



Herzlich Willkommen!

Der Workshop beginnt um 09:00 Uhr



Online-Workshop: Simulation - Digital Twin

Design, Dimensionierung
& virtuelle Inbetriebnahme
mit Automation Studio und MapleSim

Vorstellung

PERFECTION IN AUTOMATION
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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



Maplesoft
Mathematics • Modeling • Simulation
A Cybernet Group Company

Nicolas Cottureau
Territory Manager

Maplesoft
Phone: +33 1 84 73 00 13
Email: ncottureau@maplesoft.com
www.maplesoft.com



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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

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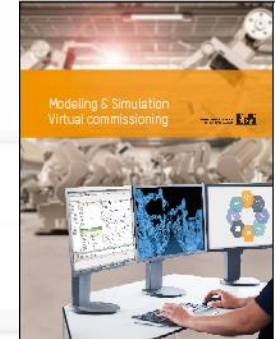


Simulation & Digital Twin – Design, Dimensionierung & virtuelle Inbetriebnahme mit Automation Studio und MapleSim - B&R IWOS 2020

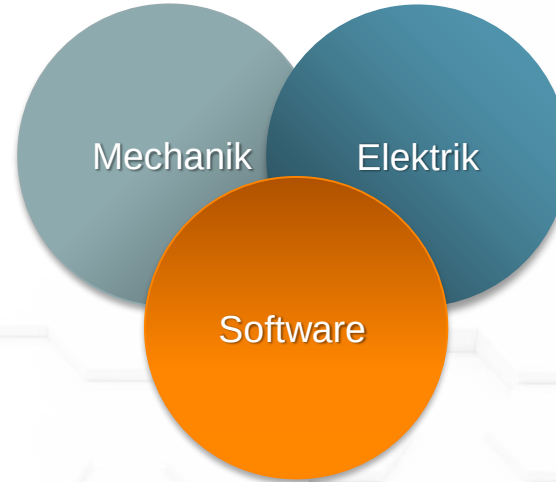
Simulation & Digital Twin – IWOS 2020 Session

Innerhalb dieser Session wollen wir folgende Themen besprechen:

1. **Überblick** zum Bereich **Simulation bei B&R**
2. **Workflow** zu MapleSim
3. **Anwendungsbeispiele**
4. **Kundenanwendung**
5. **Wo** gibt es weiterführende **Informationen?**
6. **Zusammenfassung**



