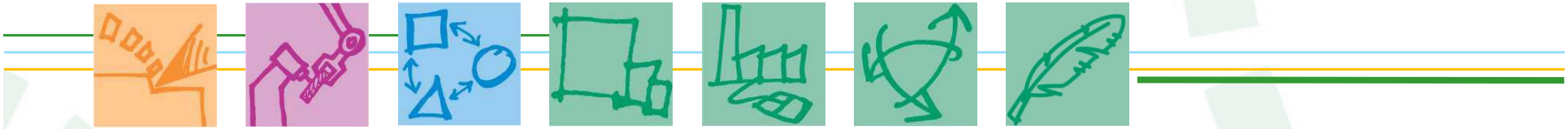
Institute Presentation
wbk Institute of Production Science



Adam-Mwanga Dieckmann

Karlsruhe, 30.5.2010

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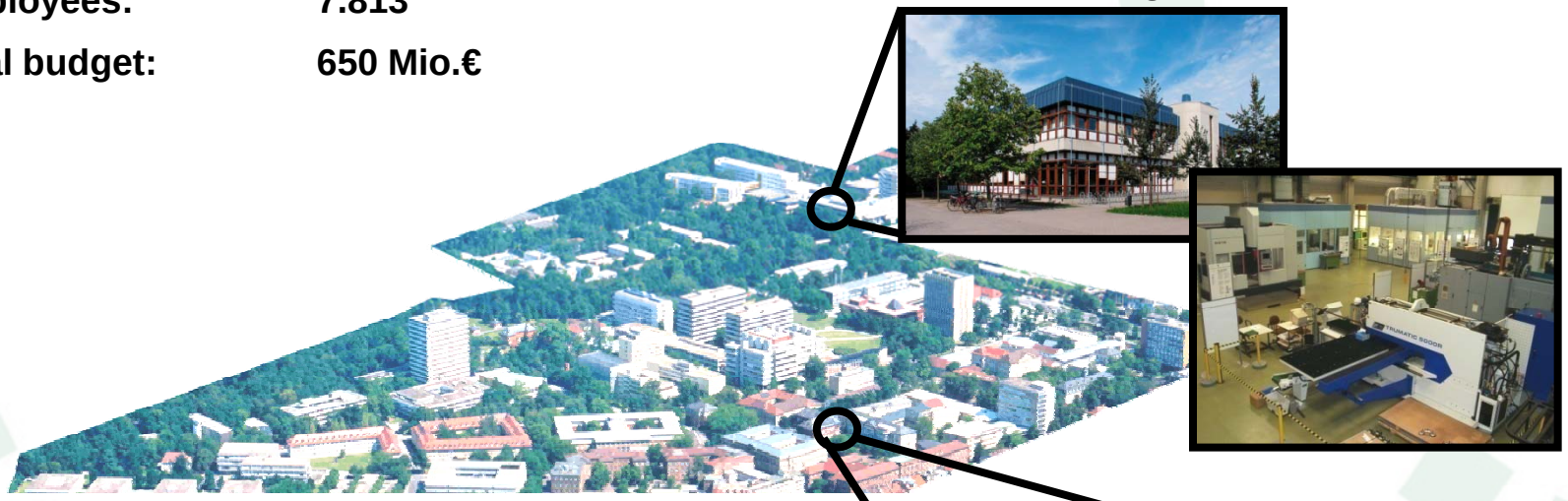
Karlsruhe Institute of Technology (KIT)

University of the State of Baden-Württemberg and
National Laboratory of the Helmholtz Association

- **Established:** **1. October 2009**
  (University Karlsruhe (TH): 1825, Forschungszentrum Karlsruhe: 1956)
- **Courses of studies:** **44 (technical, natural and economic sciences)**
- **Students:** **19.000**
- **Employees:** **7.813**
- **Total budget:** **650 Mio.€**

wbk: Fasanengarten



Two locations:

- **wbk at the Fasanengarten**
- **wbk on Campus**

wbk: Campus

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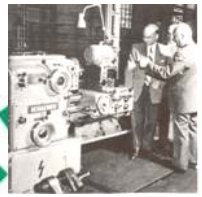
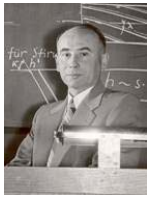
The **wbk** Institute of Production Science

50‘s:
Simple mechanics determine the standard for machines and tools





Prof. Dr.-Ing. habil.
Walter Schmidt
1952-1964 at the wbk; previously head of development at Rheinmetall Borsig AG

Management Board since 2008

Prof. Dr.-Ing. **Gisela Lanza**
Dr.-Ing. **Christian Munzinger**
Prof. Dr.-Ing. habil. **Volker Schulze**

60‘s:
Process technology finds its way into cutting

Prof. Dr.-Ing.
Hans Victor
1965-1980 at the wbk; former managing director of AEG

70‘s:
Complex fabrication processes are automated with NC-technology

Prof. Dr.-Ing.
Jürgen Schmidt
1967 – 2007 at the wbk

Prof. Dr.-Ing.
Jürgen Fleischer
at the wbk since 2003
2008- 2012 Chairman of MAG Europe

80‘s:
Computer-aided manufacturing changes the production process making it less labor intensive.

Prof. Dr.-Ing.
Hartmut Weule
1982-2003 at the wbk; during this time he was temporarily a member of the managing board for research and technology at Daimler

90‘s:
Highest system utilization becomes the uppermost goal. Technically economical production gains favor.

