



Philipp Schmid
Head Industry 4.0 & Machine Learning

WIE IST HOCHLEISTUNGSPRODUKTION IN DER SCHWEIZ NOCH MÖGLICH?

A photograph of a modern, multi-story building with a white facade and a large glass section. The building has the 'csem' logo on its upper left corner. The sky is clear blue, and there are some trees in the foreground.

csem

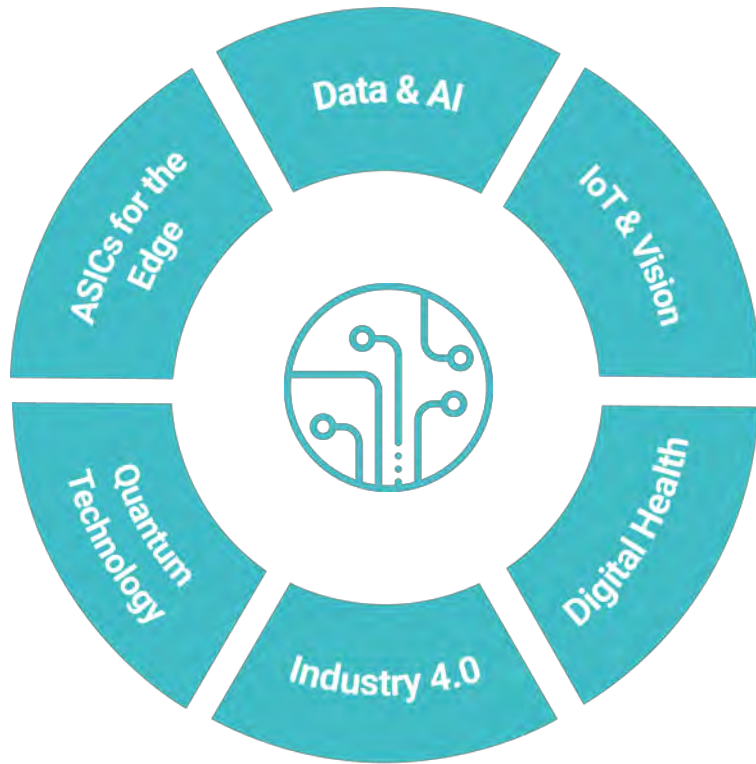
TECHNOLOGY TRANSFER TO INDUSTRY

:: csem

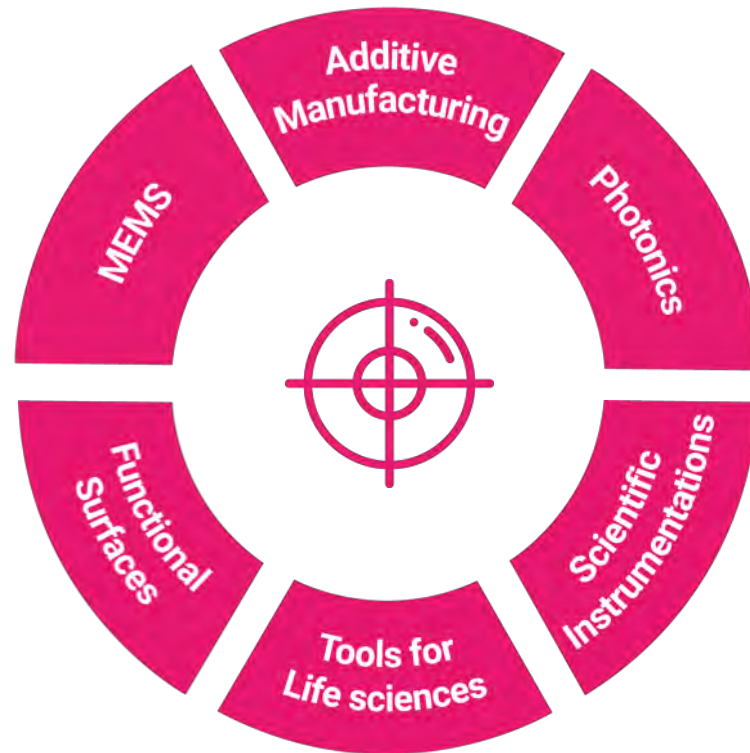
FACING THE CHALLENGES OF OUR TIME

WE FOCUS ON THREE RESEARCH PRIORITIES

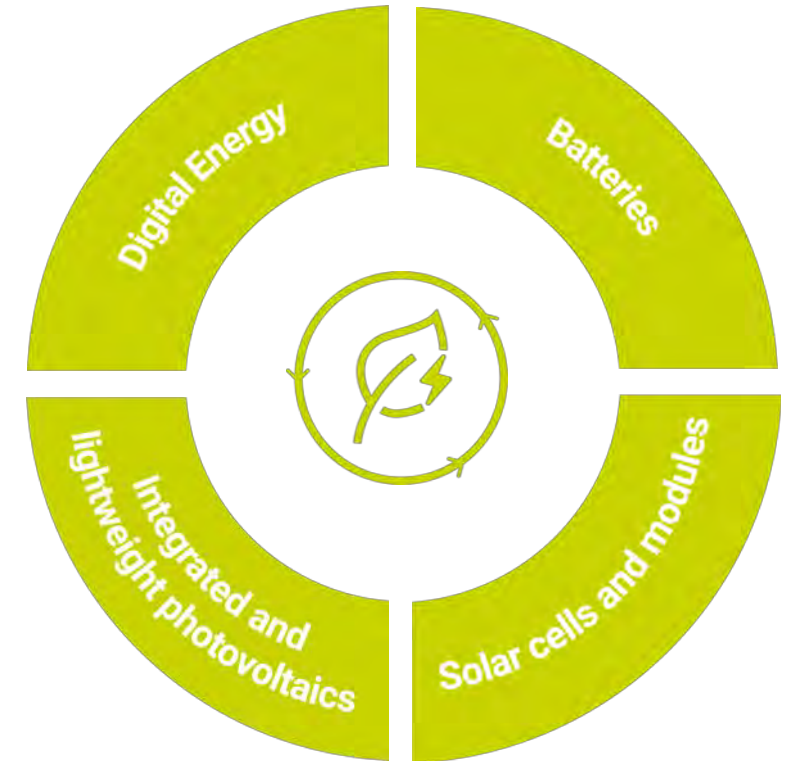
Digital Technologies



Precision Manufacturing



Sustainable Energies



KEY DRIVERS

Efficiency

- Automation / Robotics
- Maintenance



Quality Control

- Lean manufacturing
- Total-Quality-Management (TQM)



Traceability

- Regulations
- Liability



An iceberg floating in the ocean. The tip of the iceberg is above the water surface, while the much larger, jagged base is submerged underwater. The sky is blue with some clouds, and the water is a deep blue. In the top right corner, there is a grid of semi-transparent grey circles.

