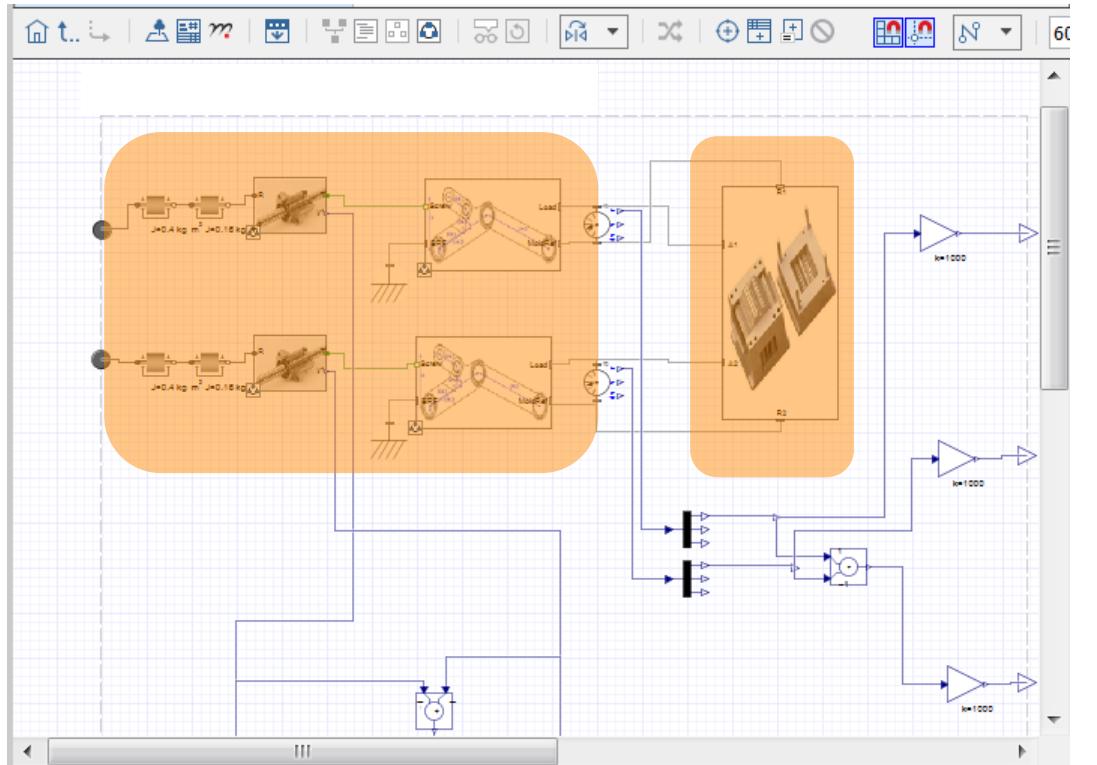


Modell der Schließe (FB)

Automation Studio – Configuration View



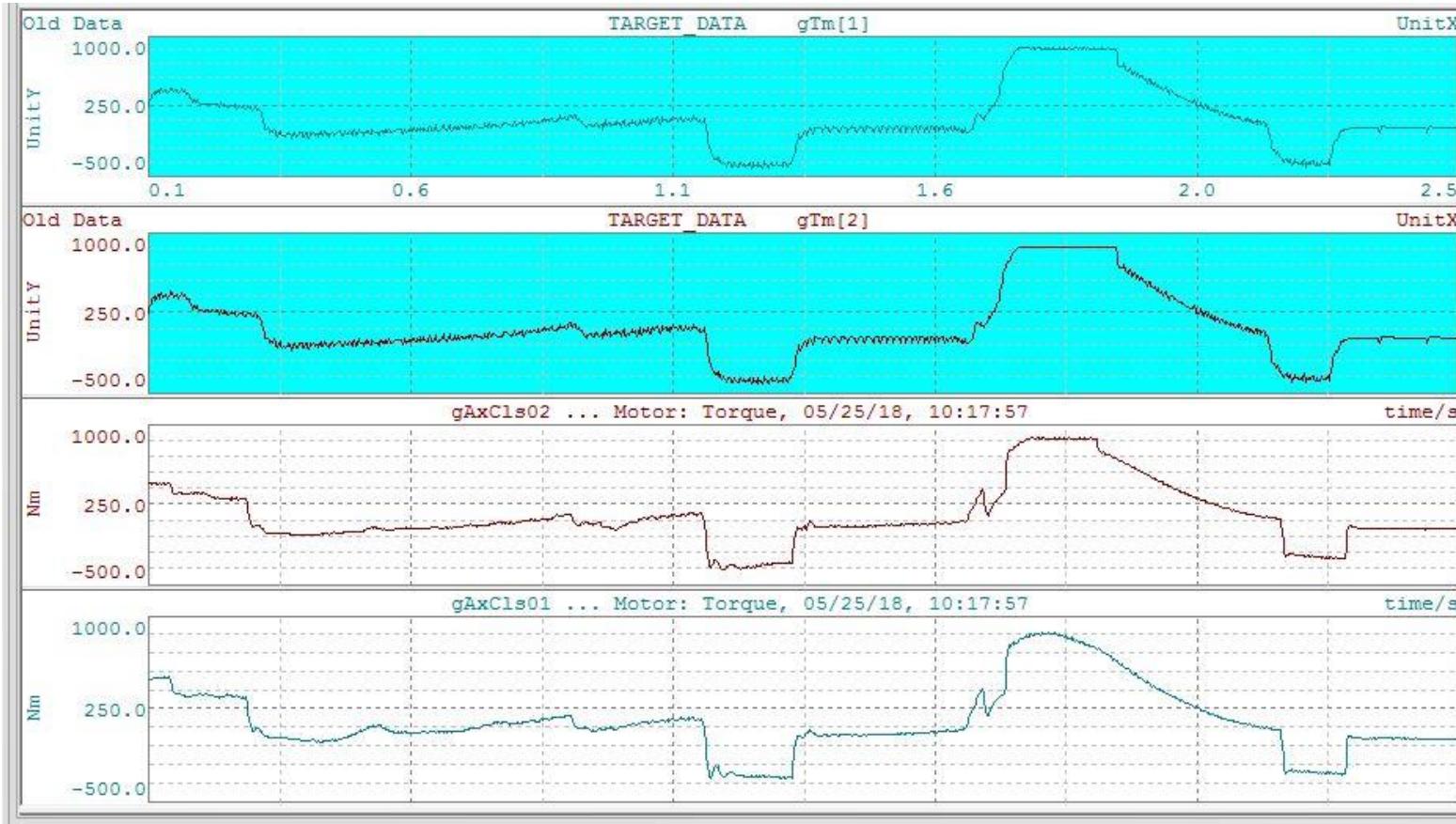
Maschinen Modell für virtuelle Inbetriebnahme



fb_MoldCG

MoldCG	1
Enable	out_Theta1
in_Torque_1	out_Theta2
in_Torque_2	out_X1
Screw_friction_1	out_X2
Screw_friction_2	out_Xdiff
Gantry_stiffness	out_Y1pos
	out_Y2pos
	out_Ydiff