Prof.-Dr.-Ing. **Dieter Spath**
1992-2002 at the wbk; previously managing director of KASTO

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The wbk in numbers (2009)

Employees:

- Scientists ~45
- technical and admin. Staff ~26
- science assistants ~140

Teaching:

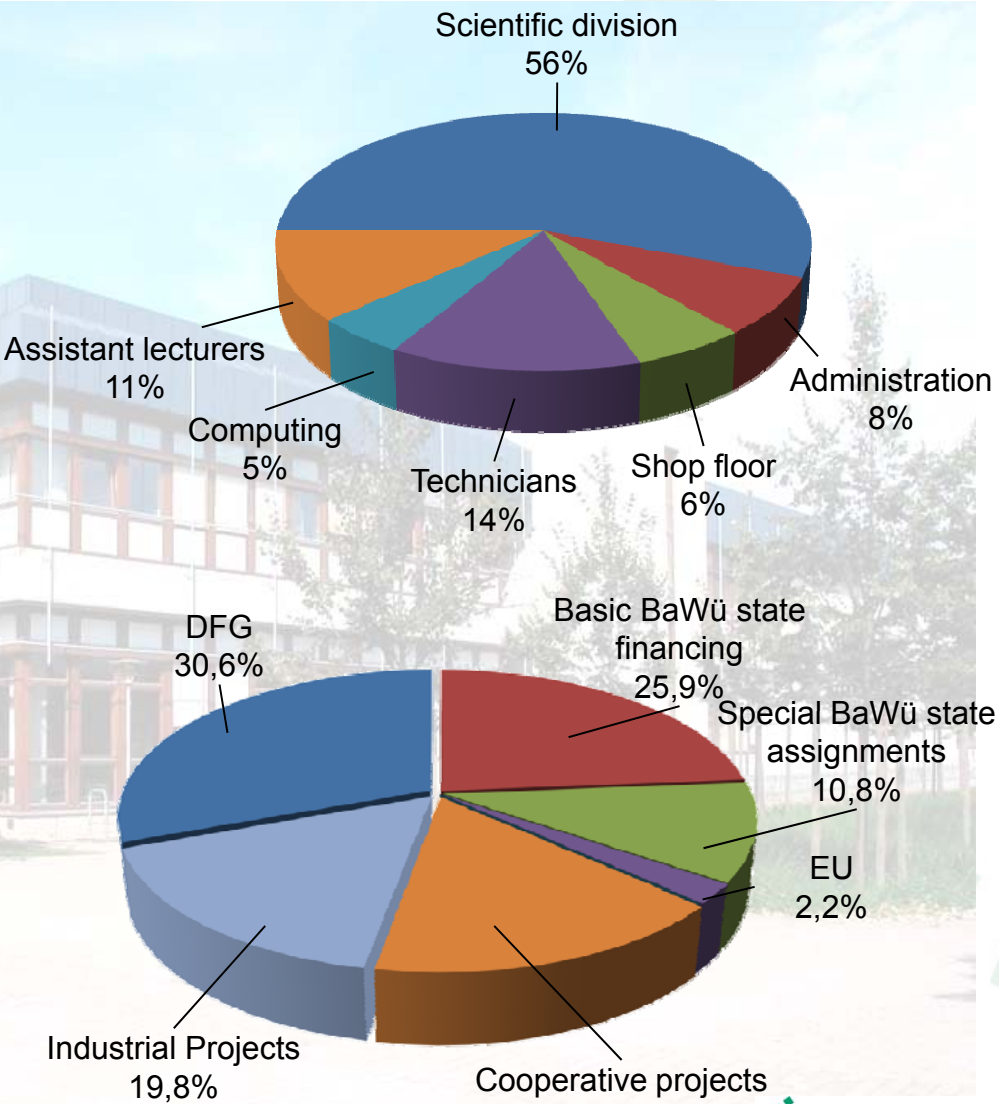
- 20 lectures
- approx. 1200 students per year
- approx. 170 student research projects and diploma theses per year

Equipment:

- two testing areas with 1.220m² of laboratory space
- approx. 30 experimental rigs
- two mechanical workshops offering apprenticeship
- comprehensive range of computer and simulation equipment

Current numbers and facts:

- 27 basic-research projects
- 16 cooperative projects
- 42 industrial projects



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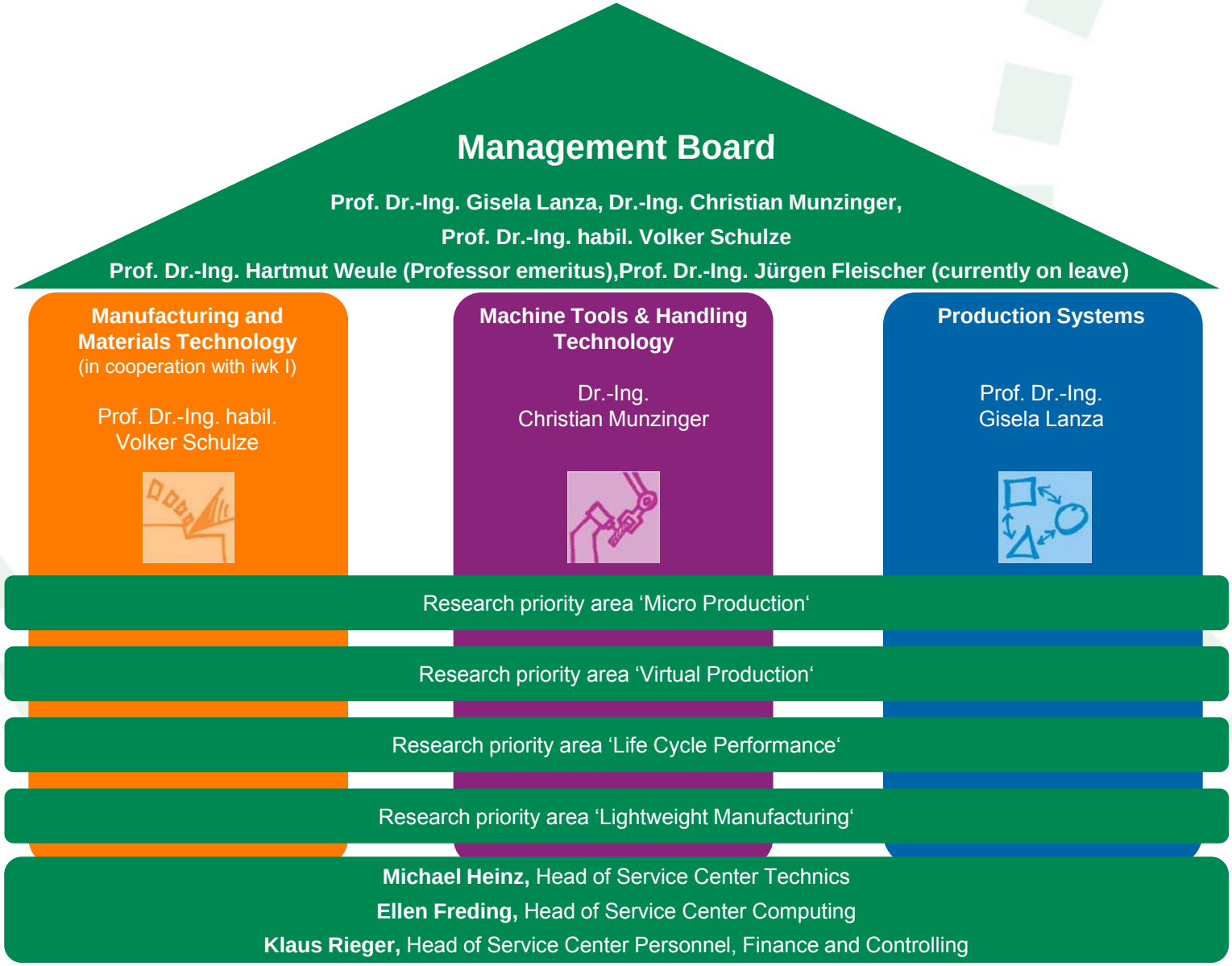
The organizational structure of the **wbk**



The scope of lectures offered by wbk

- **Integrated Production Planning**
  Lanza, SS, 4SWS
- **Quality Management**
  Lanza, WS, 2SWS
- **Operational Production Management**
  Lanza, Zülch, Furmans, SS, 4SWS
- **Global Production**
  Lanza, WS, 2SWS
- **Production Science Laboratory I & II**
  Furmans, Ovtcharova, Schulze, Zülch, SS/WS, je 5SWS
- **Production System and Technologies of Power Train Production**
  Stauch, SS, 2SWS
- **Process Simulation in Chipping Technology**
  Zabel, WS, 2SWS
- **Materials and Processes for Lightweight Design of Car Bodies in the Automotive Industry**
  Haepp, SS, 2SWS
- **Product Planning / Production**
  Schulze, SS, 2SWS
- **Production Technology**
  Schulze, WS, 4SWS
- **Deformation Technology**
  Geiger, SS, 2SWS
- **Toothing Technology**
  Felten, WS, 2SWS
- **Microproduction Laboratory**
  Schulze, WS, 4SWS
- **Actuating Elements**
  Munzinger, Kohl
  WS, 2SWS
- **Machine Tools and Handling Technologies 1 + 2**
  Munzinger, WS, 2+2SWS
- **Control Engineering**
  Gönnheimer SS, 2SWS
- **Electronic Business for Industrial Enterprises**
  Weisbecker WS, 2SWS

technical-operational

organizational-strategical

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8

Production Techniques Laboratory

In the course of the Production Technique Laboratory the following exercises will be held:

V1 Computer Aided Product Development IMI
V2 Computer Aided Process Planning IMI
V3 Production of Parts with CNC Turning Machines wbk
V4 Storage an order-picking systems IFL
V5 Optical Identification in Production and Logistics IFL
V6 Industrial Robots wbk
V7 Controlling of Production Systems using PLCs wbk
V8 Workplace configuration ifab
V9 Computer Communication in Factory IMI
V10 Configuration of Display Work Stations ifab

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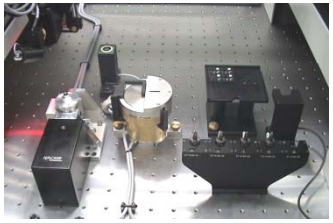
Microproduction Laboratory

Aim:
To give the students a feeling for the difference between micro and conventional manufacturing (theoretical and practical)

Content:

- Microproduction processes (lessons)
  - Introduction
  - µ-milling
  - M-laserablation
  - µ-EDM
  - LiGA-technique
  - powder injection molding
  - µ-metrology / quality assurance
  - Excursion to a company
  - Summary, evaluation of the project work (test runs)