Neural Network

Data Acquisition

Data Generation

Data Management

Expert Knowledge

Pre-, Post-Processing

Retro-Fitting

Deployment

Version Control

Usability

DEEP LEARNING FÜR DIE INDUSTRIE



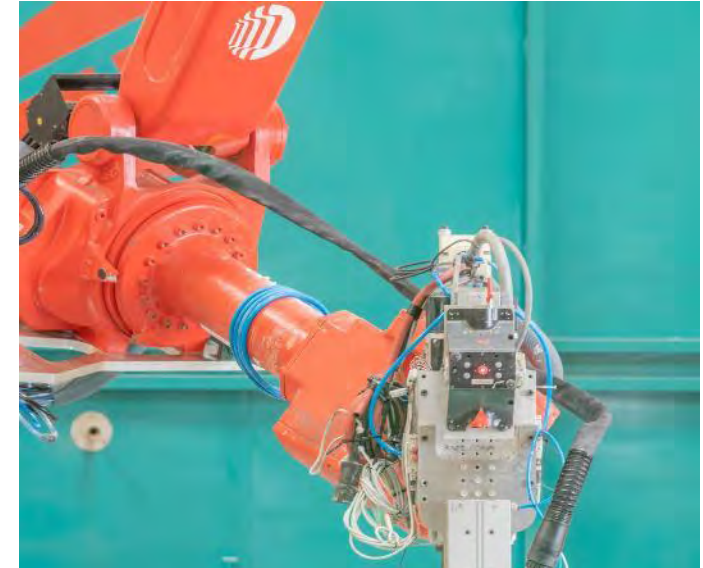
Quality & Process Control

- 2D/3D inline inspection
- Multimodal data
- Data driven optimization



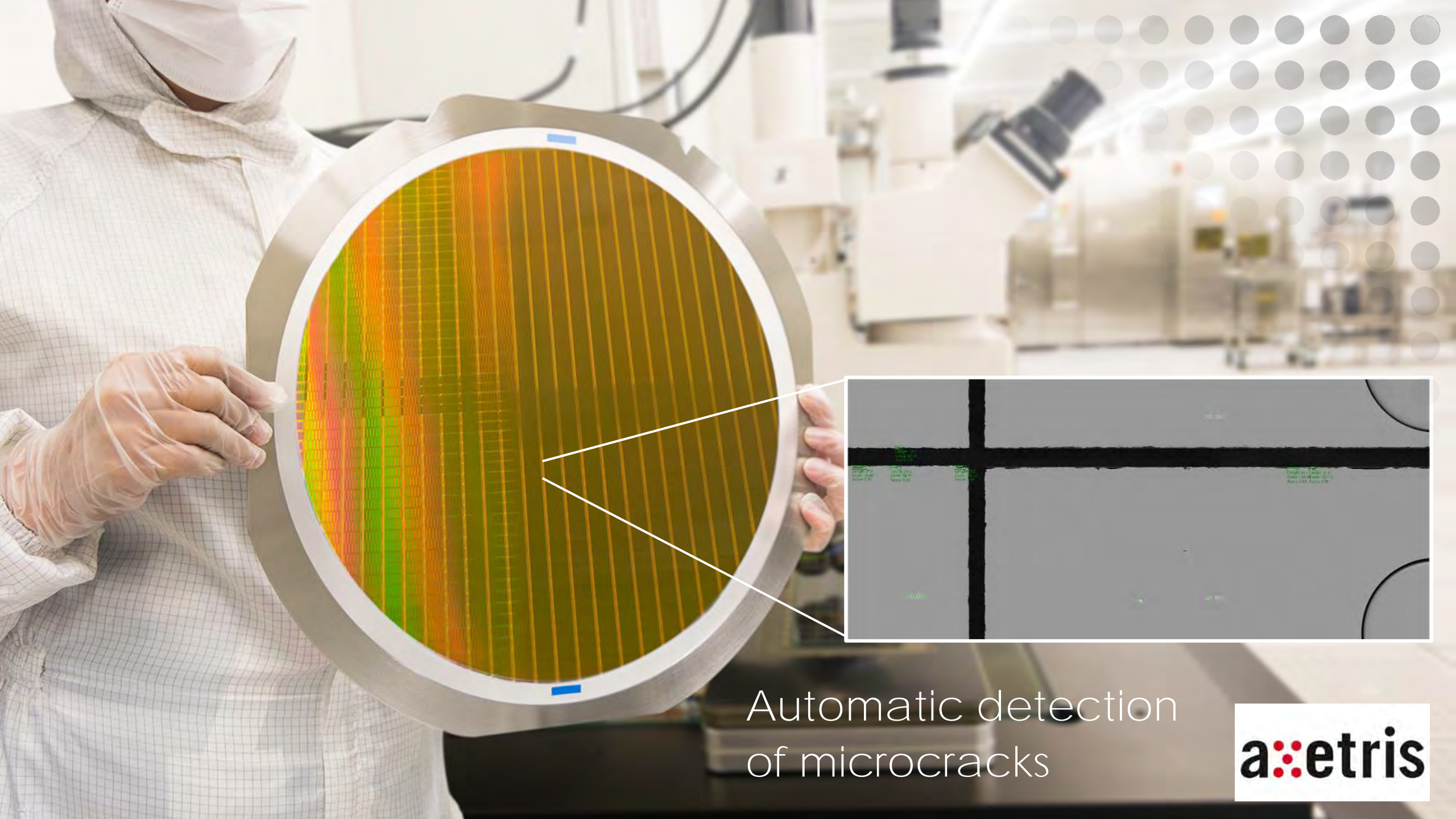
Predictive Analytics

- Machine health monitoring
- Predictive quality
- Complex system modelling



Cognitive Robotics

- Smart human-robot interaction
- From sensing to awareness
- Agile, customized production

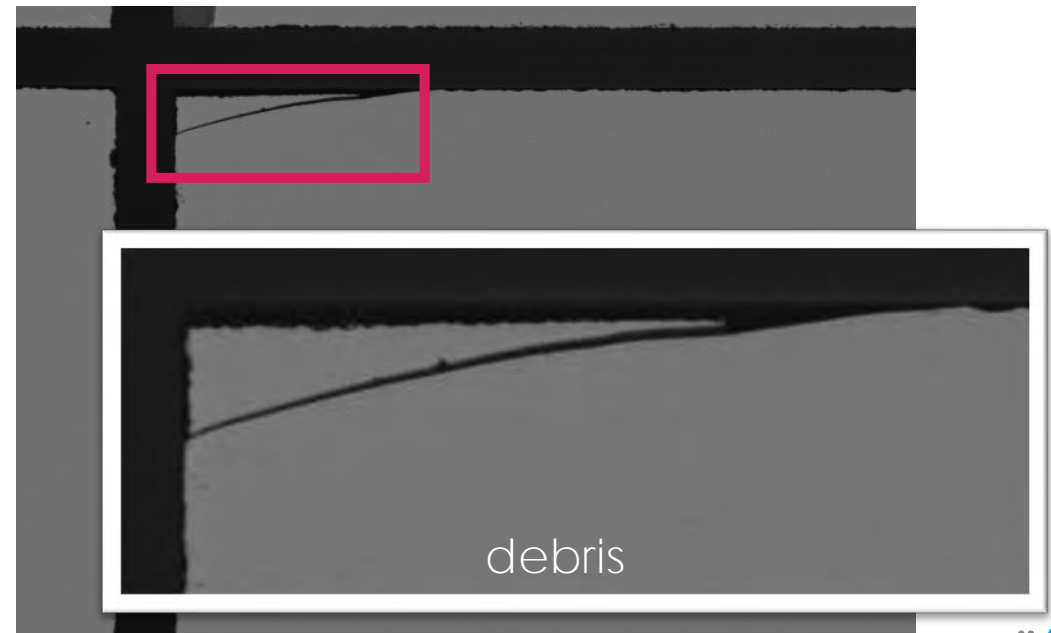


Automatic detection
of microcracks

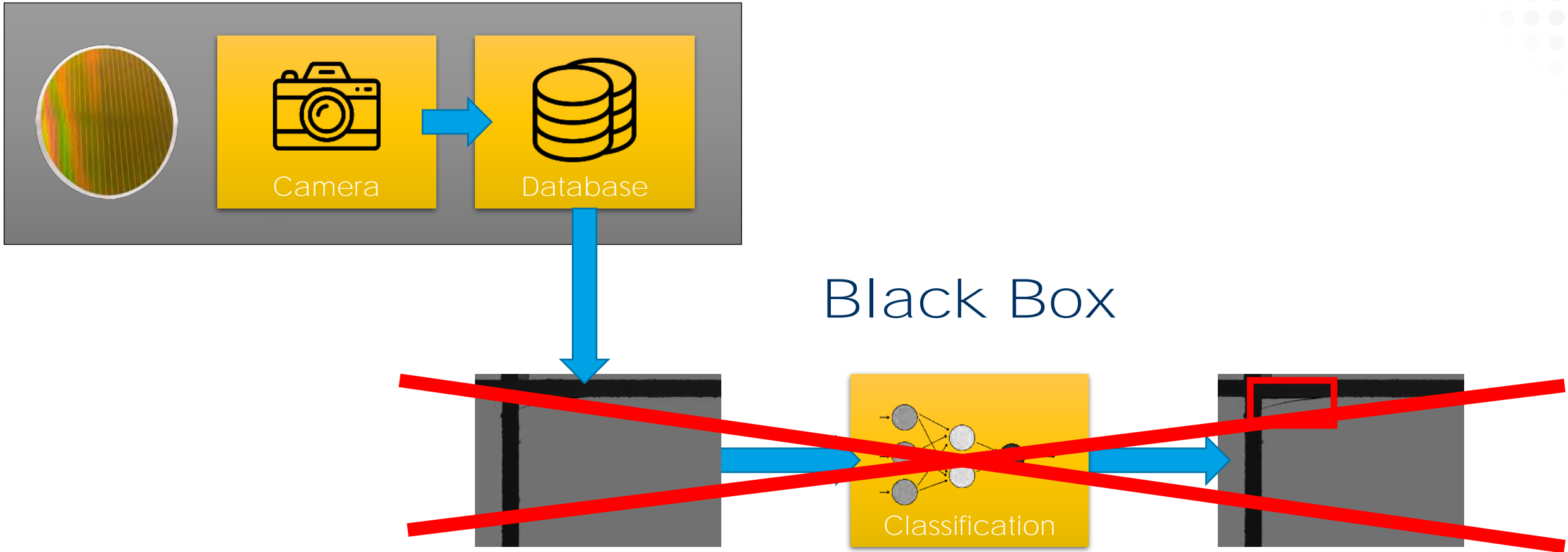


SPEZIFIKATIONEN

- Erkennung von **Cracks** und **Trümmerteilen**
- **Bewertung** ob kritisch, oder nicht
- **Verfolgbarkeit** der Entscheidungsgrundlage



CLASSICAL AI PROCESSING PIPELINE



FLEXIBLE AI PROCESSING PIPELINE

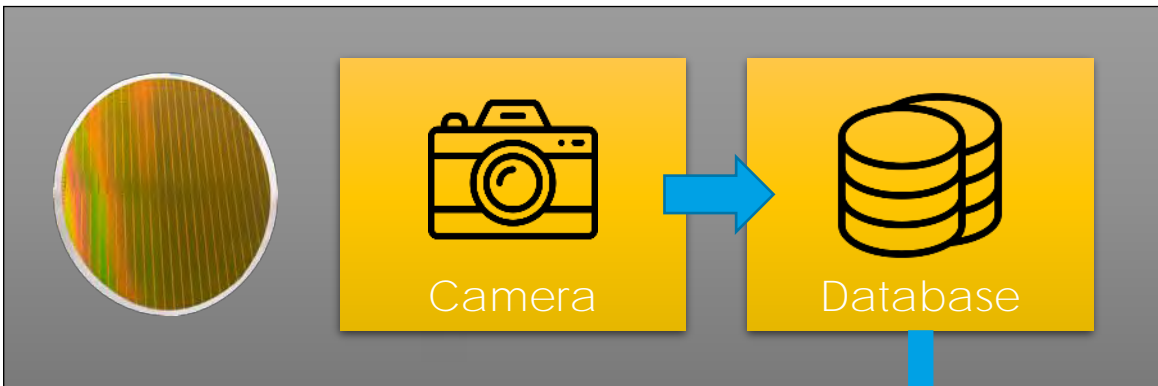
Accuracy (13'200 images)