Verifikation des Maschinenmodells beim Schließvorgang



Modell

Messung

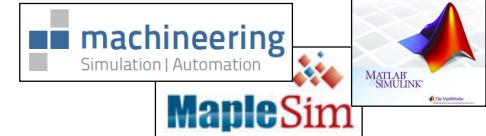
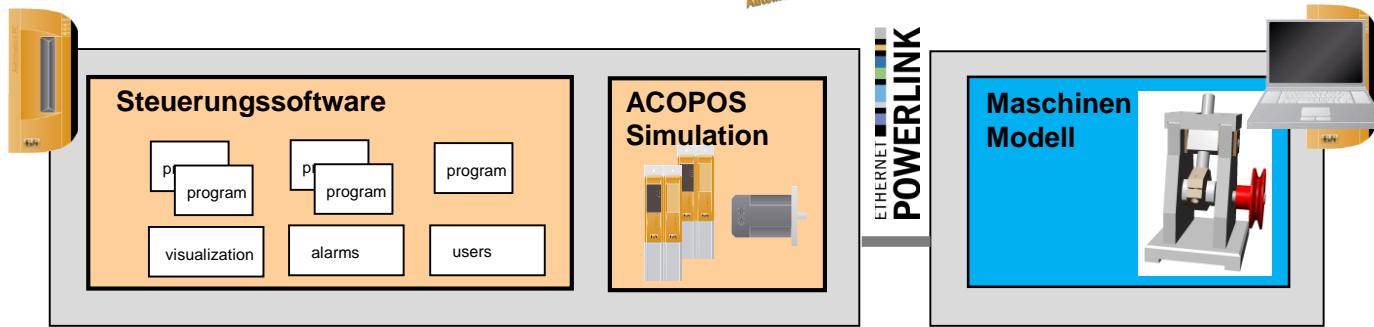


PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP

Virtuelle Maschinen 3

Hardware-in-the-Loop

Hardware in the Loop Simulation



- **Auswahl der Zielhardware**
- Test der Automatisierungssoftware
- Verifikation Integrationstests
- Verifikation Inbetriebnahme

- **Einfache Simulation des ACOPOS**
- Kopplung des Maschinenmodells via

ETHERNET
POWERLINK

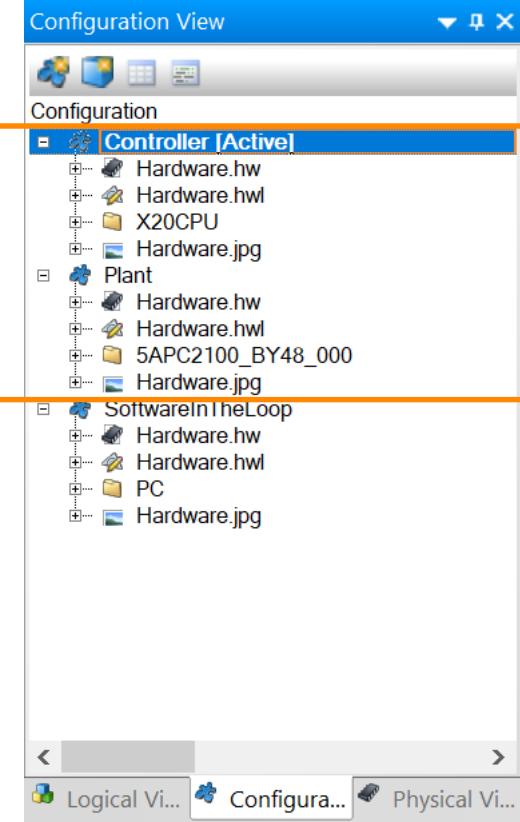
OPC UA

TCP/IP, UDP, ...

- Nutzung des Maschinenmodells
- Grobe zeitliche Synchronisierung

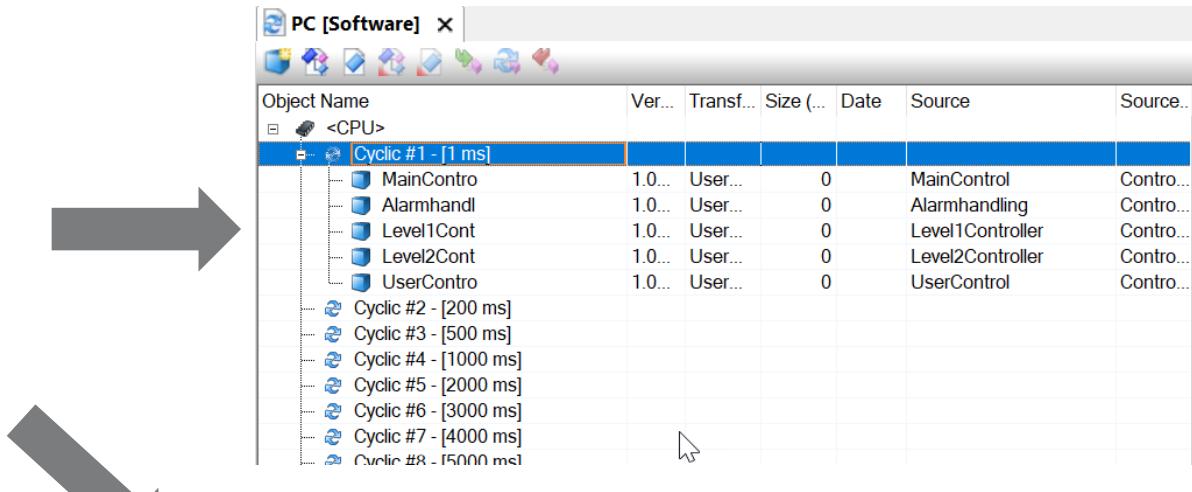
Konfiguration für Hardware-in-the-loop

Configuration View

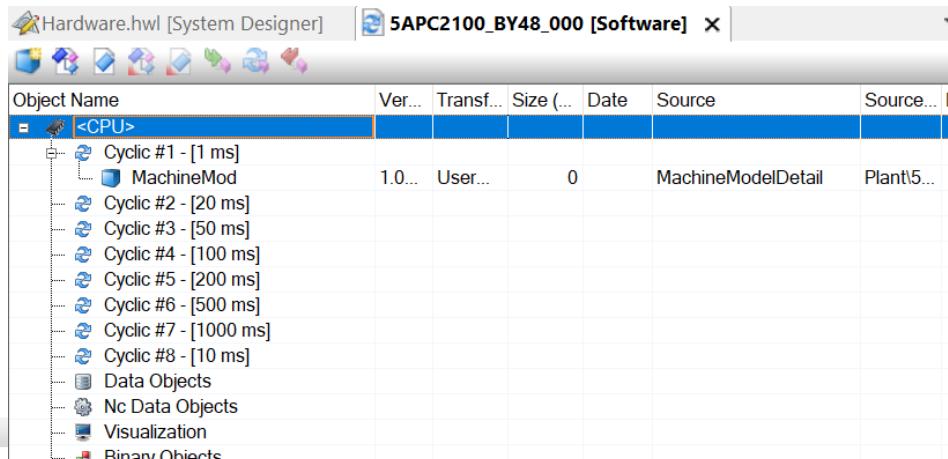


- Controller [Active]
 - Hardware.hw
 - Hardware.hwl
 - X20CPU
 - Hardware.jpg
- Plant
 - Hardware.hw
 - Hardware.hwl
 - 5APC2100_BY48_000
 - Hardware.jpg
- SoftwareInTheLoop
 - Hardware.hw
 - Hardware.hwl
 - PC
 - Hardware.jpg