- Project work
  - Miniaturization, manufacturing and assembly of a micro system

Time period: 1 semester, 9 lessons, 4 hours each lesson

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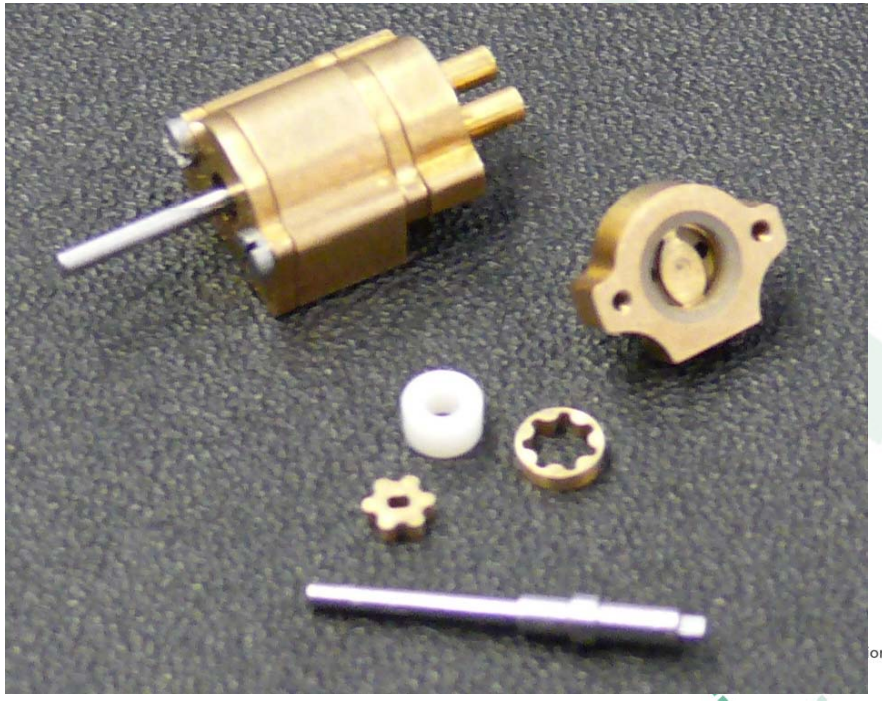
Project work

- Miniaturization
- Construction
- Manufacturing
- Assembly
- Test runs

2009/2010: Annular gear pump

2008/2009: Stirling engine

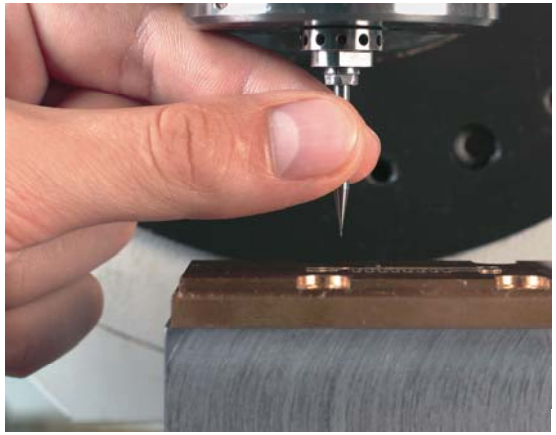


onstechnik

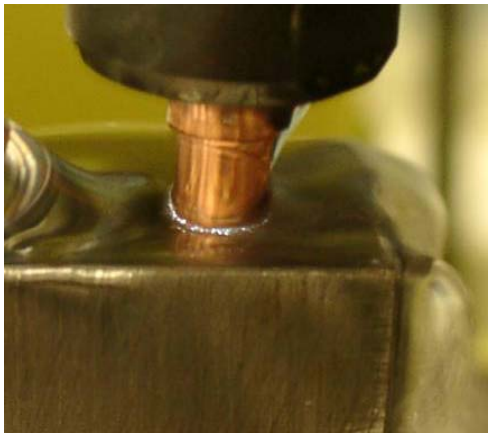
Micro Production Technologies

primary structuring

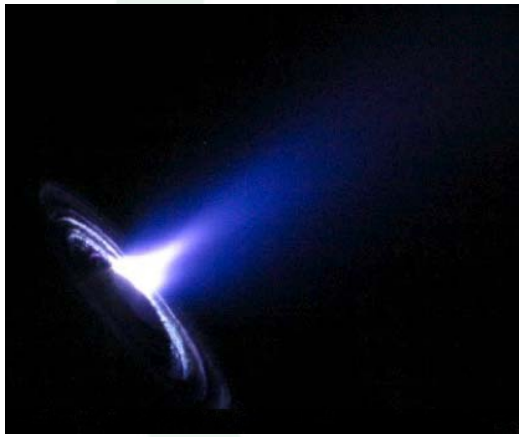
micromilling



microEDM



microlaserablation



fine machining

micro abrasive peening

ultrasonic wet peening

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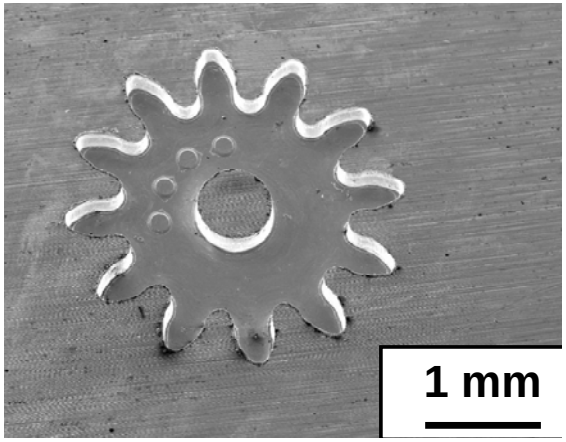
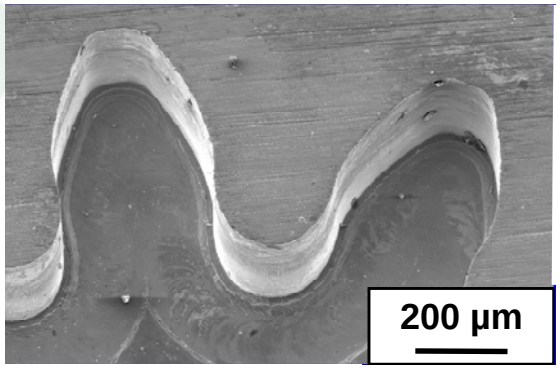
Micro Production Technologies