99.9%

Klassische Algorithmen

+

Benutzerdefinierte
Regeln, Schwellwerte & Einstellungen

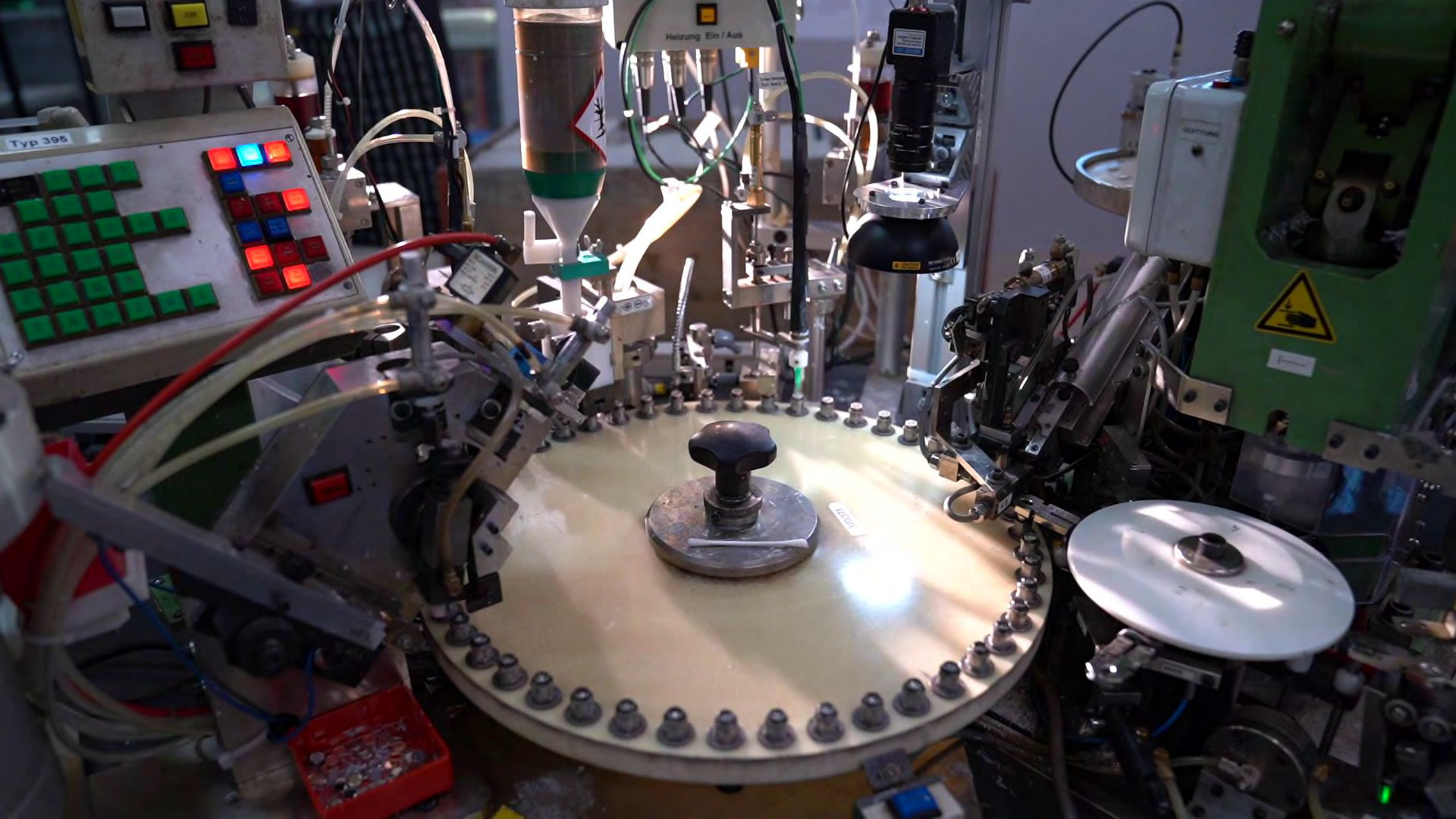


<https://www.csem.ch/de/nachrichten/zusammenarbeit-mit-der-axetris/>

renata batteries

- Weltweit führender Hersteller von Knopfbatterien
- Itingen (BL) – gehört zur Swatch Group SA
- Produktion ~1Mio Batterien pro Tag





Heizung Ein / Aus

Typ 395



12345

3D IM BECHER – ABER WIE?



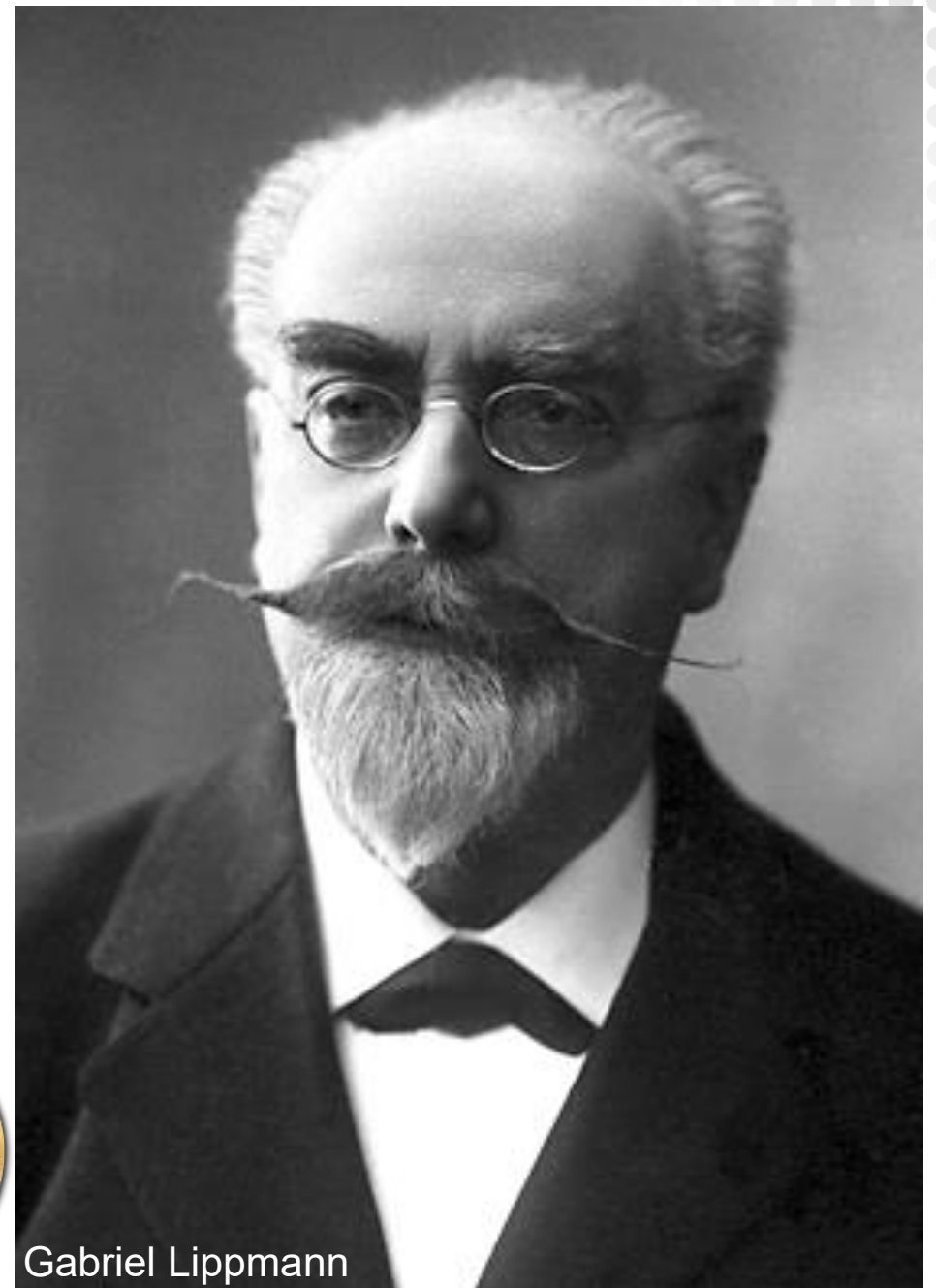


GESCHICHTE

Journal de Physique Théorique et Appliquée

Volume 7 / Numéro 1 (1908)