Logical Vi... Configuration... Physical Vi...

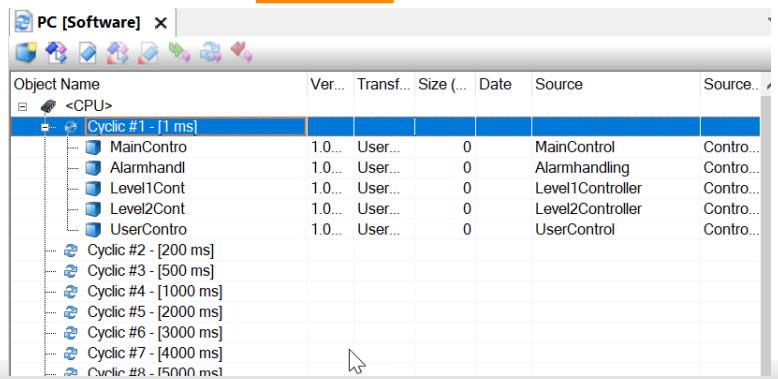
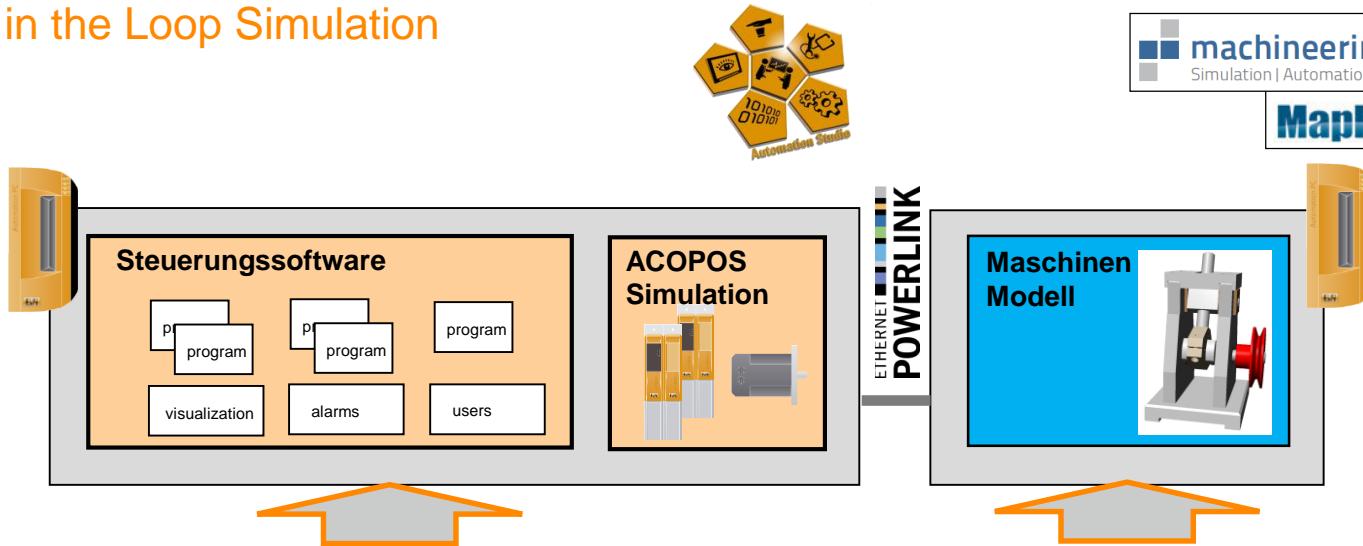


Object Name	Ver...	Transf...	Size (...)	Date	Source	Source...
<CPU>						
Cyclic #1 - [1 ms]	1.0...	User...	0		MainControl	Contro...
MainContro	1.0...	User...	0		Alarmhandl	Contro...
Alarmhandl	1.0...	User...	0		Level1Cont	Contro...
Level1Cont	1.0...	User...	0		Level2Cont	Contro...
Level2Cont	1.0...	User...	0		UserContro	Contro...
UserContro	1.0...	User...	0			
Cyclic #2 - [200 ms]						
Cyclic #3 - [500 ms]						
Cyclic #4 - [1000 ms]						
Cyclic #5 - [2000 ms]						
Cyclic #6 - [3000 ms]						
Cyclic #7 - [4000 ms]						
Cyclic #8 - [5000 ms]						



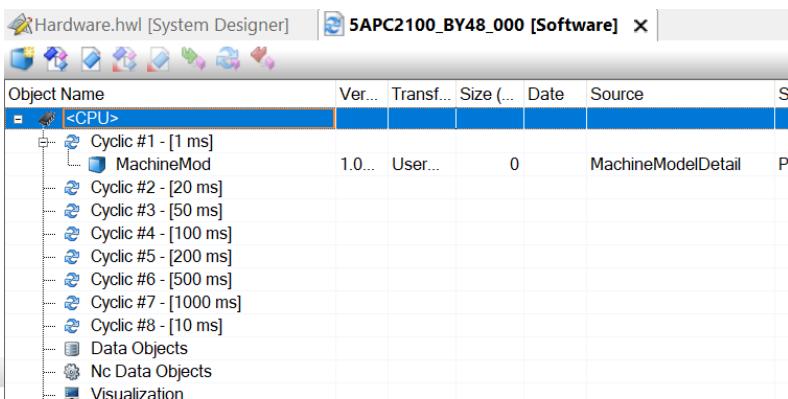
Object Name	Ver...	Transf...	Size (...)	Date	Source	Source...
<CPU>						
Cyclic #1 - [1 ms]	1.0...	User...	0		MachineMod	MachineModelDetail
MachineMod	1.0...	User...	0			Plant5...
Cyclic #2 - [20 ms]						
Cyclic #3 - [50 ms]						
Cyclic #4 - [100 ms]						
Cyclic #5 - [200 ms]						
Cyclic #6 - [500 ms]						
Cyclic #7 - [1000 ms]						
Cyclic #8 - [10 ms]						
Data Objects						
Nc Data Objects						
Visualization						
Binary Objects						