primary structuring

micro milling

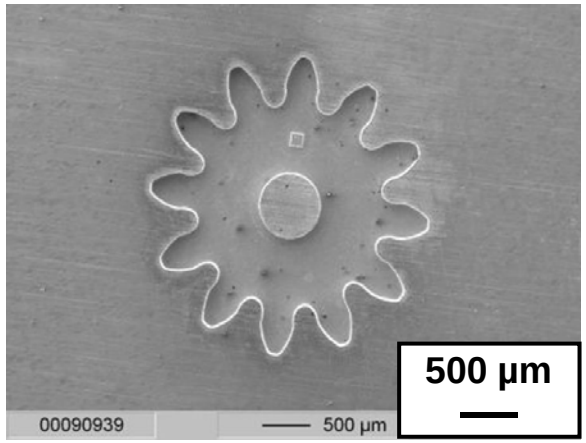


30CrMo6

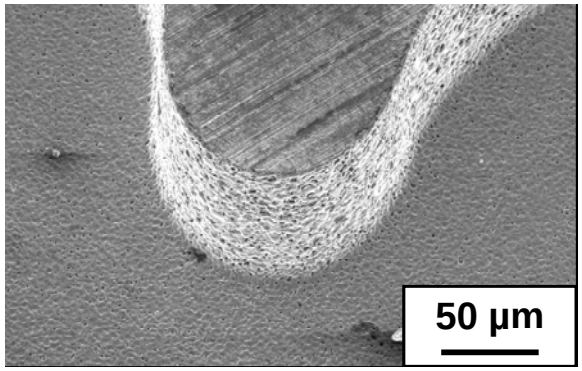


+ removal rates
+ geom. flexibility
- hardness limited to 64 HRC

micro EDM

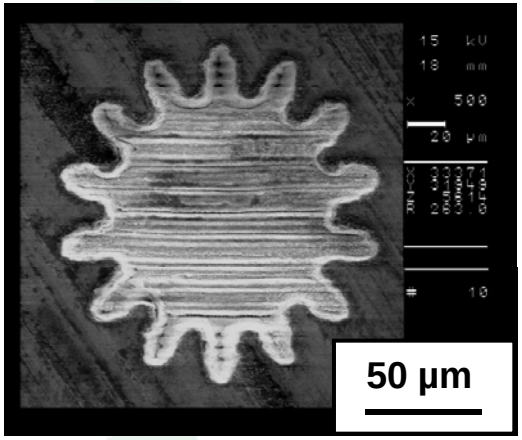


30CrMo6

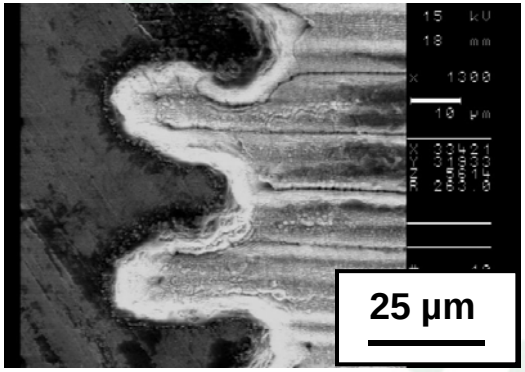


+ not limited in hardness
+ geom. flexibility
- removal rates

micro laserablation



WC-12Co



+ wide range of materials
+ miniaturisation
- removal rates

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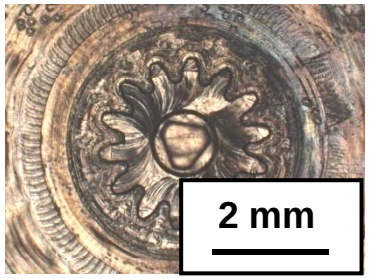
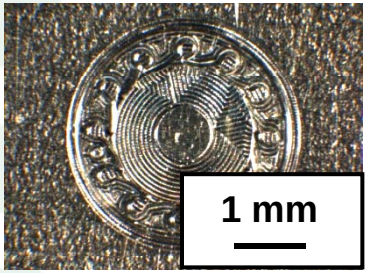
Micro Production Technologies



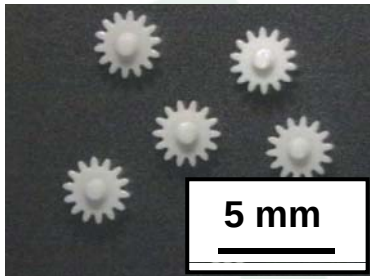
sun wheel, micro milled

dispenser screw, micro milled

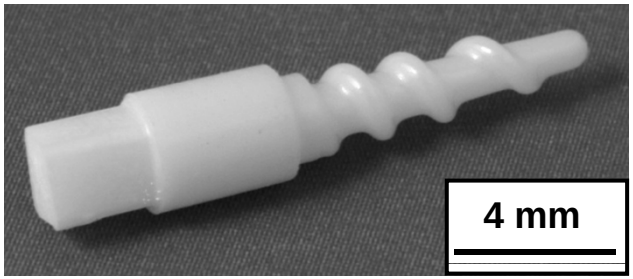


mould, micro milled

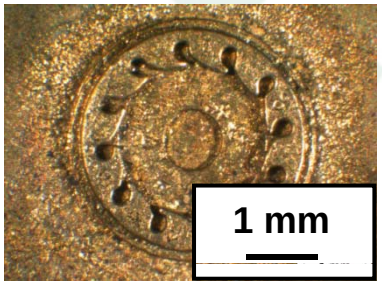
fine machining (if necessary)



injection moulding, ZrO_2



low pressure injection moulding, ZrO_2



micro casting, Al-Bronze

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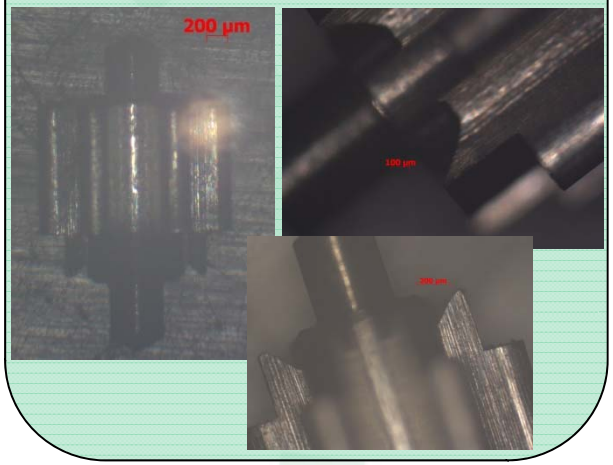
Transfer of technology