1908



Gabriel Lippmann

100 JAHRE SPÄTER...

2008



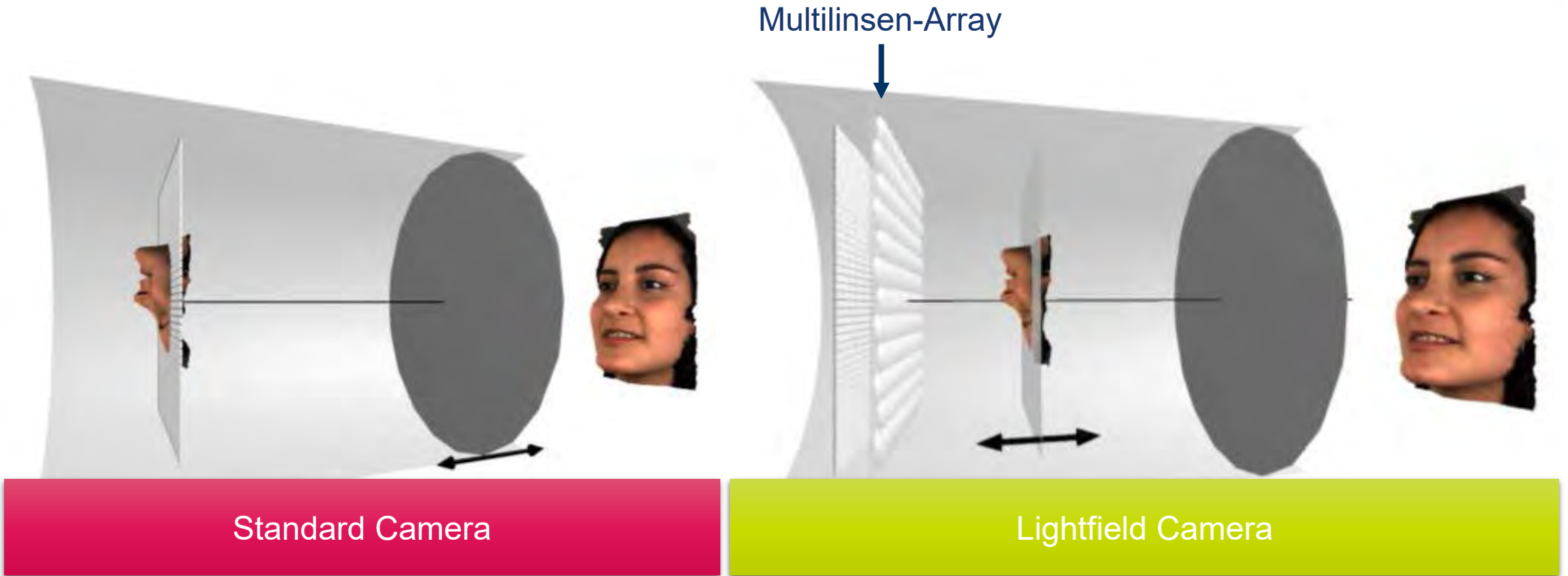
- ❖ Market entrance 2010
- ❖ Light field cameras for industry
- ❖ Patented Multi-Lense-Array



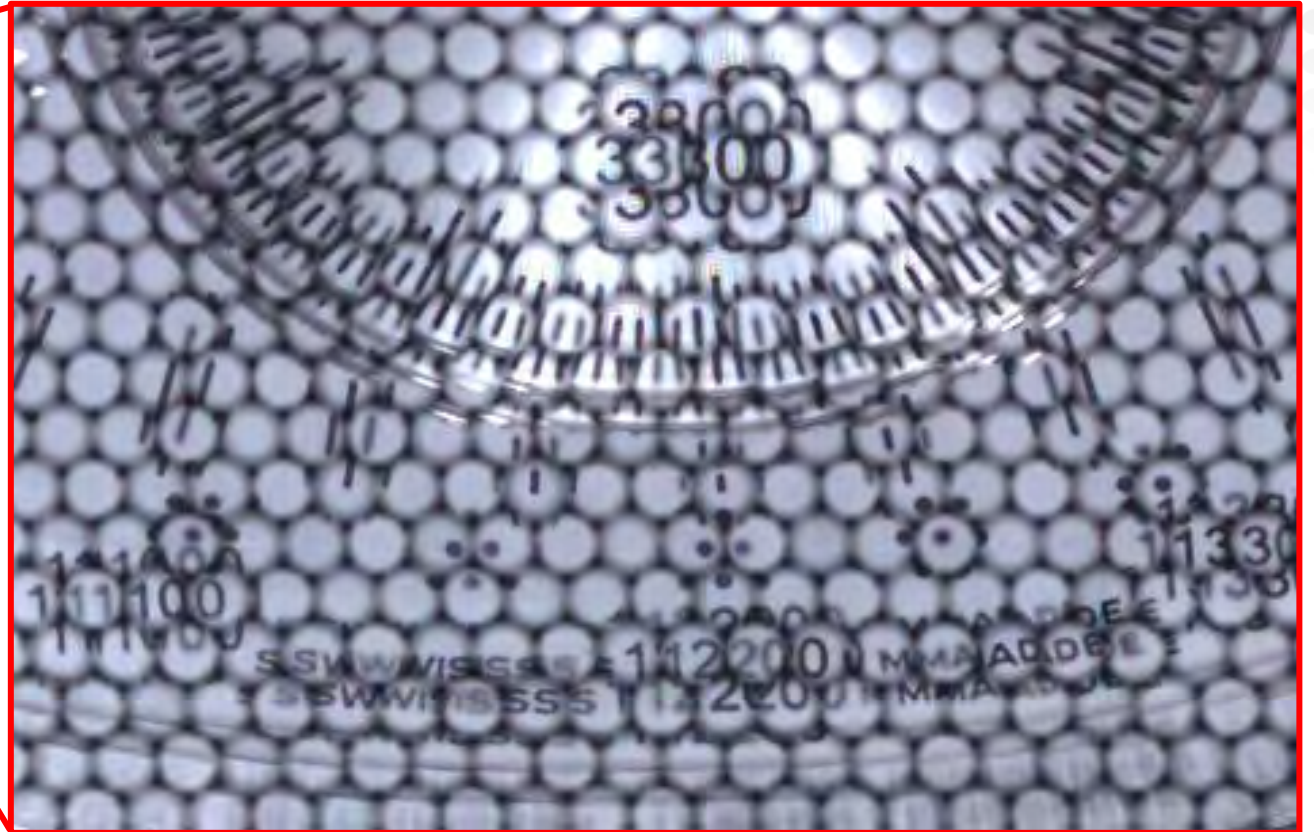
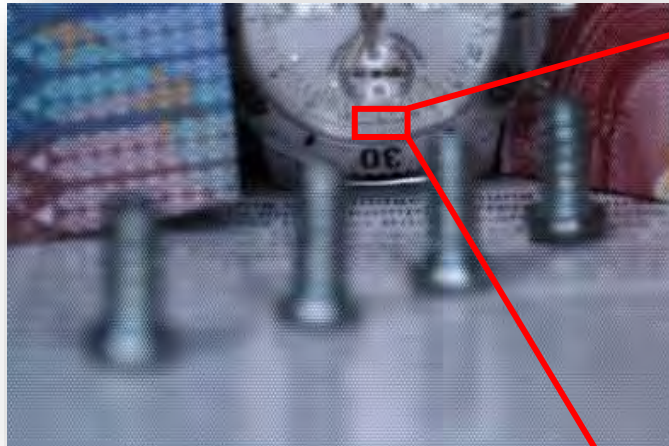
reddot award
winner



FUNKTIONSPRINZIP

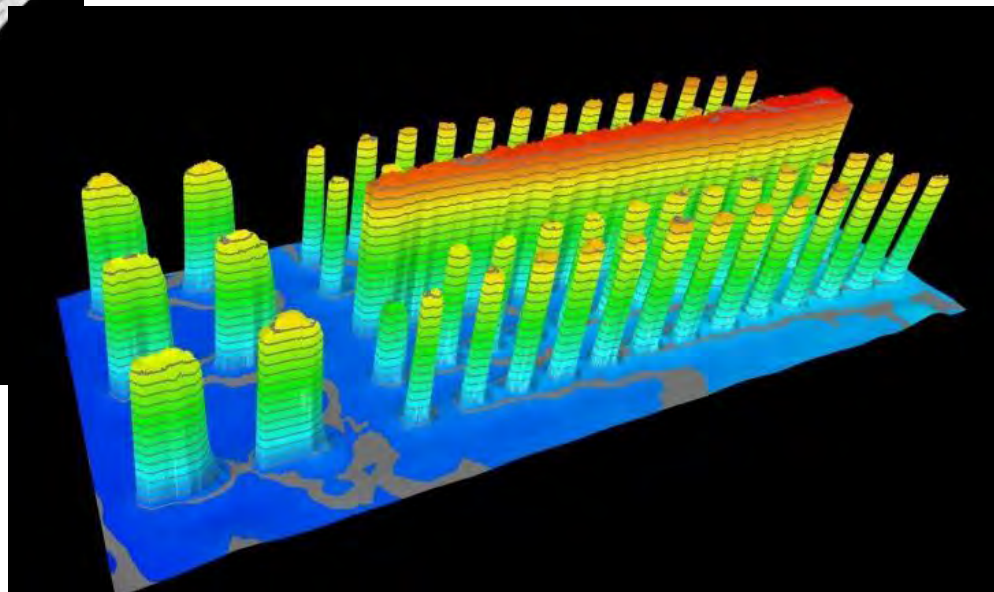
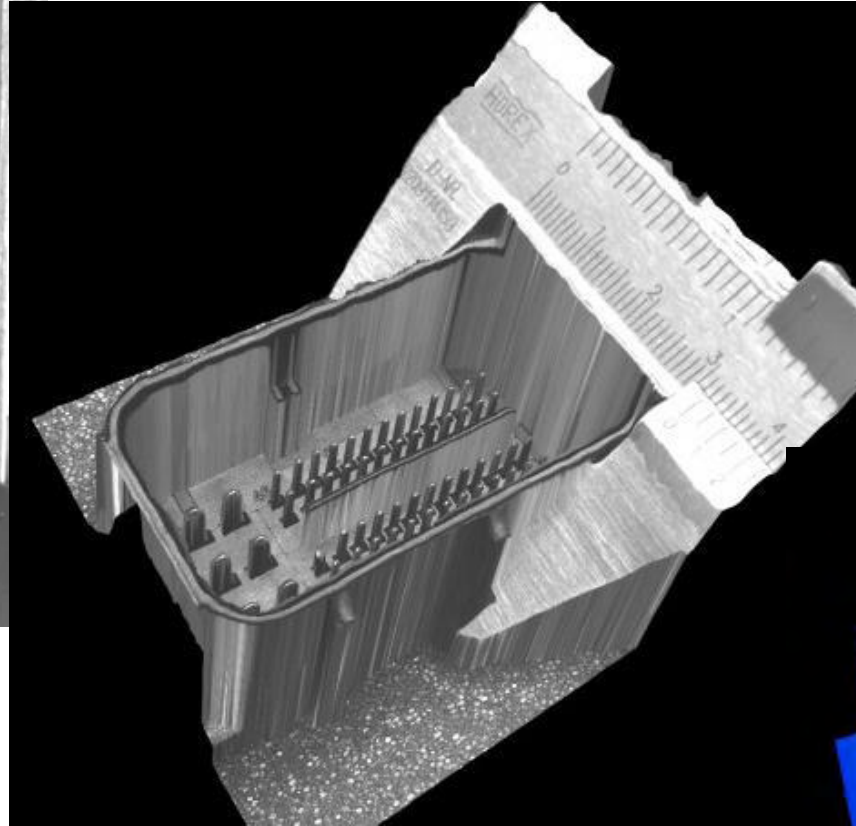
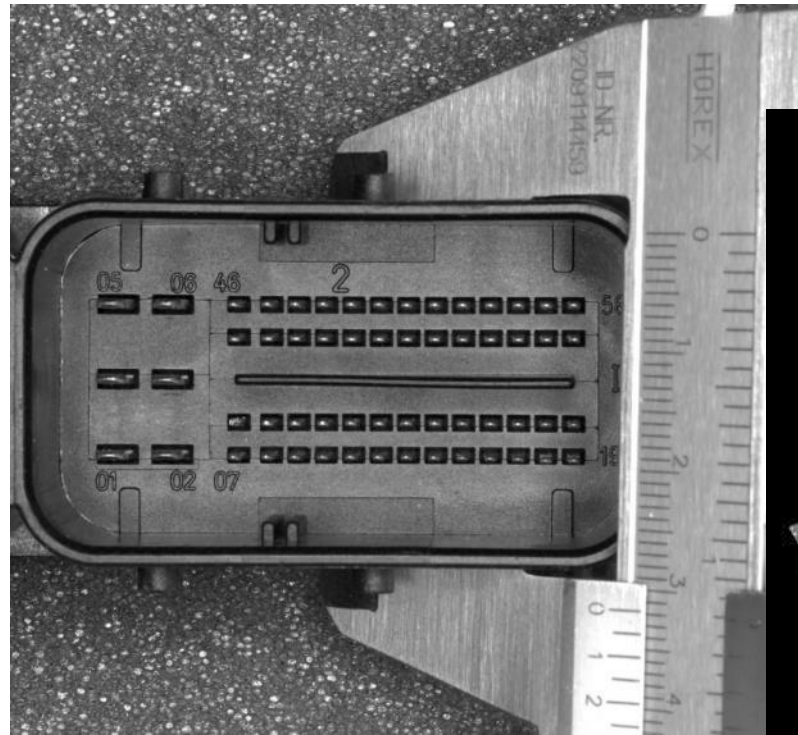