Herausforderungen in der Softwareentwicklung



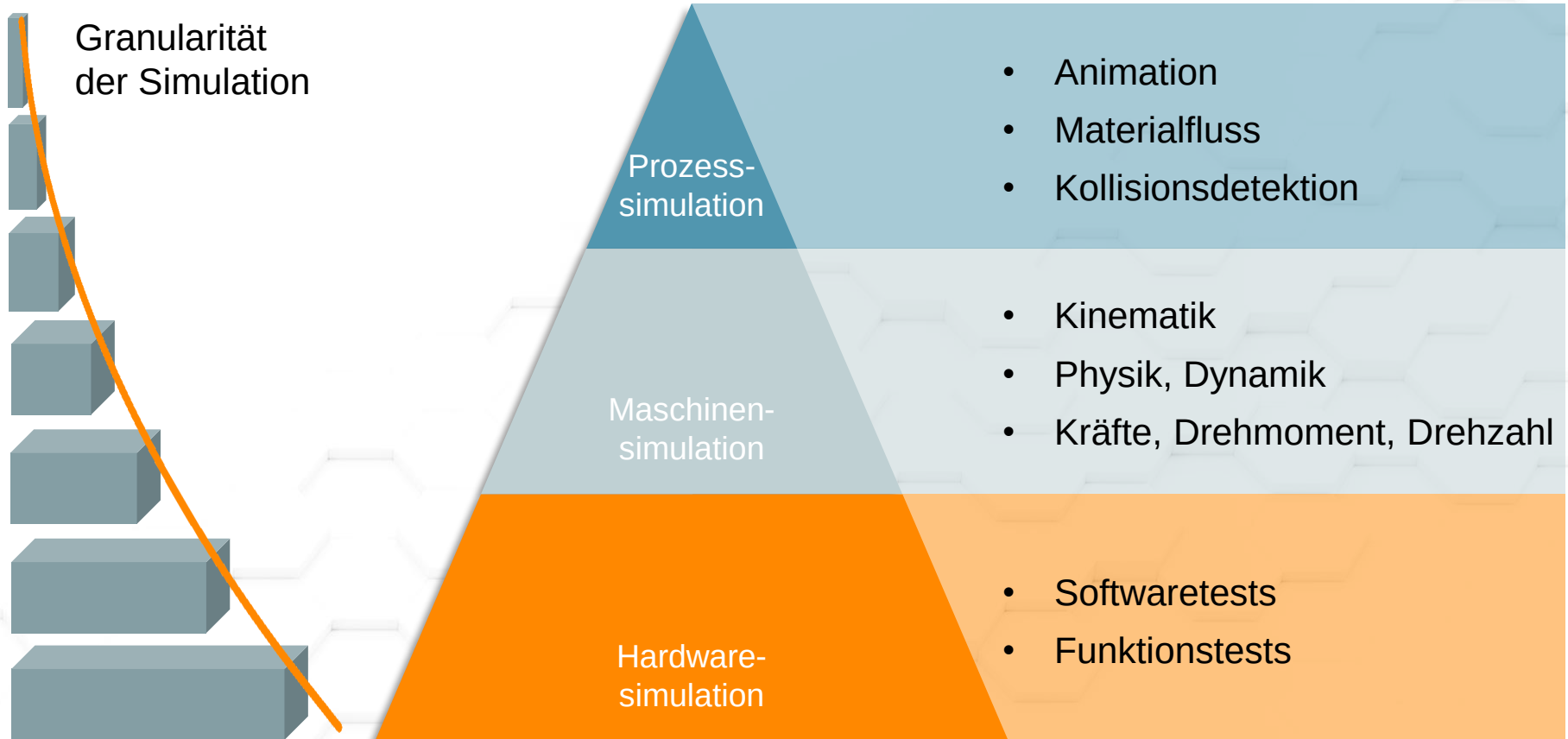
W  at

Prozess Know-how in Software
Anspruchsvolle Visualisierungen
Komplexe Aktoren und Sensoren
IT und Daten Management
Maschinenvariationen
Sicherheit
Motion

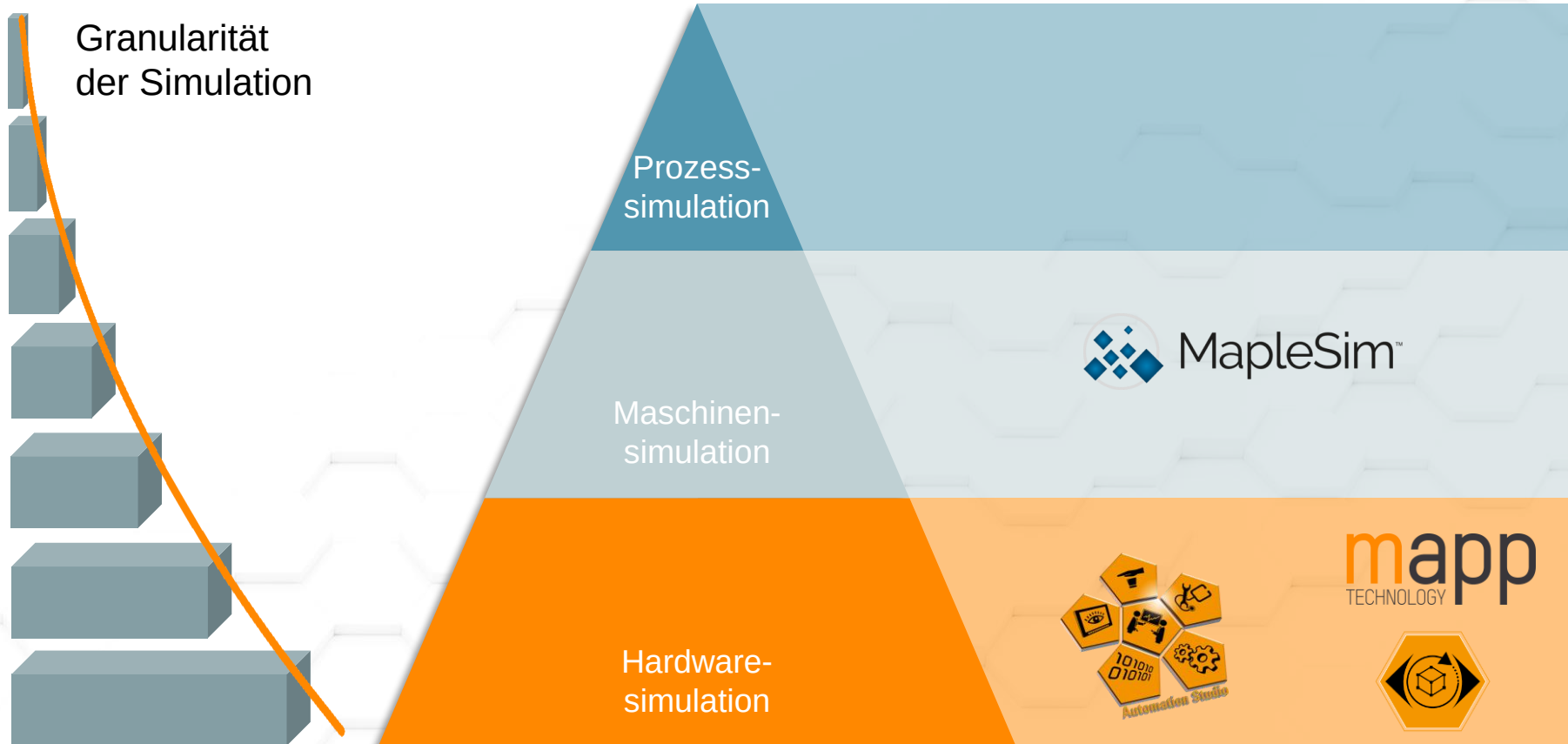
Warum arbeiten Maschinenentwickler mit digitalen Zwillingen?