JUNGHANS microtec

Comparision of *micro EDM, laserablation* and *micromilling*

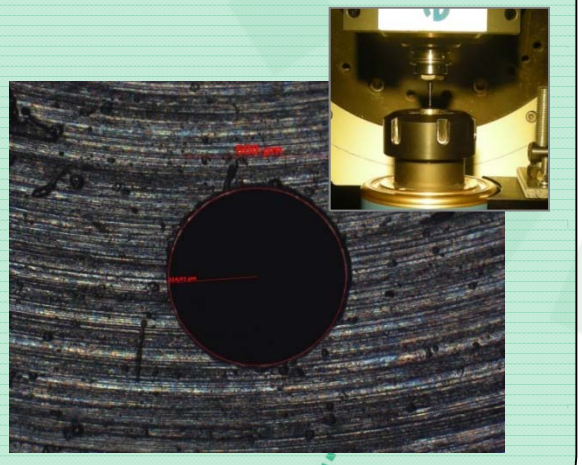


Freudenberg

Miniaturisation of a radial sealing

BOSCH

Process stability in micro drilling



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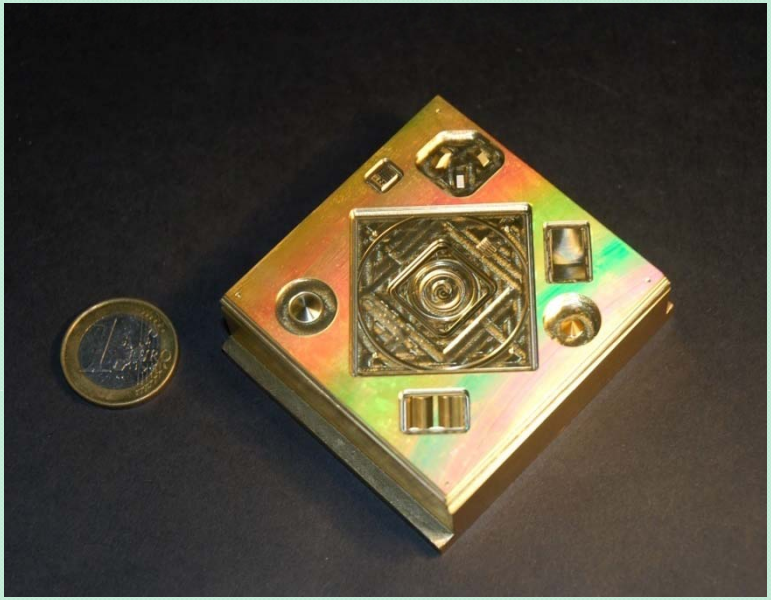
Test workpiece for 5 axis micro milling machine tools (NcG, VDI)

Micro-Testworkpiece

Material:	MS 58
Machining time:	app. 30 min

Standardised

(combined VDI- and NcG-standard)



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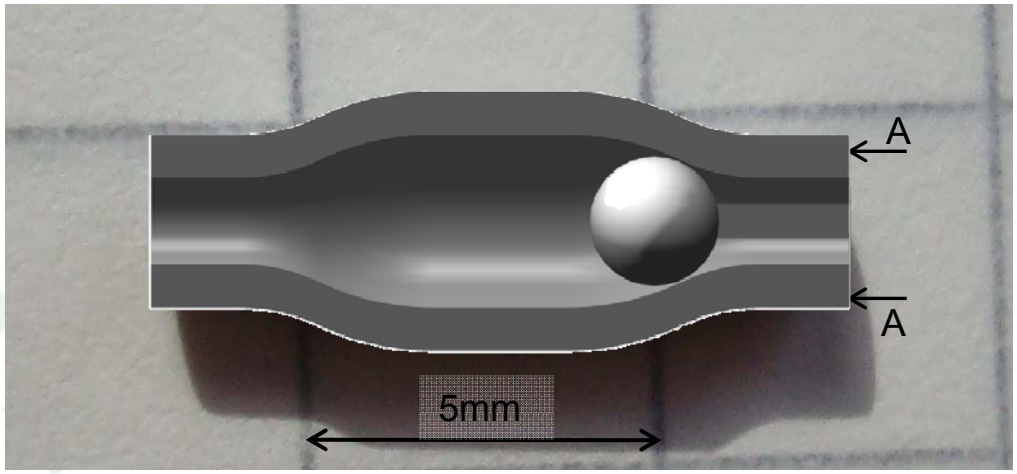
Aim and approach sinter-joining

- Simplifying the process by combination:
- Final mounting operation can be omitted
- Complexity of the joining operation can be lowered



A : A

- Joining in green state
- The joint is produced during sintering
- Injection moulding tools can be simplified