LIGHTFIELD (PLENOPTIC) CAMERA



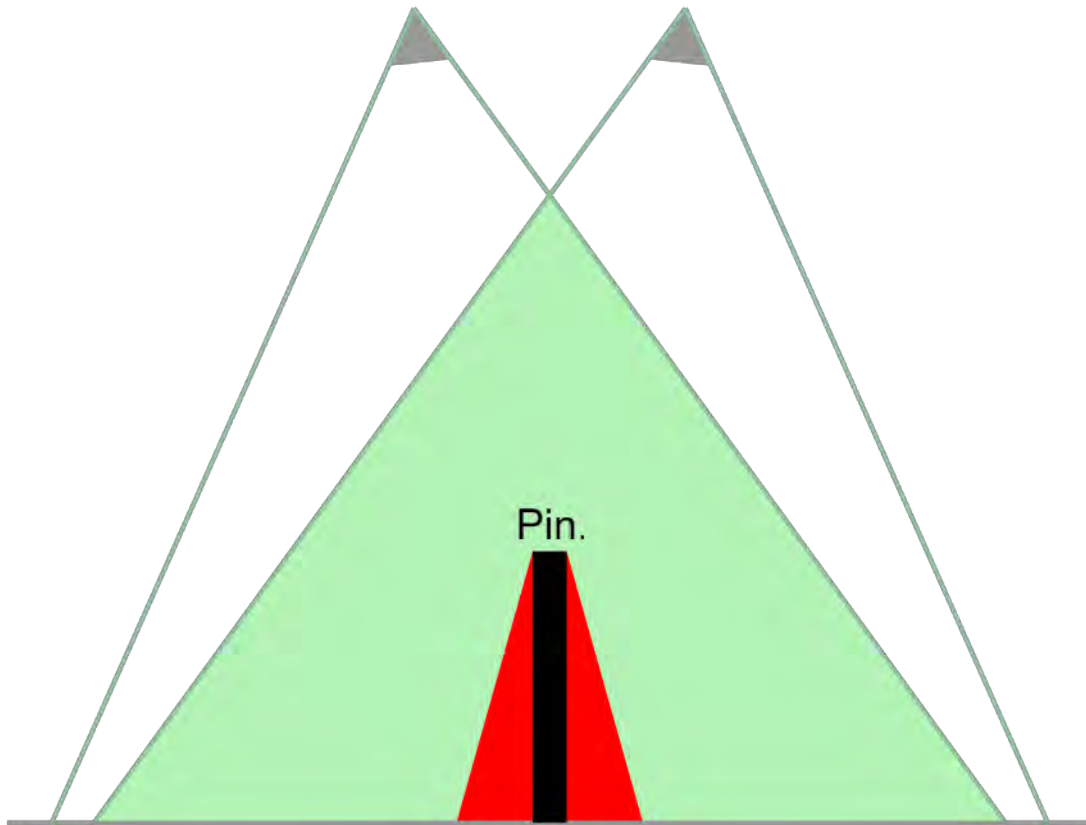
GPU Power

3D LIGHTFIELD CAMERA

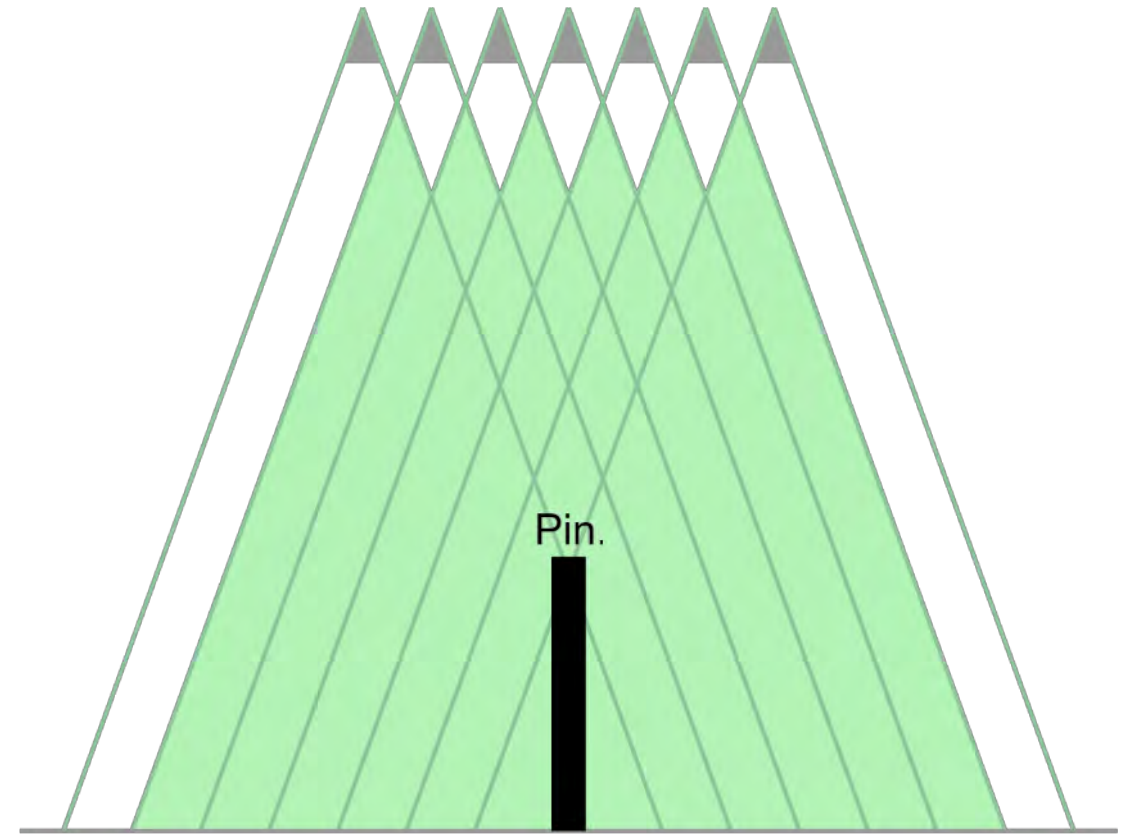


OCCLUSION

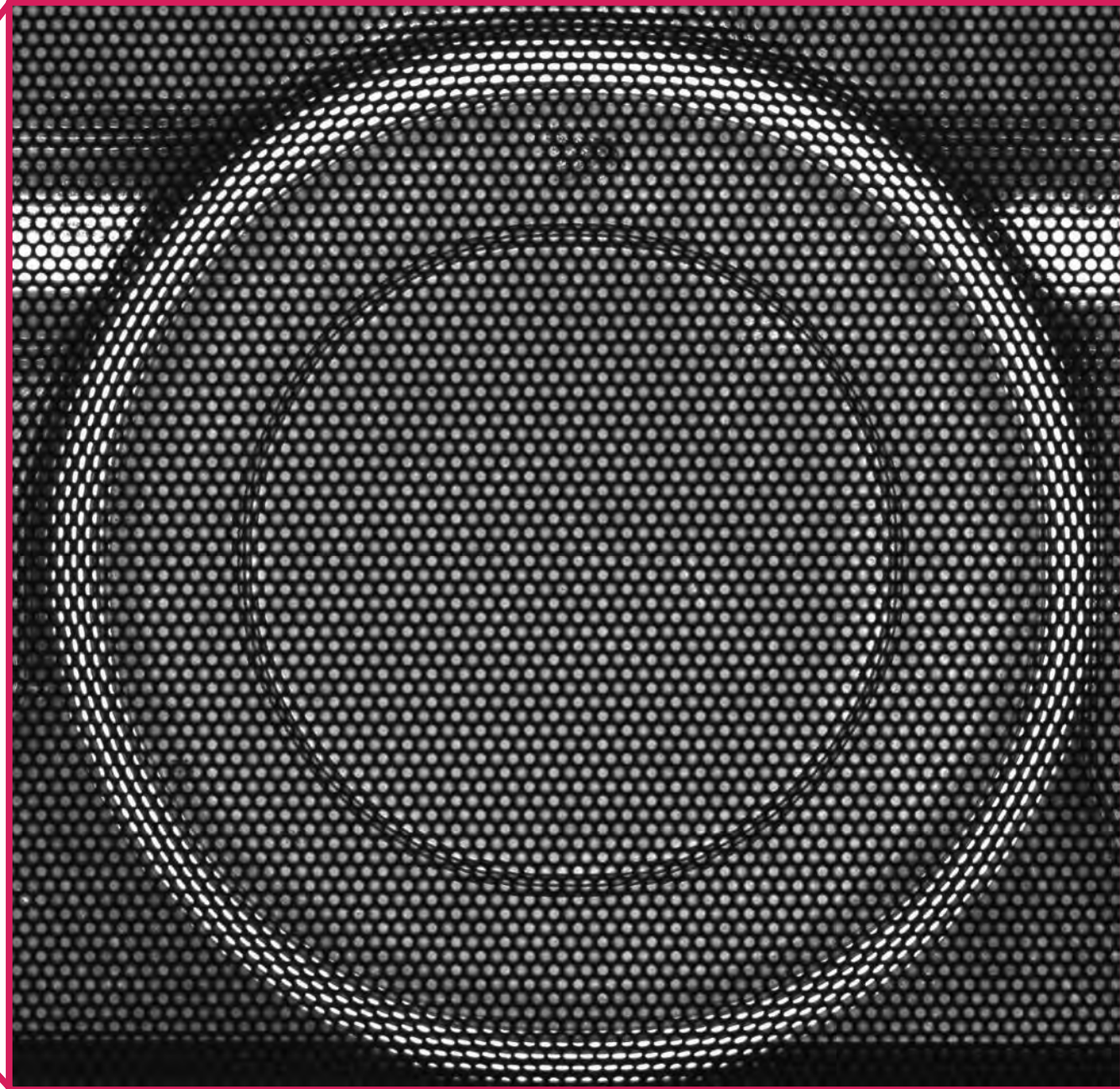