Hardware in the Loop Simulation



PC [Software] X

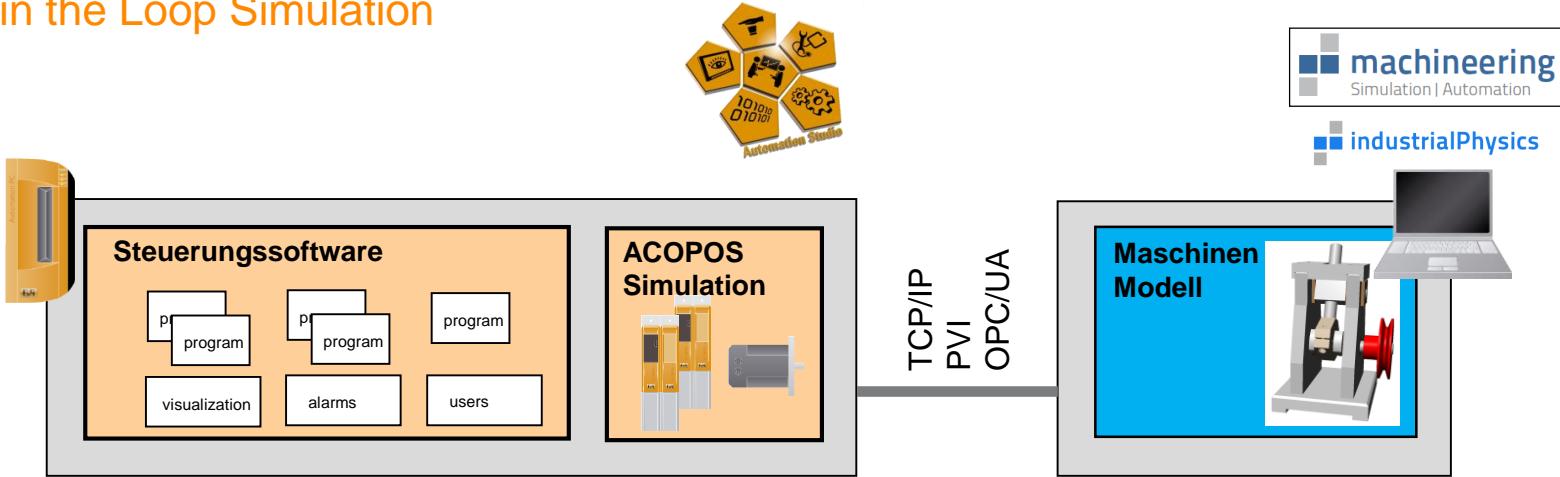
Object Name	Ver...	Transf...	Size (...)	Date	Source	Source...
<CPU>						
Cyclic #1 - [1 ms]						
MainContro	1.0...	User...	0		MainControl	Contro...
Alarmhandl	1.0...	User...	0		Alarmhandling	Contro...
Level1Cont	1.0...	User...	0		Level1Controller	Contro...
Level2Cont	1.0...	User...	0		Level2Controller	Contro...
UserContro	1.0...	User...	0		UserControl	Contro...
Cyclic #2 - [200 ms]						
Cyclic #3 - [500 ms]						
Cyclic #4 - [1000 ms]						
Cyclic #5 - [2000 ms]						
Cyclic #6 - [3000 ms]						
Cyclic #7 - [4000 ms]						
Cyclic #8 - [5000 ms]						



Hardware.hwl [System Designer] | **5APC2100_BY48_000 [Software] X**

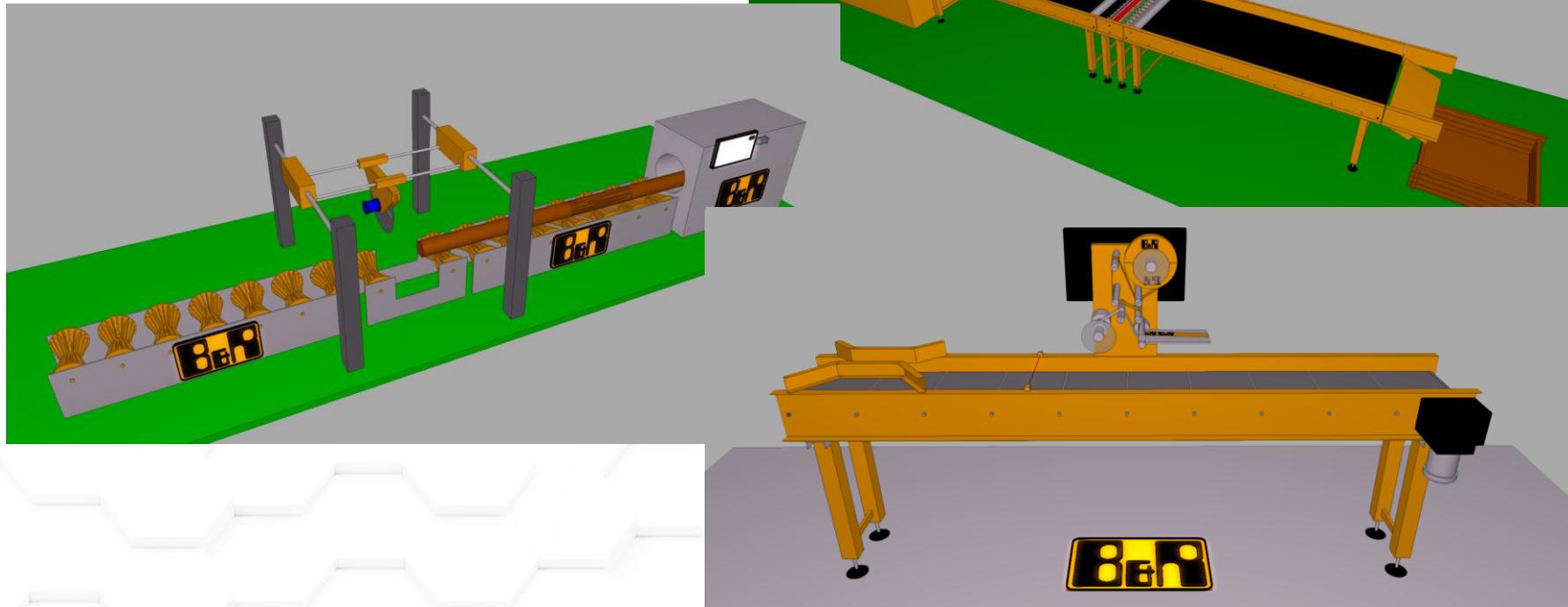
Object Name	Ver...	Transf...	Size (...)	Date	Source	Source...
<CPU>						
Cyclic #1 - [1 ms]						
MachineMod	1.0...	User...	0		MachineModelDetail	P...
Cyclic #2 - [20 ms]						
Cyclic #3 - [50 ms]						
Cyclic #4 - [100 ms]						
Cyclic #5 - [200 ms]						
Cyclic #6 - [500 ms]						
Cyclic #7 - [1000 ms]						
Cyclic #8 - [10 ms]						
Data Objects						
Nc Data Objects						
Visualization						