- Minimierung von Projekt Risiken
 - ✓ Proof-of-Concept kann schnell gemacht werden (sichert Projektplan ab)
- Vereinfachen der Entwicklung und Inbetriebnahme
 - ✓ Sofort gesamtes Design im Blickfeld
 - ✓ Leichte und schnelle Anpassung bei Änderungen
 - ✓ Test/Inbetriebnahme in geschützter Umgebung – **Keine Gefahr von Maschinenschaden!**
 - ✓ Optimierte Reglereinstellungen, Timing, Wartezeiten, etc.
 - ✓ **Viel schnellere Inbetriebnahme der realen Maschine**
- Schnelleres und planbareres Time-to-Market
- Vereinfachung der Wartung





Herausforderungen in der Software Entwicklung





More than 30 years of Engineering Computation

- 1980: Research project at University of Waterloo, Ontario
- Company founded in 1988
- Leading provider of high-performance solutions for engineering, science and mathematics

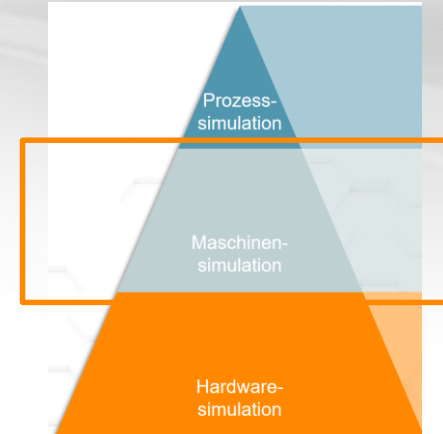
Global Presence

- Part of the Cybernet Group (since 2009)
- Offices in Canada, US, Germany, France, UK, Japan and China
- >30 partners worldwide
- Strong partnership and solution connection with B&R

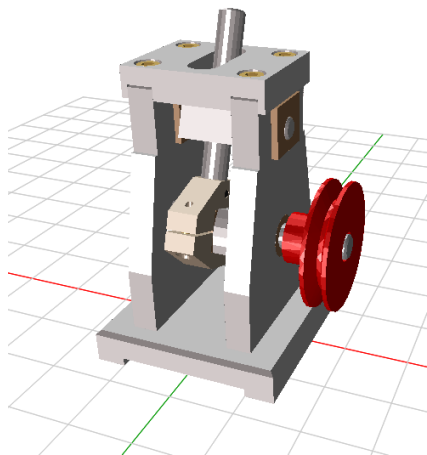


Schnittstelle MapleSim – Automation Studio

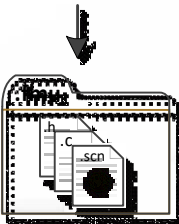
MapleSim Connector for Automation Studio