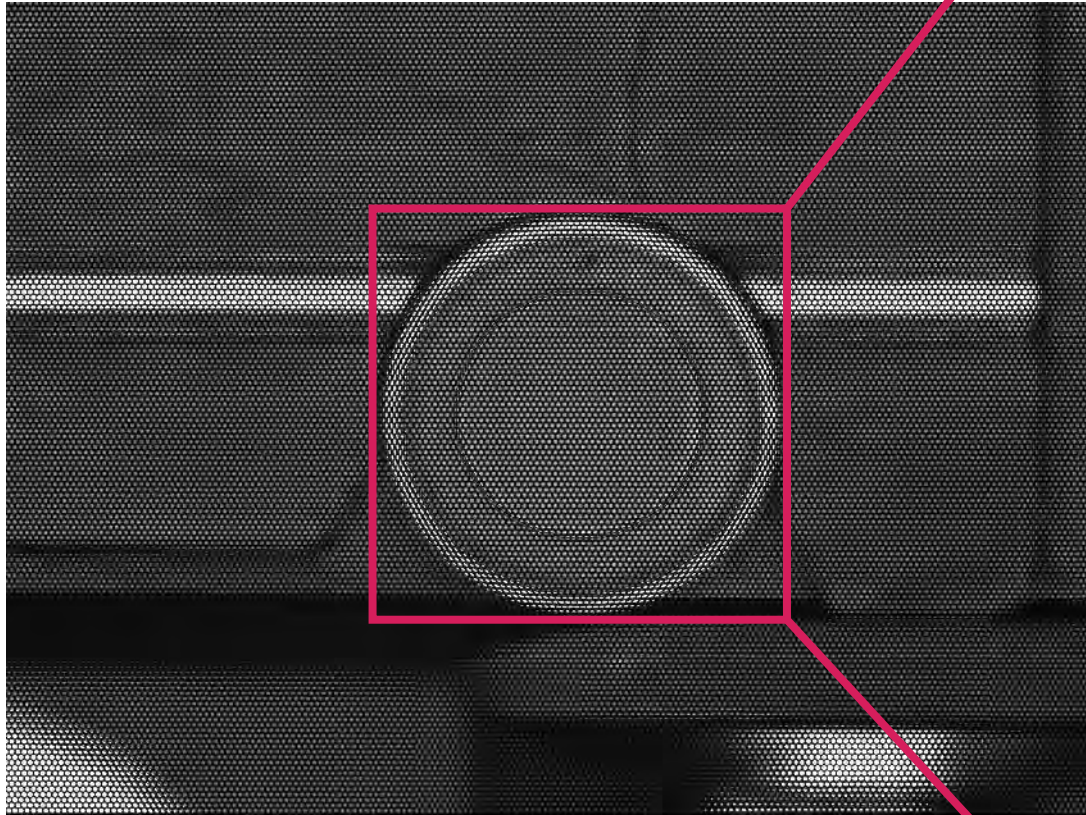
Stereo Camera



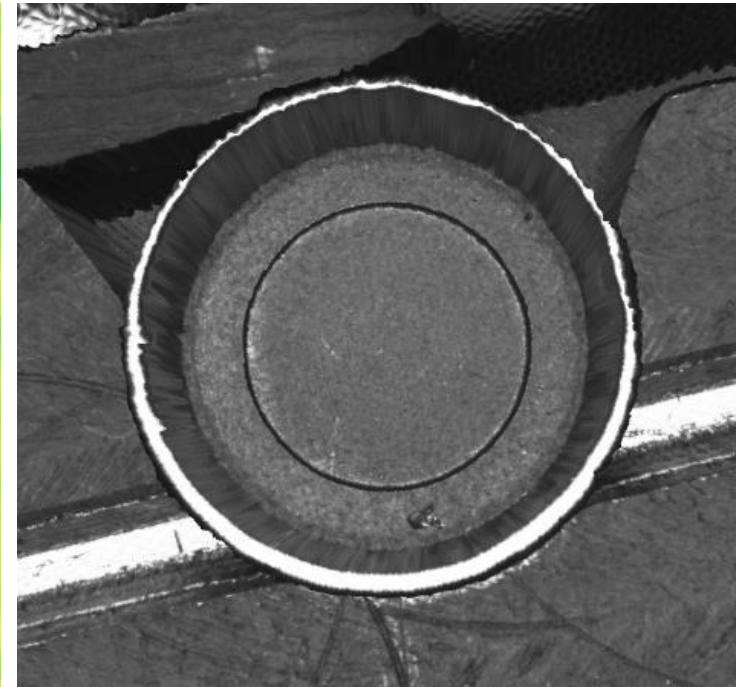
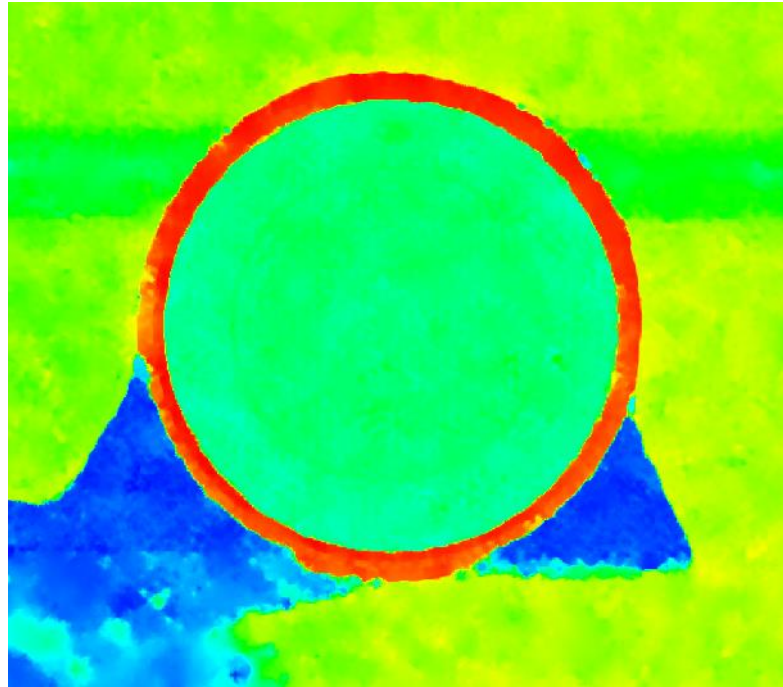
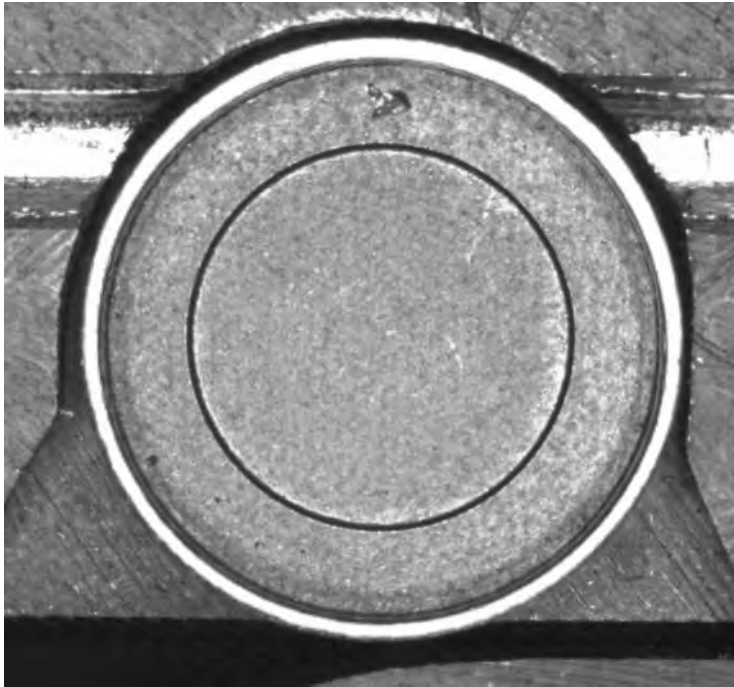
Lightfield Camera