Hardware in the Loop Simulation



Virtuelle Inbetriebnahme im B&R E-Camp Training

PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP

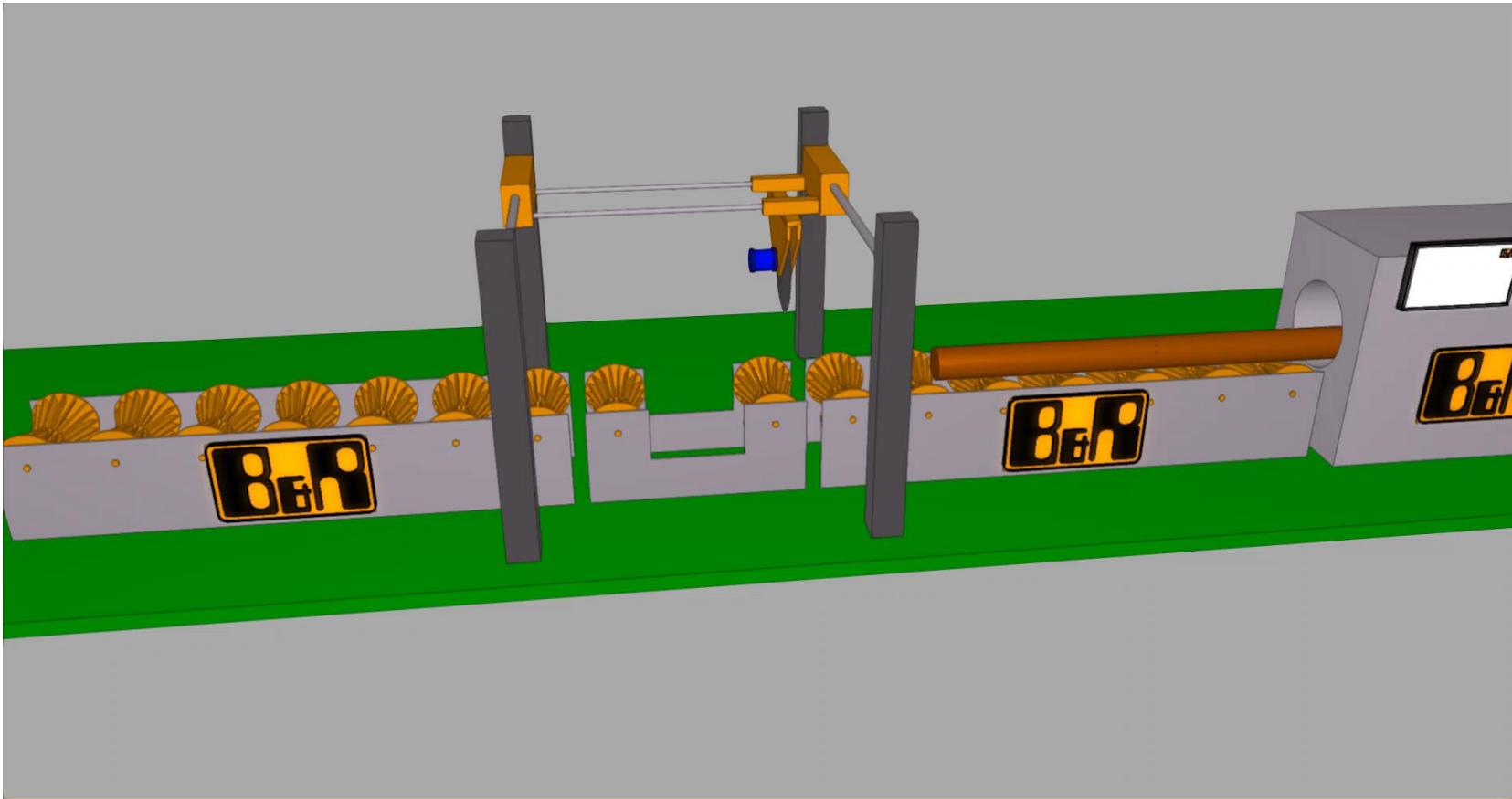


B&R E-Camp: Flying Saw - Automatisierungslösung

PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP



Video



B&R DeltaPicker

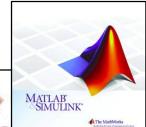
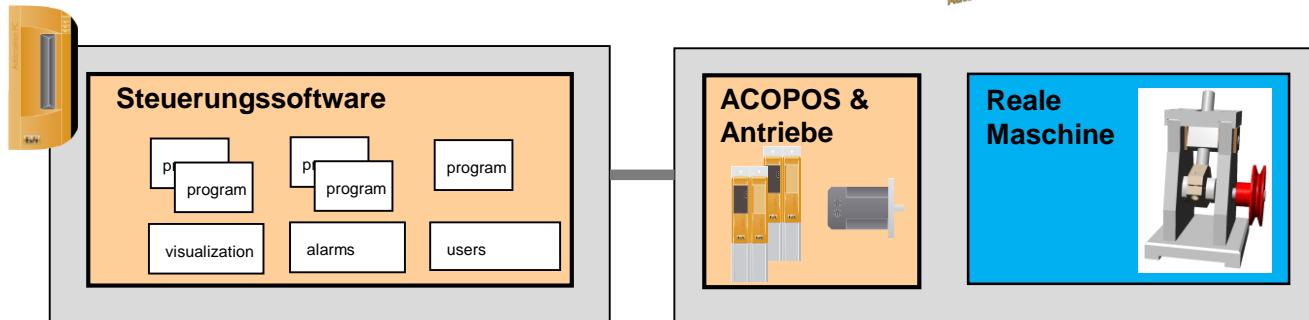
Darstellung in Form von
Augmented Reality:



Delta-Roboter

Augmented Reality – Microsoft Hololens Ansicht

Reale Maschine/Anlage

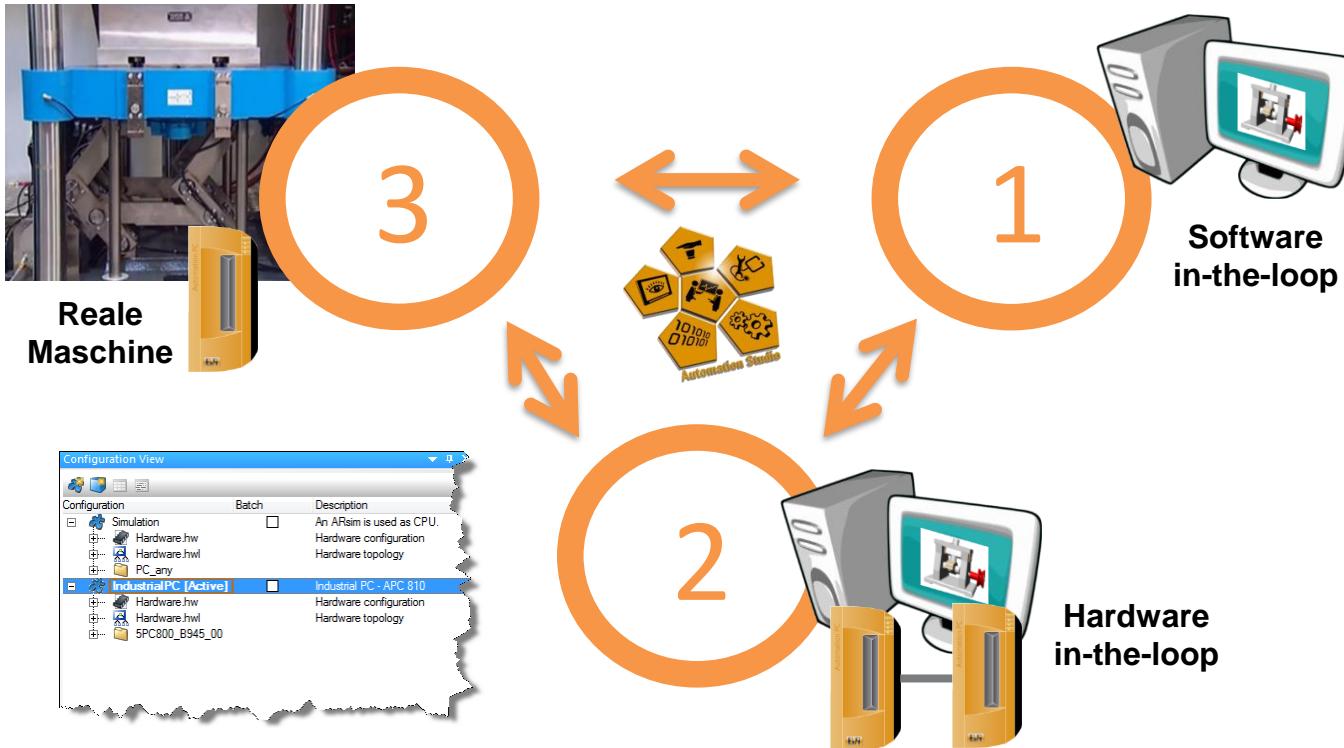


- Reale Inbetriebnahme

- Realer ACOPOS
- Reale Antriebe
- **Identische Regler Struktur**

- Nutzung des Modells auch im Regler (z.B. als Beobachter)