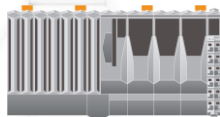
Workflow



MapleSim™

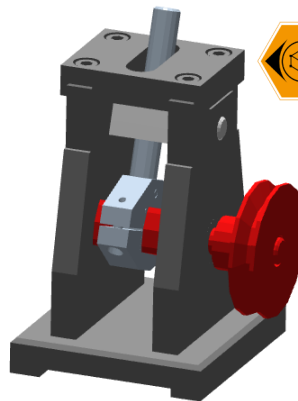


B&R Automation Studio®



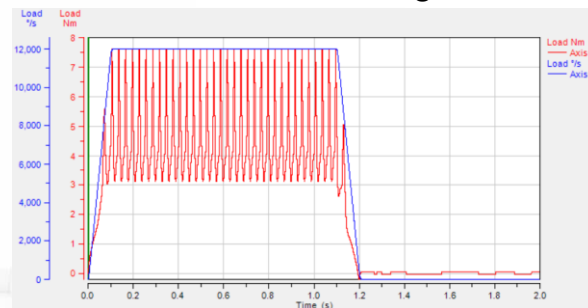
Solve model in real time

$$\dot{x} = f(x, u)$$



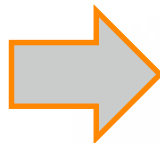
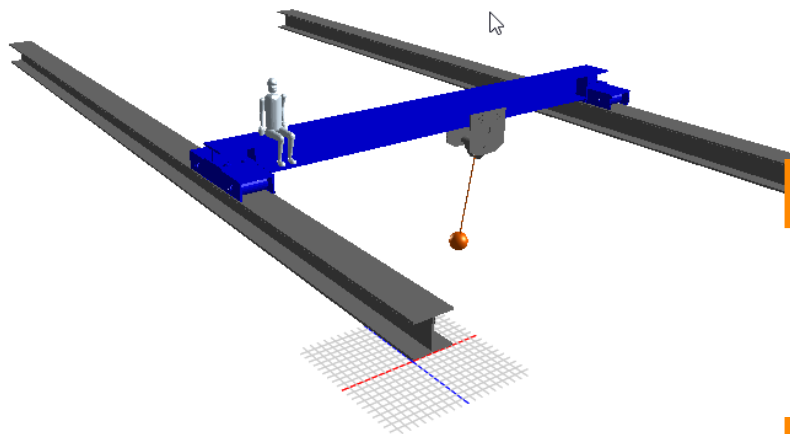
Scene Viewer
Visualization

SERVOsoft Drive Sizing

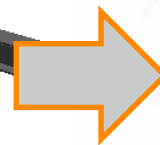




Beispiel Hallenkran

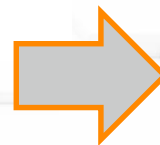


Mechanisches Design
und Antriebskonzept



Dimensionierung
der Antriebe
(ACOPOS, Motoren)

**B&R ServoSoft
Generation
Toolbox**



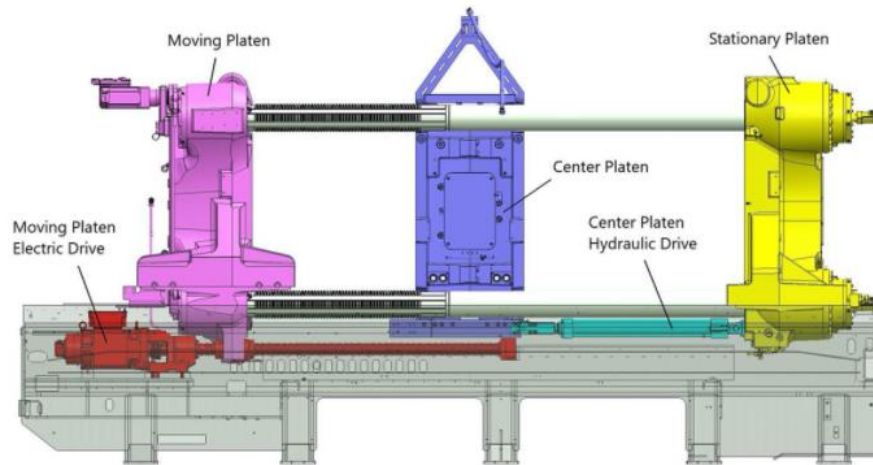
Aufbau und Verifikation
des Software- und
Regelungskonzepts