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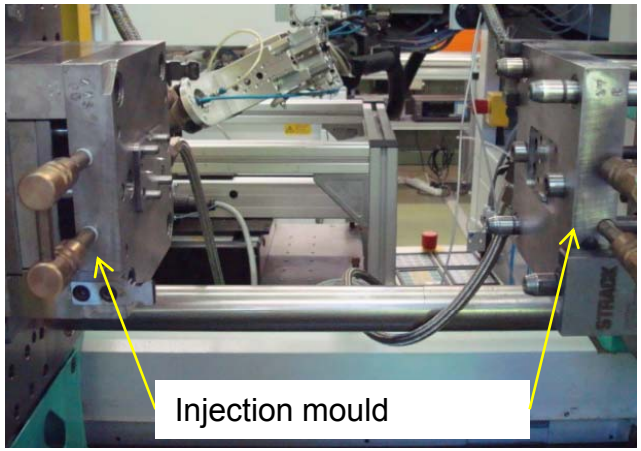
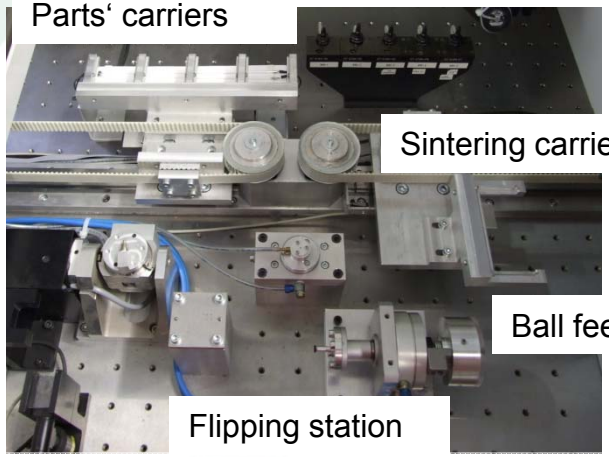
Result: check valve production



Injection moulding of check valve cases

Grippers



Automated mounting of green parts

Sintering

Sinter-joined check valve

- Necessary precision for joining lowered
- Undercuts produced without pullers
- Movable parts integrated
- Joined by sintering

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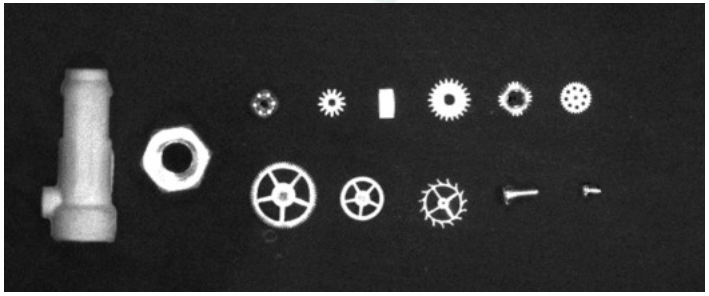
3D vibrating conveyor for feeding micro parts

Initial situation



- Increasing demand for micro assembly installations
- Present installations are very complex and can only convey one particular component
- High costs in the field of feeding and orientation technology
- Conventional vibrating conveyors come up against physical barriers conveying micro components smaller than 1 mm (adhesion)

Goal of the project

Development of a computer-based 3D vibrating conveyor for the contour-controlled conveyance of micro components

Approach

- Using sliding conveyance of parts
- Using piezo bending actuators for frequencies up to 500 Hz and accelerations up to 200 m/s², orthogonal superposition of vibrations including phase shift
- Integration of a vision system and computerized control
- Tests with different micro parts on different surfaces

