Welcome!

Profitable Automation for High-Mix Small-Volume Production
Lucas Renfer, Scientific assistant, HuCE
A robot system must be easily adaptable to changes in products or processes without the need to rely on extensively trained employees in order to be profitable for small production batches and customized products.

*euRobotics Multi-Annual Roadmap, 2016*
**Fixed Automation**
- Expert systems
- Optimal solutions, known environment
- Not flexible

**Agile automation**
- Intuitive systems
- “Smart” solutions, sensed environment
- Flexible

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**Performance**

**Reactivity & Resilience**
INTERNATIONAL COMPETITION

FULL AUTOMATION

AGILE AUTOMATION

TOO EXPENSIVE FOR LOW VOLUMES!

FOCUS ON PERFORMANCE

FOCUS ON FLEXIBILITY AND RESILIENCE, BUT ALSO ON WORKER UPSKILLING
Collaborative robotics, an opportunity for the industry 4.0
WHY ARE COBOTS NOT AGILE ENOUGH?

• Online programming requires fixed environments and is limited to simple tasks

• Intuitive programming apps require a model of the workspace which is too time consuming/complex

• Sensor integration often requires expert knowledge and reduces reactivity/profitability
FUNDAMENTAL VALUES OF AGILE MANUFACTURING

empower the worker

FLEXIBILITY

BOTTOM-UP

RAPID ITERATION

AUGMENTED WORKERS

ResearchXchange - 30.09.22 Lucas Renfer, lucas.renfer@bfh.ch - Bern University of Applied Sciences (BFH)
INNOVATIONS IN ROBOTICS

FLEXIBLE ROBOTIC CELLS
WITH UNIVERSAL SOFTWARE FOR ALL HARDWARE

DIGITAL TWIN

INNOVATIONS IN HUMAN MACHINE INTERFACE

NO-CODE INTERFACE

USER-CENTERED DESIGN

AUGMENTED REALITY

TUTORIALS

SMART TOOLS

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- Bern University of Applied Sciences (BFH)
Autogenerated Simulator

Easy Trajectory definition

Easy vision programming

Workspace integration
Agile manufacturing is about ...

... and that is exactly what humans are good at
One software
One Cell

Universal no-code
programming

Visual simulation
Virtual - and Augmented Reality

Tutorials
Smart Tools

High mix, low volumes
(SME’s)

Worker upskilling
for autonomous companies

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- Bern University of Applied Sciences (BFH)
Flexibility – Usability Tradeoff

Tasks:
- Assemble rotor
- Fetch rotor cores

Skills:
- Pick object
- Navigate to location
- Calibrate to station

Device Primitives:
- Move robot cartesian
- Open gripper
- Capture point cloud

SAFE ENVIRONMENT

USABILITY
- Assemble rotor
- Pick rotor
- Place on stator
- Go to new rotor orientation
- Place on stator
- Assemble rotor with new orientation

FLEXIBILITY

Thank you!
SOFTWARE ARCHITECTURE

COLLABORATE – HUMAN-MACHINE INTERFACES

DB MANAGER

PROGRAMMING INTERFACE

AR-DEVICE

SENSORS

ROBOTS

ACTIONS

PRIMITIVES

TASK DATABASES

OBJECTS

TASK-INDEPENDENT MODULES

SENSE - VIRTUAL MODEL

THINK - ACTION MANAGER

ACT - TRAJECTORY GENERATION

AGENTS

SENSORS

Security layer

Security layer

Security layer

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USE CASE: Sensor packaging
USE CASE: Sorting and palletizing watch links

1. Box of links
2. Put on wire
3. Polishing
4. Put in final boxes
5. Washing
6. Put on basket
Detection of Pallets and Boxes by Markers

Pick/Place Pallet

Cabinet

Pick/Place Box

Put links in Asycube

Detect links in Asycube

Find free places

Place Links in Pallet

Place Pallet on Table
USE CASE: Loading a press with various parts
Thank you for your attention!

Lucas.renfer@bfh.ch

With the kind support of:
Next Meetings

Biel/Bienne
Quellgasse 21, Aula


28.10.22 UAS-Thermaldaten zur Erkennung von Steinen auf landwirtschaftlichen Nutzflächen Prof. Florian Thürkow, Dozent, Fachbereich Wirtschaftsingenieurwesen, BFH-TI

11.11.22 The GNU Taler Payment System Prof. Dr. Christian Grothoff, Professor & CEO, Institute for Cybersecurity and Engineering ICE, BFH-TI & Taler Systems SA

25.11.22 Experimental heart rate variability characterization Lars Brockmann, Assistant, Institute for Human Centered Engineering HuCE, BFH-TI

09.12.22 Parylene-based encapsulation technology for wearable or implantable electronic devices Dr. Andreas Hogg, CEO, Coat-X AG, La Chaux-de-Fonds

13.01.23 Care@Home mit technischer Unterstützung Prof. Dr. Sang-II Kim, Professor, Institute for Medical Informatics 14MI, BFH-TI

Burgdorf/Berthoud
Pestalozistrasse 20, E 013

07.10.22 Tilted washboards and Chaotic Dynamics In a Vintage Rotating Roasting Spit Prof. Dr. Julio Rodriguez, Dozent, Abteilung MNG Allgemeinbildung, BFH-TI

21.10.22 Robot Task Model and Notation Congyu Zhang Sprenger, Wissenschaftliche Mitarbeiterin, Institute for Intelligent Industrial Systems I3S, BFH-TI

04.11.22 Data Science for Startups im ZID, Bernpark, Stettlen, Bern Prof. Dr. Erik Graf, Dozent, Institute for Data Applications and Security IDAS, BFH-TI

18.11.22 Flexible programming of Industrial Robots for Agile Production environments Laurent Cavazzana, Research scientist, Institute for Intelligent Industrial Systems I3S, BFH-TI

02.12.22 Wie gefährlich ist ein Unfall mit einem Cabriolet? Prof. Raphael Murri, Institutsleiter IEM, Institut für Energie- und Mobilitätsforschung IEM, BFH-TI

16.12.22 Systemtechnologie für die Mikrobearbeitung mit Hochleistungs-UKP-Lasern Prof. Dr. Beat Neuenschwander, Institutsleiter ALPS, Institute for Applied Laser, Photonics and Surface Technologies ALPS, BFH-TI