**B&R FMU
Generation
Toolbox**



Context

- Niigon Machines Ltd
- Provides modern injection moulding machines
- User of B&R solutions
- New machine running 2 injection units with both hydraulic and electric actuation





Challenge

- Once new machine delivered, end customer required a faster throughput
- But machine speed is limited by unwanted oscillations
 - ➔ necessary to run machine slower than customer's specification
- Classical solution would require replacement of hydraulic by electric components
 - ➔ cost of hardware, hundreds of engineering hours, long machine downtime



Solution

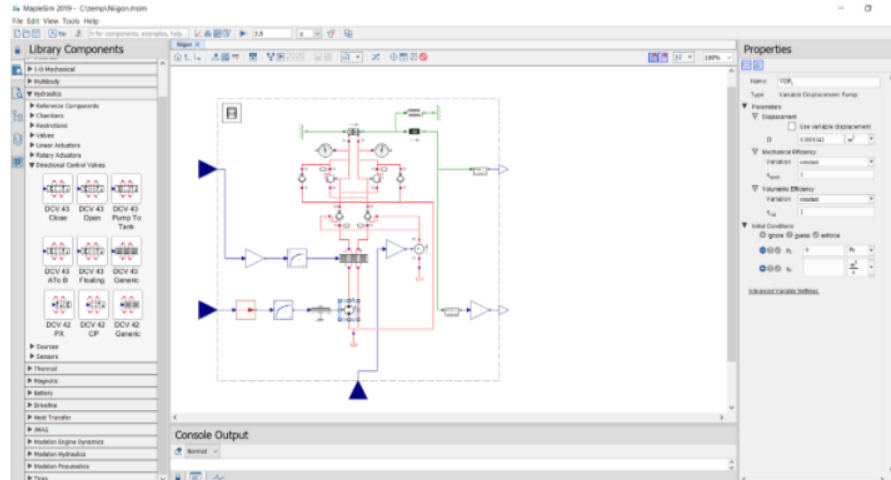
- Target? Minimize the unwanted oscillations with no new hardware, and significantly minimize downtime

- How ? Control strategy optimization via Simulation and Virtual Commissioning
 - Niigon Partnered with Maplesoft to develop simulation-based upgrade to their machine
 - Development of a validated machine model
 - Investigation of the oscillations causes
 - Use the simulation model as a virtual test platform for optimizing the machine controllers
 - Develop, test, and optimize multiple strategies
 - Without risk of damage neither taking the physical machine offline



Developing the simulation model

- Niigon provided operational data : velocity, position, torque, ...
- Modeling in MapleSim
 - Replicates the operation of the physical machine
 - Key components from the physical machine: hydraulic and mechanical systems
 - Accurately replicates the oscillations seen on the physical machine





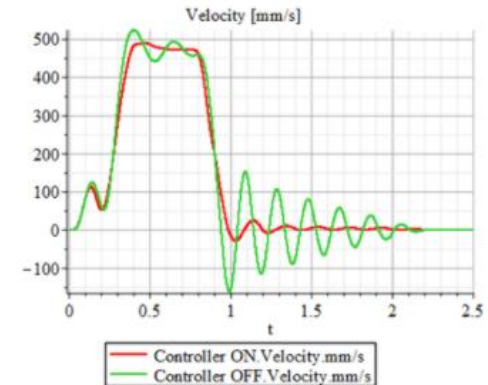
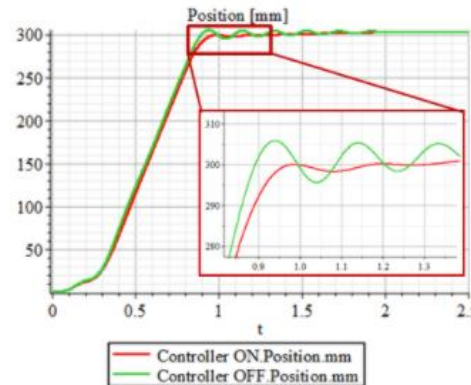
Optimizing the control code