→ Einfacher Wechsel zwischen Konfigurationen



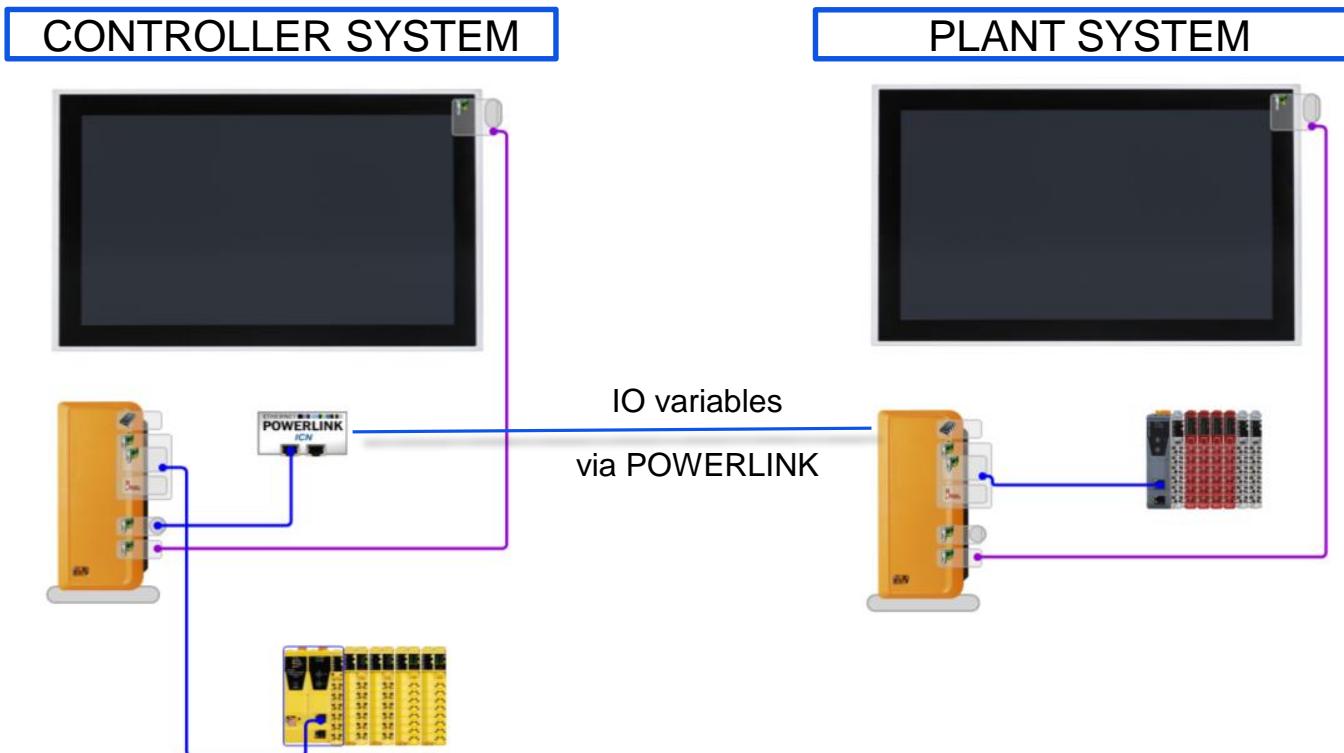


PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP

Simulation topologies
**Hardware-in-the-loop Simulation
mit Safety**

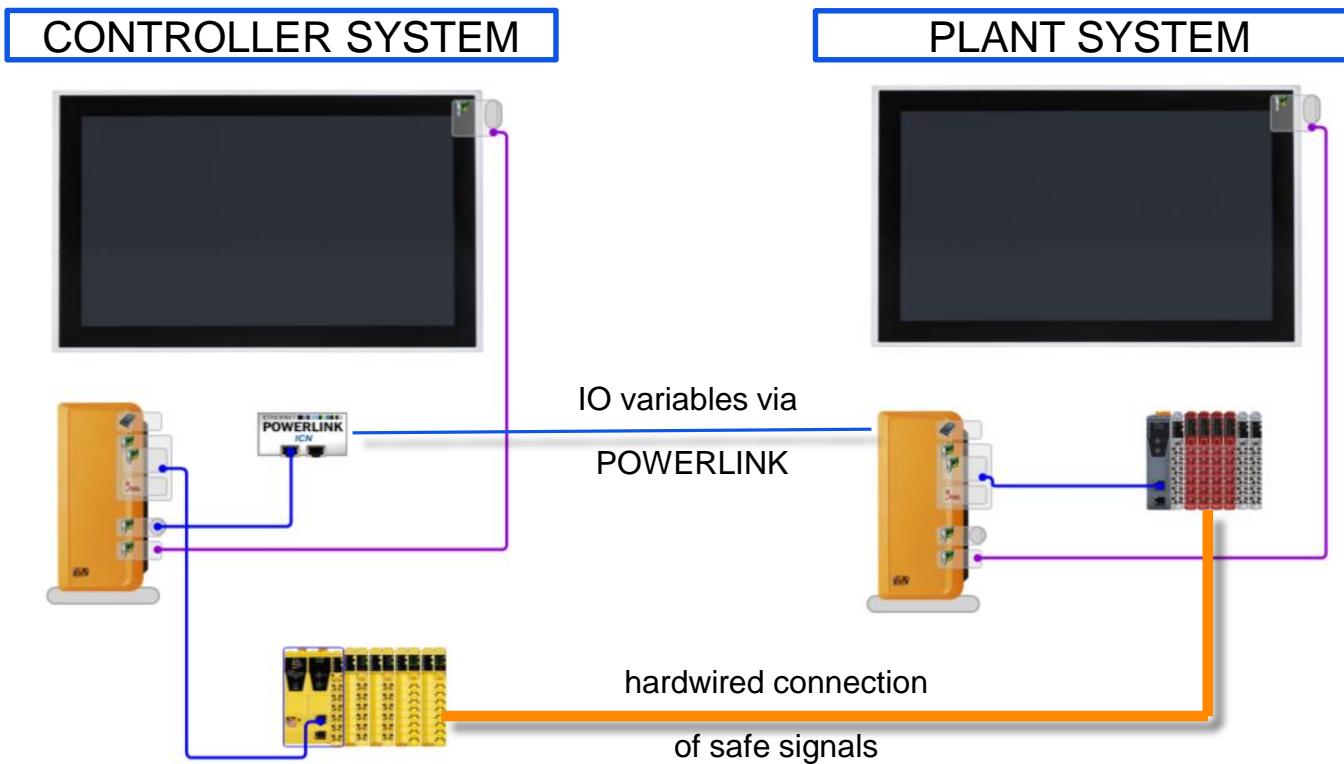
Hardware in the Loop Simulation (HiL)

System overview



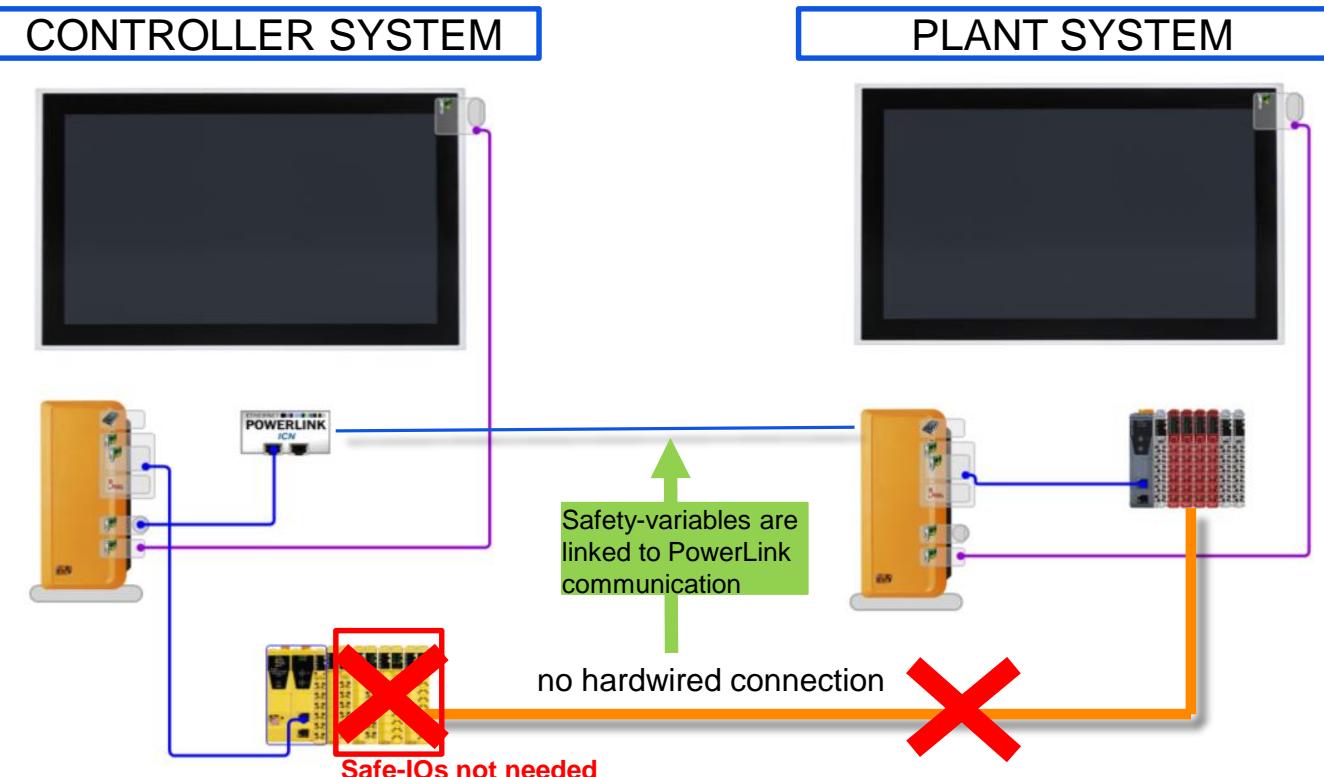
System with HiL, *no simulation of safety*