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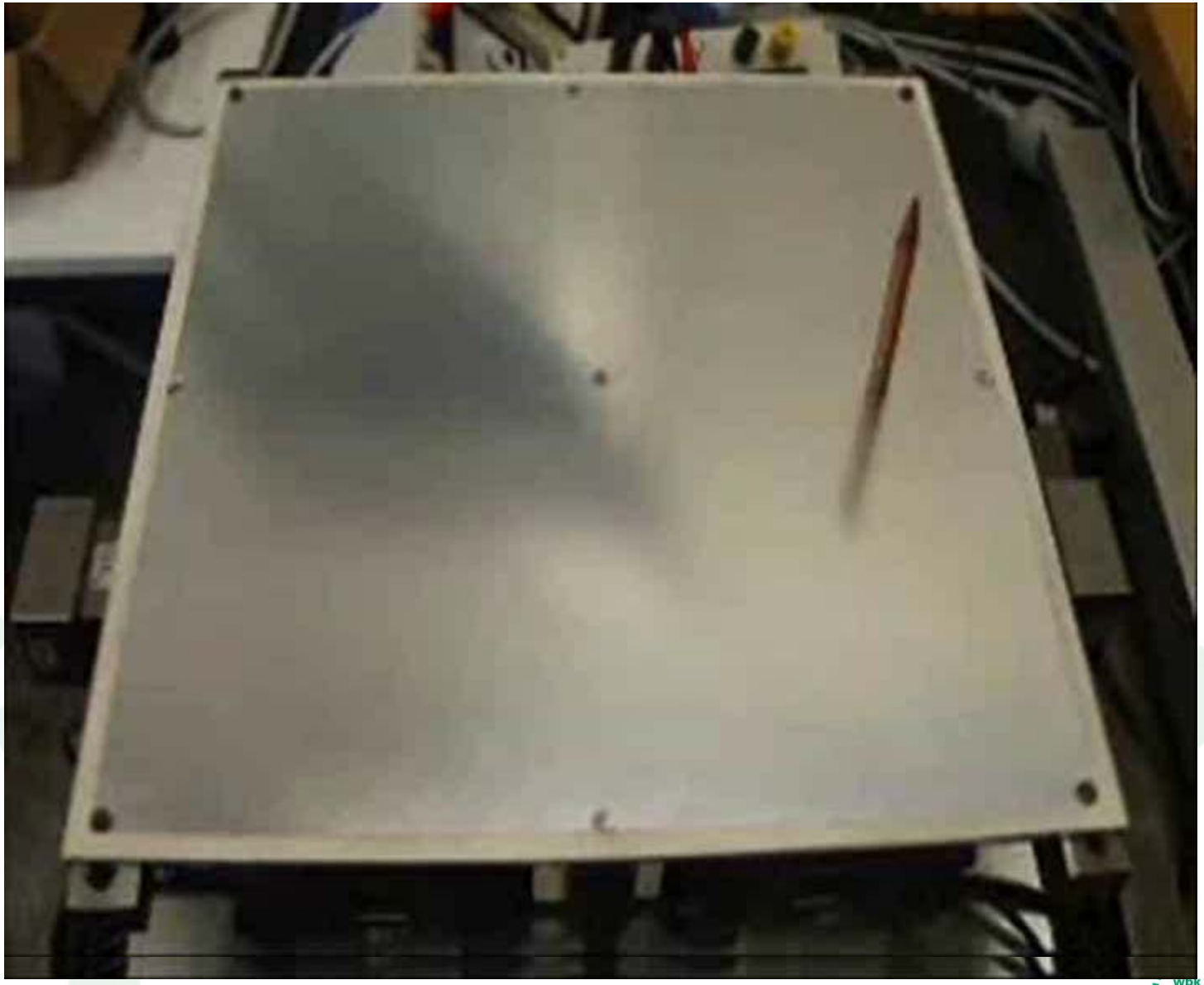
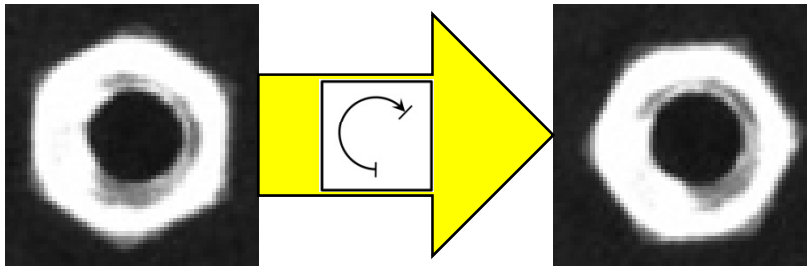
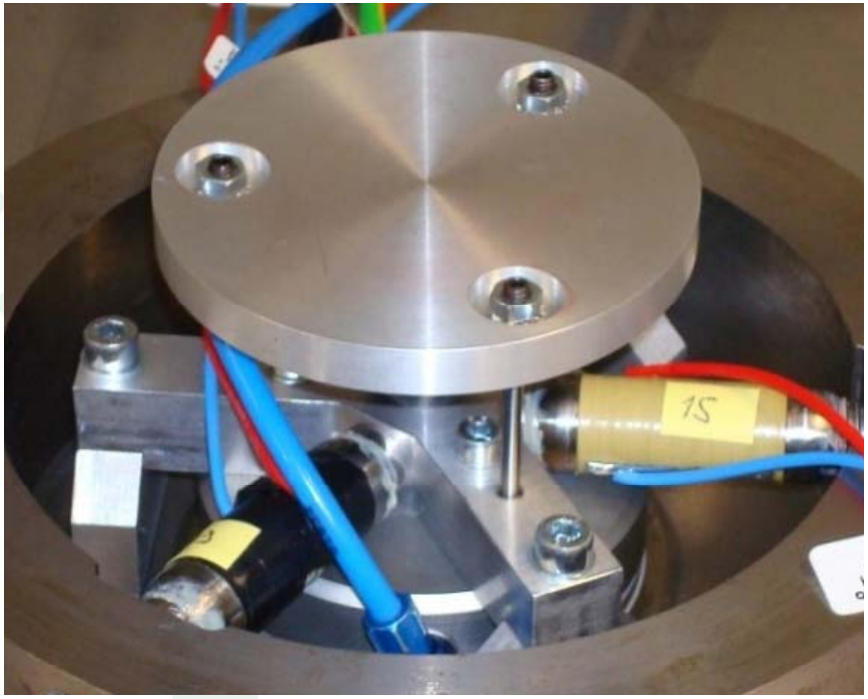


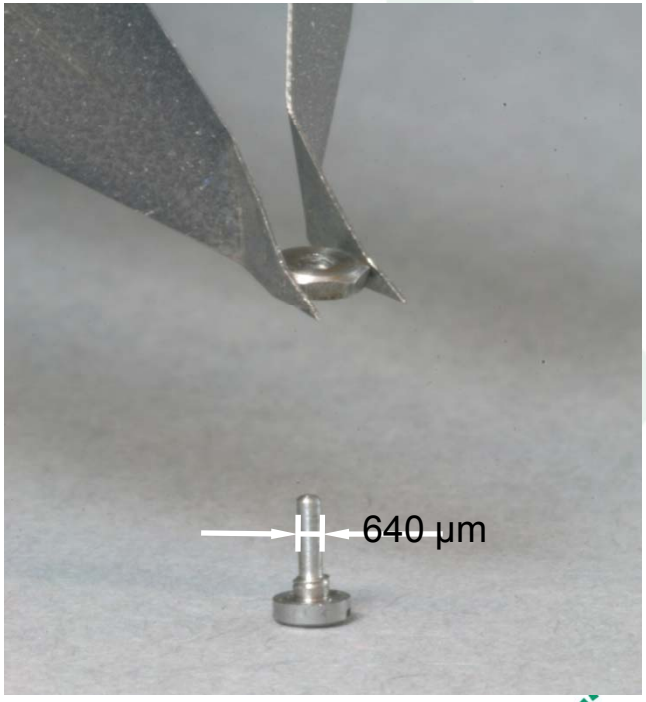
Automated feeding of micro parts



positioning orienting



separation and sorting



assembly

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Thank you for your attention!

Adam-Mwanga Dieckmann

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