- Automation Studio for control design
- MapleSim model was connected to Automation Studio using the B&R MapleSim Connector
- Iterative control code strategies on a real-time digital twin
- Visualization of machine's response (sensor data and realtime 3-D visualizations of the machine)



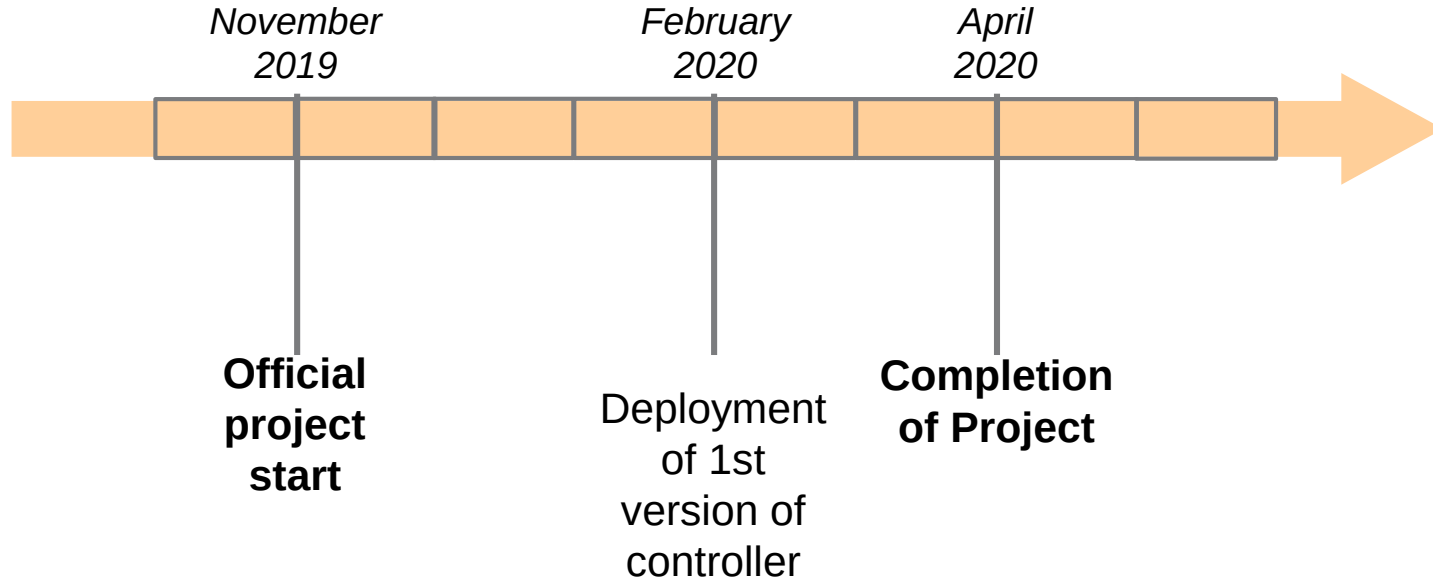
Updating the physical machine

- Implementation of 2 major control strategy solutions on the physical machine
- Reduction of the machine cycle time by over 25%
- Elimination of the oscillation issues during production
- Less than 2 days of machine downtime to implement optimizations to the machine operation





General time line



Challenge

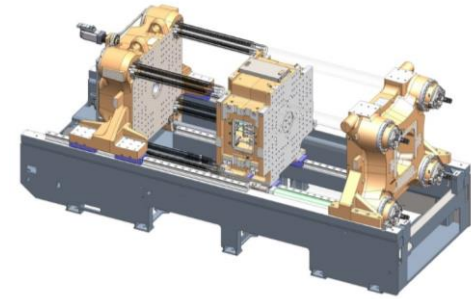
- Engineers at Niigon Machines Ltd needed to reduce cycle times on a machine that was **already on their customer's production floor**
- Hardware-based solutions were **prohibitively costly** and would require **significant operational downtime**

Solution

- Niigon partnered with Maplesoft, creating a simulation-based model of the machine to test new control strategies

Result

- The new control code resulted in a **25% increase in throughput**
- The overall project cost was a **small fraction of any other strategy**
- Overall **machine downtime was 2 days**, compared to weeks for a hardware upgrade



“For me, it’s a total no-brainer.
You will never get the best out
of your mechanical system
without simulation.”

