Towards Autonomous Machining

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IFT - Organization and Fields of Research

Institute for Production Engineering and Laser Technology
Head: Univ.Prof.Dr. F. Bleicher

Area of Research
Manufacturing Technology
Univ.Prof.Dr. F. Bleicher

Area of Research
Laser Technology
Univ.Prof.Dr. A. Otto

Technology
Machine Tools and Production Systems
Metrology and Quality
Manufacturing Automation

Cutting Technology
Non Conventional Machining

Competence Center for Digital Production
Control and Automation Technology

RSF Zerspanungstechnik
Haas Werkzeugmaschinen
Messtechnik Möller
B&R

Pilotfabrik Industrie 4.0
IFT - Organisation and research groups

Institute for Production Engineering and Laser Technology
Head: Univ.Prof. Dr. F. Bleicher

Area of Research
Machining Technology
Univ.Prof. Dr. F. Bleicher

Technology
- technology development and optimization
- cutting and forming technology
- electrochemical machining
- resource efficiency
- process simulation

Machine tools and production systems
- machine tool design and optimization
- plant design
- simulation of machine tools
- industrial handling
- metrological evaluation

Metrology and Quality
- production quality
- production metrology
- development of metrology applications
- nanometrology
- GPS – geometric product specification

Manufacturing automation
- automatization tech.
- NC-control technology
- mechatronics
- robotics
- manufacturing management
- production design and control

IFT Institute for Production Engineering and Laser Technology
IFT - Laboratory for Manufacturing Technology

Franz-Grill-Straße 4, Obj. 221
A-1030 Vienna, Austria

3 750 m² (40 365 ft²) building space, 30 workplaces for scientific staff, 3 conference rooms, lecture hall, training workshop for student education, cleanroom (ISO 6)
Pilot factory of TU Wien

- Common room
- Meeting room
- Entrance
- Reception
- Small kitchen
- Polymer 3D-Print
- SLM-Technology
- 3D-Print plastic material
- 3D Printing Center
- Ramp
- Special projects area
- Assembly
- Product presentation
- Machining
- Control panel
- Milling
- Turning
- Welding/additive
- Office
- Warehouse
- Network/Server
- 3D Printing Center
- FTS

IFT Institute for Production Engineering and Laser Technology

Technische Universität Wien
Pilot factory of TU Wien

Machining cell with robots and agv milling – turning – welding/additive
Trends in Manufacturing

Trends in manufacturing have evolved from mass production to more personalized and flexible systems. The diagram illustrates key stages:

- **1850**: Universal machine tool
- **1913**: Craft production
- **1955**: Mass customization
- **1980**: Regionalization
- **2000**: Personalization
- **Future**: Optimal manufacturing system, dedicated manufacturing line (DML), flexible manufacturing system (FMS), reconfigurable manufacturing system (RMS)

Fields of Research

- develop the manufacturing systems of the future

overcome existing process limitations
CDP – Center for Digital Production

The CDP is supported by a network of more than 30 companies and 20 research institutions

**M2M – Communication:**
Standardised and real time capable M2M communication mechanisms allow sensing and reconfigurable machining infrastructures

**Data Analytics:**
Comprehensive and in-depth data acquisition allows immediate improvements of processes, and shopfloor and quality management

**Automated Lot Size 1:**
Integrating design automation with M2M enabled machinery allows single part production with a cost footprint of high volume production.

**Dyn. Production Networks:**
Interconnecting individual automated shopfloors allows the creation of virtual factories enables higher valued production.
Fields of Research

- collect, store, visualize & analyze data
- orchestration and integration of hardware (sensory tool holder, etc.)
Cyber-Physical Systems

- Clamping device as a showcase
- Tombstone offers data and functions using OPC UA
  - Engineering data
  - Sensoric data (temperature, stresses, clamping force)
  - Communication by means of OPC UA
- Calculation of the thermal distortion due to temperature change
Adaptive control system with a sensory tool holder

- Detect and avoid milling process instabilities like “chatter”
- Active control system to allow in-process adaption of machining parameters
- Sensory tool holder with acceleration sensor and wireless data transmission
- Signal processing unit is coupled to the NC-control of the machine in real time
- In-process regulation of feed rate and rotational speed depending on strategies

Cooperation with My TOOL IT
Composing Production Systems

Process Engine

Endpoint-Drivers

UA Client

UA Server

UA Server

UA Server

Administration shell

Interface

TU WEN

TECHNISCHE UNIVERSITÄT WIEN

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Demonstration cell at AMTC

- Collaborative work between AMTC, CDP, IFT, KIT
- Automation
  - Layout
  - Simulation
  - Robot handling
- Development of manufacturing orchestration
  - Interfaces
  - Transformation to machine layers
- Adaptive security system
Demonstration cell at AMTC

- EMCO Concept Mill 260
  - Table size: 520 x 300 mm
  - Table load: max. 100 kg
  - Spindle drive power: 7 kW
  - 20 tool stations

- ABB IRB 1410
  - 6 axes
  - 5 kg handling capacity
  - Reach of 1.44 m

- Work piece provided by an AGV

- Step 1: Full automated production cell using quick change systems for grippers and pallet systems

- Step 2: Flexible and autonomous manufacturing cell using an orchestration software (Centurio, OPC UA)