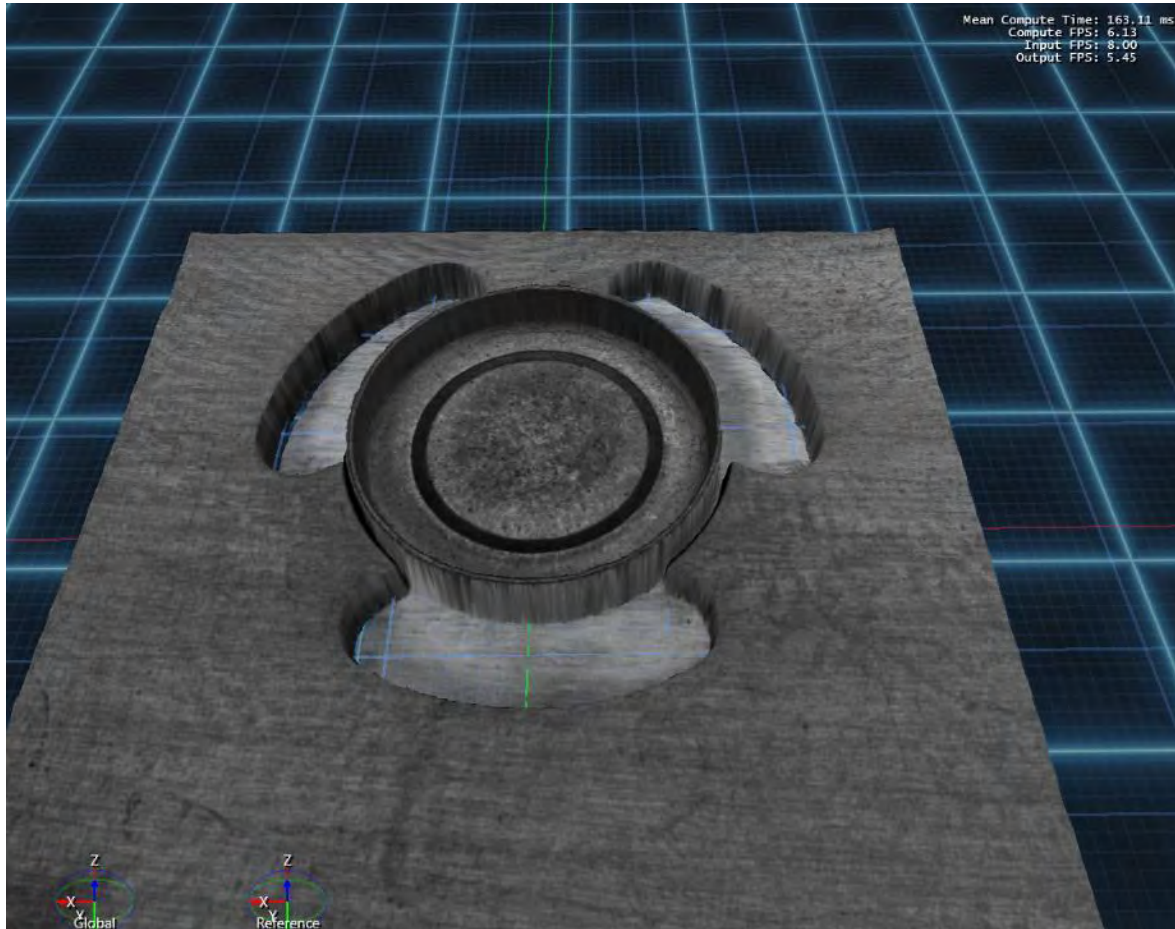
RAW BECHER



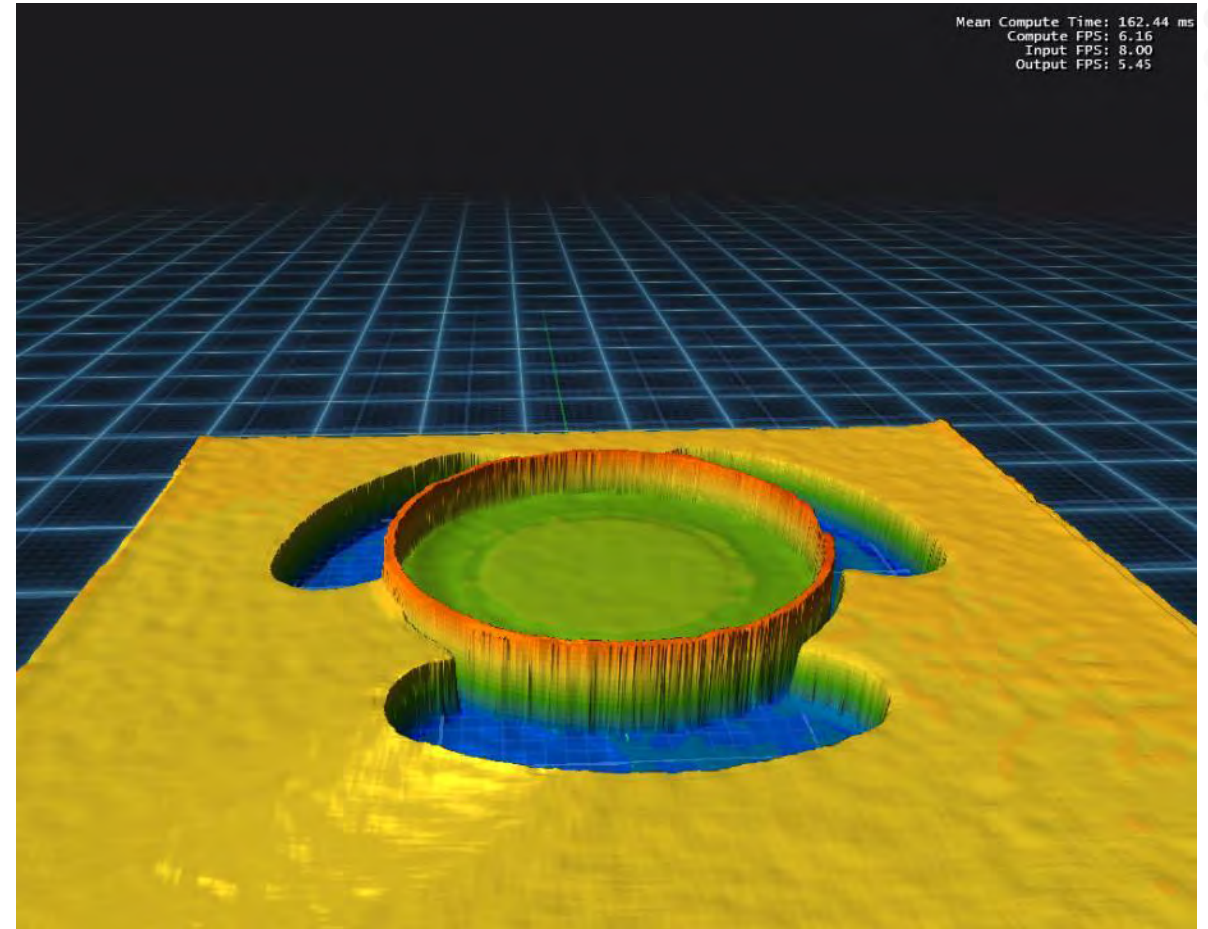
PROZESSIERTE BILDER BECHER



METROLOGY 3D



XY- Präzision
Z - Präzision



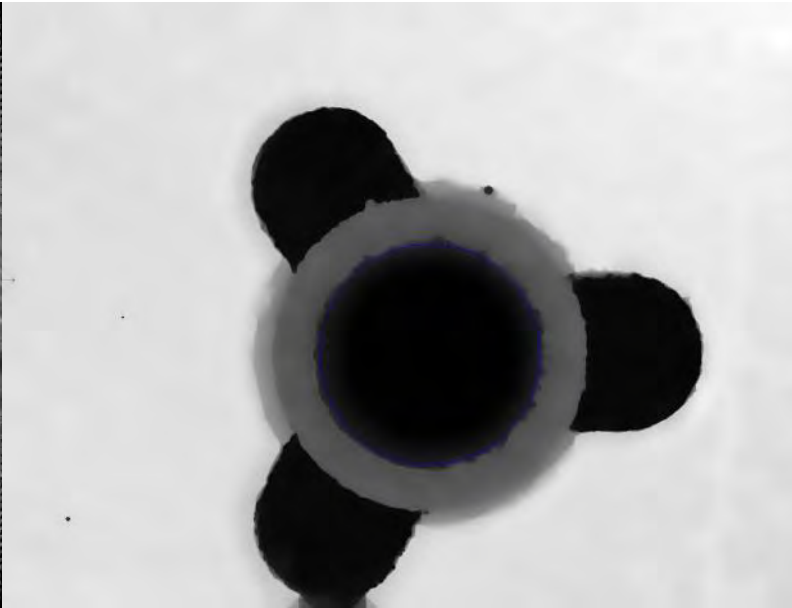
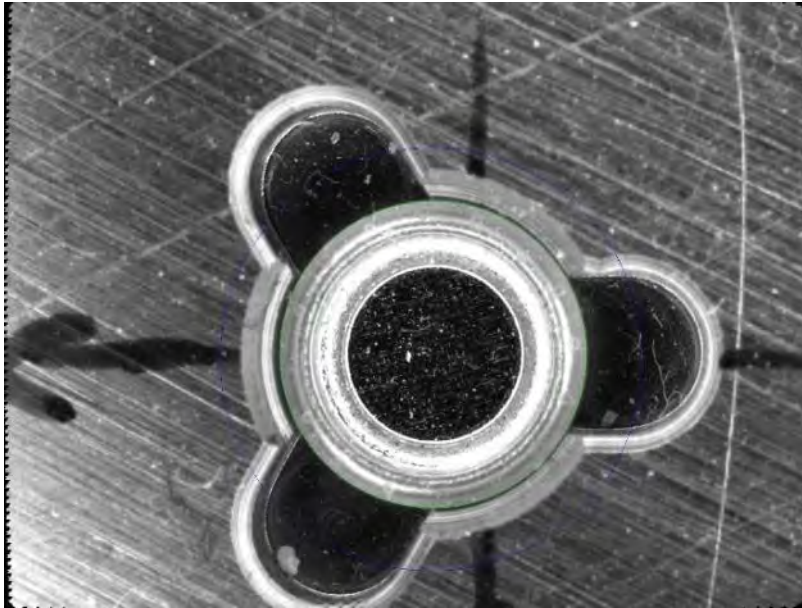
2 μ m
10 μ m

High-Speed 3D in Industry



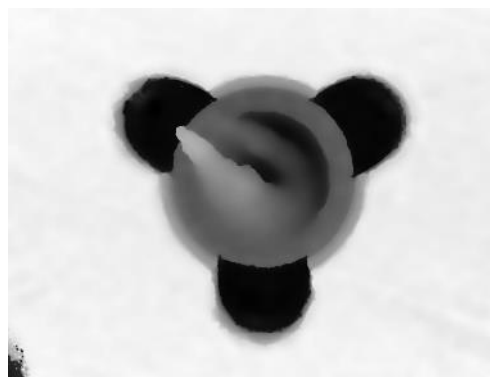
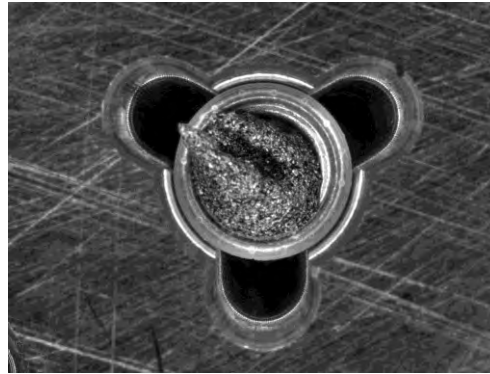
DECKELVERMESSUNG

- Überprüfung der Dichtung
- Aussendurchmesser
- Höhe
- Planarität



VOLUMENVERMESSUNG

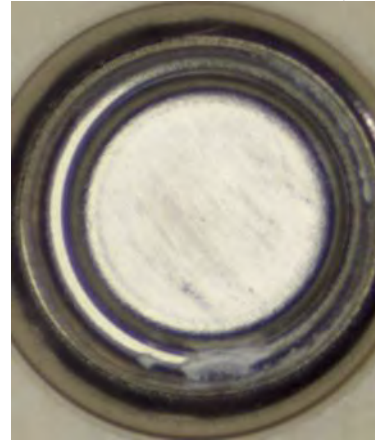