-Marc Ricke, Controls Engineer & IT Manager, Niigon



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 Informationen

- **B&R Homepage – Software**

- **B&R Youtube Kanal**

The screenshot shows the B&R website with a navigation menu at the top. The menu includes: COMPANY, INDUSTRIES, TECHNOLOGIES, PRODUCTS, EVENTS, ACADEMY, CAREER, DOWNLOADS, SERVICE. Below the menu, there is a list of categories: I/O systems, Vision systems, Safety technology, Motion control, Transport systems, Mobile automation, Networks and fieldbus modules, and Software. The Software section is expanded, showing: Automation Studio, Automation Runtime, mapp Technology, mapp Services, mapp Control, mapp View, mapp Vision, GMC - Generic Motion Control, Automation Net/PVI, and Operating systems. A red box highlights the 'Modeling and simulation' section, which includes: Automation Studio Target for Simulink, Automation Studio MapleSim, Functional Mock-up Interface, Automation Studio industrialPhysics, Remote maintenance, and Other. To the right of the menu, there is a diagram titled 'Seamless integration at all levels' showing a pyramid with three levels: Level of Detail, Prozess-Simulation, Maschinen-Simulation, and Hardware-Simulation. The diagram also shows logos for various software tools: industrialPhysics, WinMOD, CATIA, MapleSim, MODELICA, MATLAB/SIMULINK, and mapp. Below the diagram, there are three paragraphs of text explaining the integration levels and the tools used.

Seamless integration at all levels

Level of Detail

Prozess-Simulation

Maschinen-Simulation

Hardware-Simulation

At the first level, Automation Studio supports simulation of all B&R hardware components with Automation Runtime Simulation (ARsim) and ACOPOS simulation.

At the level of components and machines, B&R supports a variety of simulation and modeling tools such as MATLAB®/Simulink® and MapleSim for dynamic modeling of machines and machine components.

At the highest level, complex system processes such as material flow or entire production plants can also be simulated. To make this possible, Automation Studio features interfaces for external tools such as industrialPhysics and ISG-virtuos.

MathWorks

Maplesoft

fmi

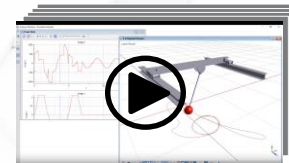
functional mock-up interface

industrialPhysics

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



► [Simulation with B&R](#)



► [Modeling and Simulation Tutorials](#)



Simulation & Digital Twin - Design, Dimensionierung & virtuelle Inbetriebnahme

Folgende Themen haben wir heute behandelt:

1. **Überblick** zum Bereich **Simulation bei B&R**
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Q&A –Session

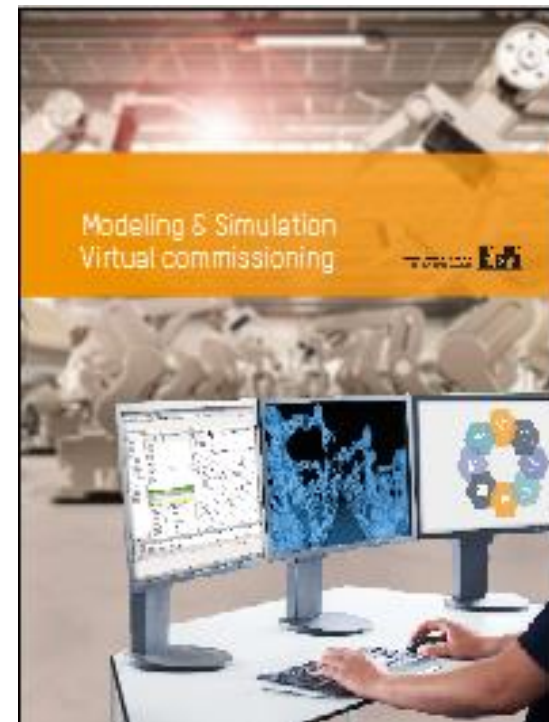
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Vielen Dank für Ihre Aufmerksamkeit!