System overview



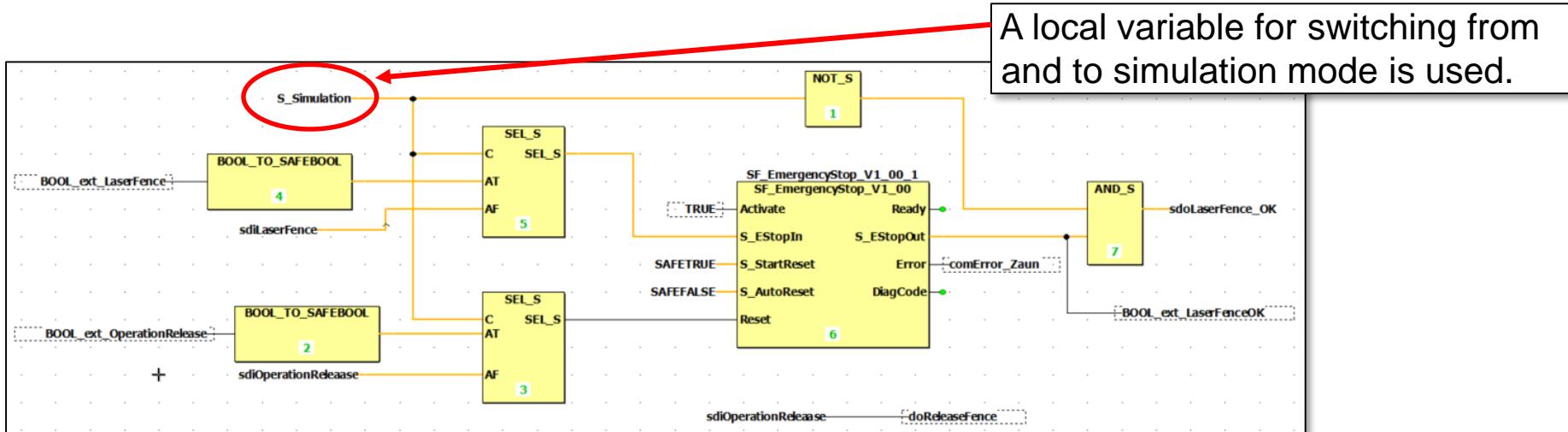
System with HiL, **simulation** of safety

System overview



System with HiL, **simulation** of safety

HiL_Controller_SIMULATION - SafeDesigner



ToCPU_BOOL			
•	BOOL001	comError_Zaun	BOOL
•	BOOL002	BOOL_ext_LaserFenceOK	BOOL
•	BOOL003		BOOL
•	BOOL004		BOOL
•	BOOL005		BOOL
•	BOOL006		BOOL
•	BOOL007		BOOL
•	BOOL008		BOOL
FromCPU_BOOL			
•	BOOL101	comReset	BOOL
•	BOOL102		BOOL
•	BOOL103	BOOL_ext_LaserFence	BOOL
•	BOOL104	BOOL_ext_OperationRelease	BOOL

	Name	Data type	Description	Terminal	Init
1	NewGroup				
2	comError_Zaun	BOOL		SL1.SM1 BOOL001	
3	comReset	BOOL		SL1.SM1 BOOL101	
4	sdiLaserFence	SAFEBOOL		SL1.SM2 SafeDigitalInput01	
5	sdoLaserFence_OK	SAFEBOOL		SL1.SM4 SafeDigitalOutput01	
6	doReleaseFence	BOOL		SL1.SM4 ReleaseOutput01	
7	BOOL_ext_LaserFence	BOOL		SL1.SM1 BOOL103	
8	BOOL_ext_OperationRelease	BOOL		SL1.SM1 BOOL104	
9	BOOL_ext_LaserFenceOK	BOOL		SL1.SM1 BOOL002	
10	sdiOperationRelease	SAFEBOOL		SL1.SM2 SafeDigitalInput02	

Modeling & Simulation Trainings



- SEM 293 - AS Target for Simulink (1 day)**
- SEM 292 - MapleSim (1 day)**
- SEM 294 - industrial Physics (1 day)**

Organisation: Automation Academy
Dates: B&R homepage & on-demand

Modeling & Simulation Services & Workshops

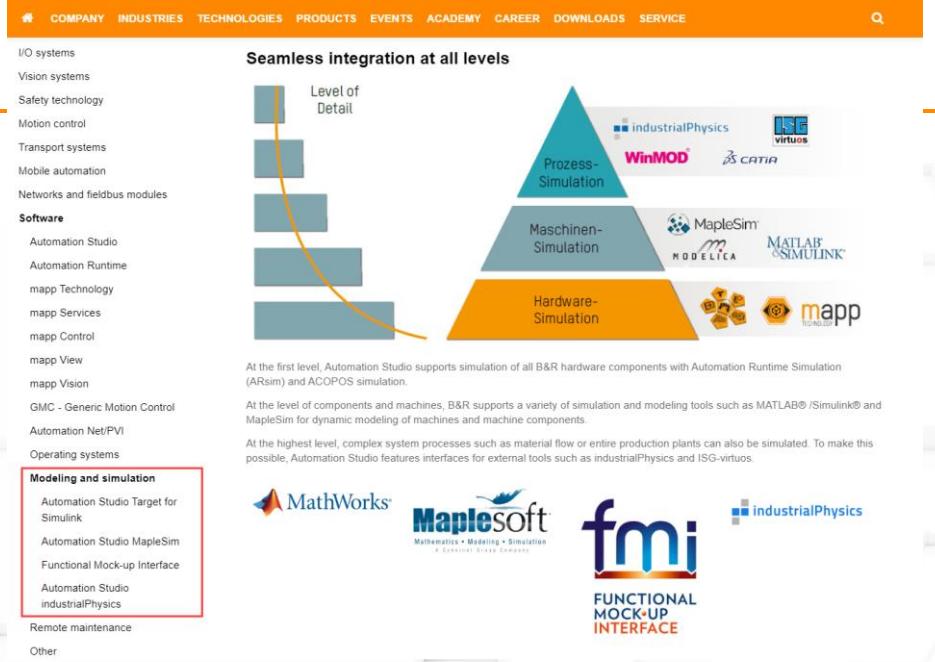


- SEM 298 - Model Requirements (1 day)**
- SEM 299 - Model & Simulation setup (x days)**
- SEM 290 - Model training (1 day)**

**Bitte kontaktieren Sie Ihren B&R
Ansprechpartner!**

Weitere Online-Informationen

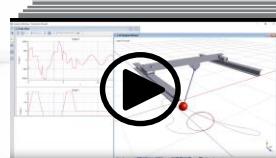
- **B&R Homepage – Software**



<https://www.youtube.com/user/BerneckerRainer/playlists>



► [Simulation with B&R](#)



► [Modeling and Simulation Tutorials](#)

Simulationskonzepte für die Maschinenautomatisierung – IWOS 2020 Session

Folgende Themen haben wir heute behandelt:

1. **Überblick** über Simulationslösungen für B&R Kunden
2. **Projektphasen** und Ziele für die Simulation
3. **Simulationskonzepte** und deren Umsetzung
4. **Anwendungsbeispiele** zu den Konzepten
5. **Zusammenfassungen** der gezeigten Information



Q&A – Session

???

Für weitere Fragen oder Informationen erreichen Sie uns unter:

events.de@br-automation.com



Online-Workshop:
Virtuelle Inbetriebnahme mit Automation Studio und MapleSim

Produktneuheiten

10.11.2020 – 09:00 Uhr