- Gewichtsbestimmung
- Paste sauber dispensiert



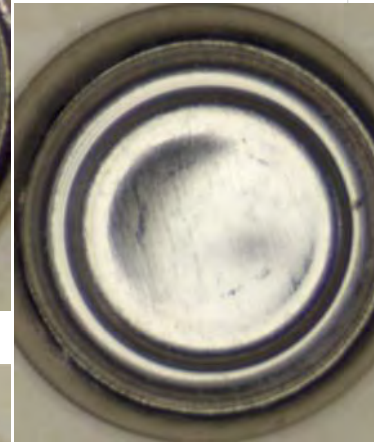
FEHLER



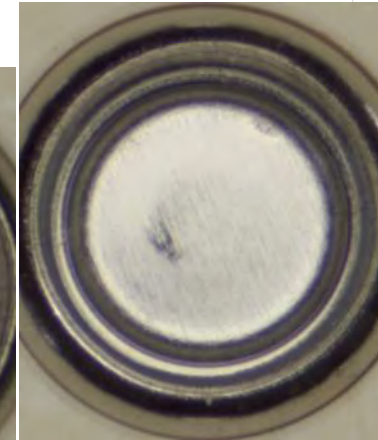
Fliesen



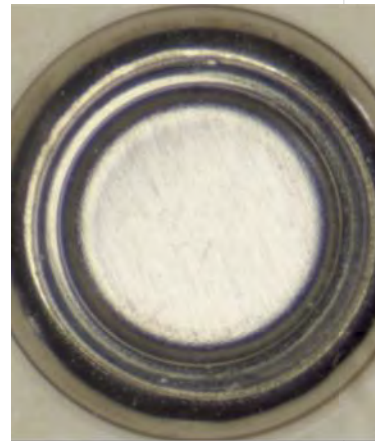
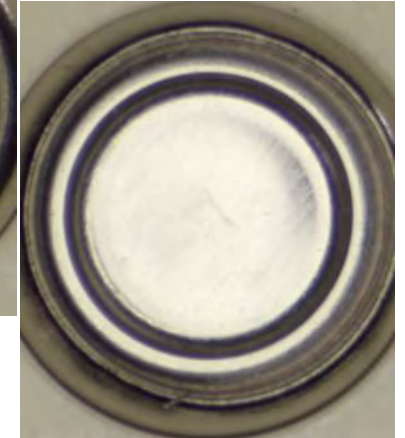
Eingedrückt



Kratzer



Span



Abgeschabt



Kratzer



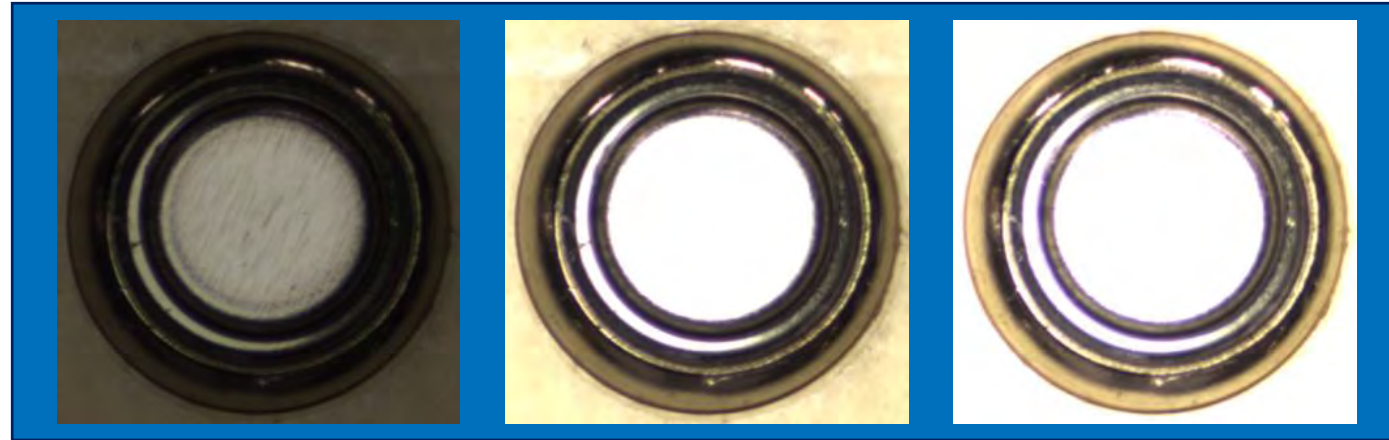
Flecken



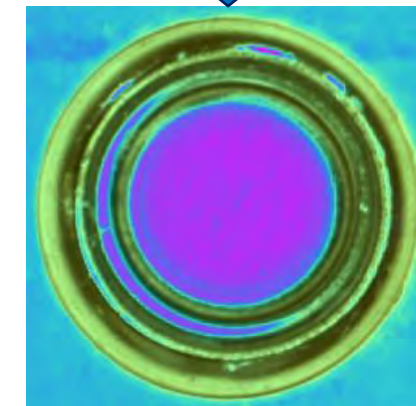
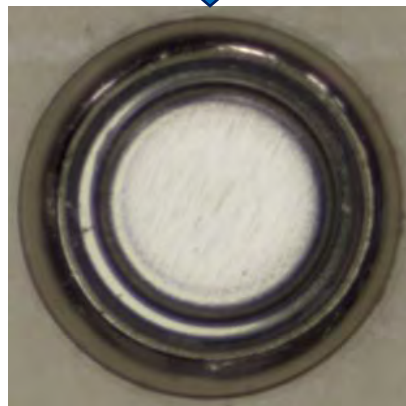
Laser

QUALITÄTSKONTROLLE

3 Rohbilder
unterschiedliche
Belichtungszeiten

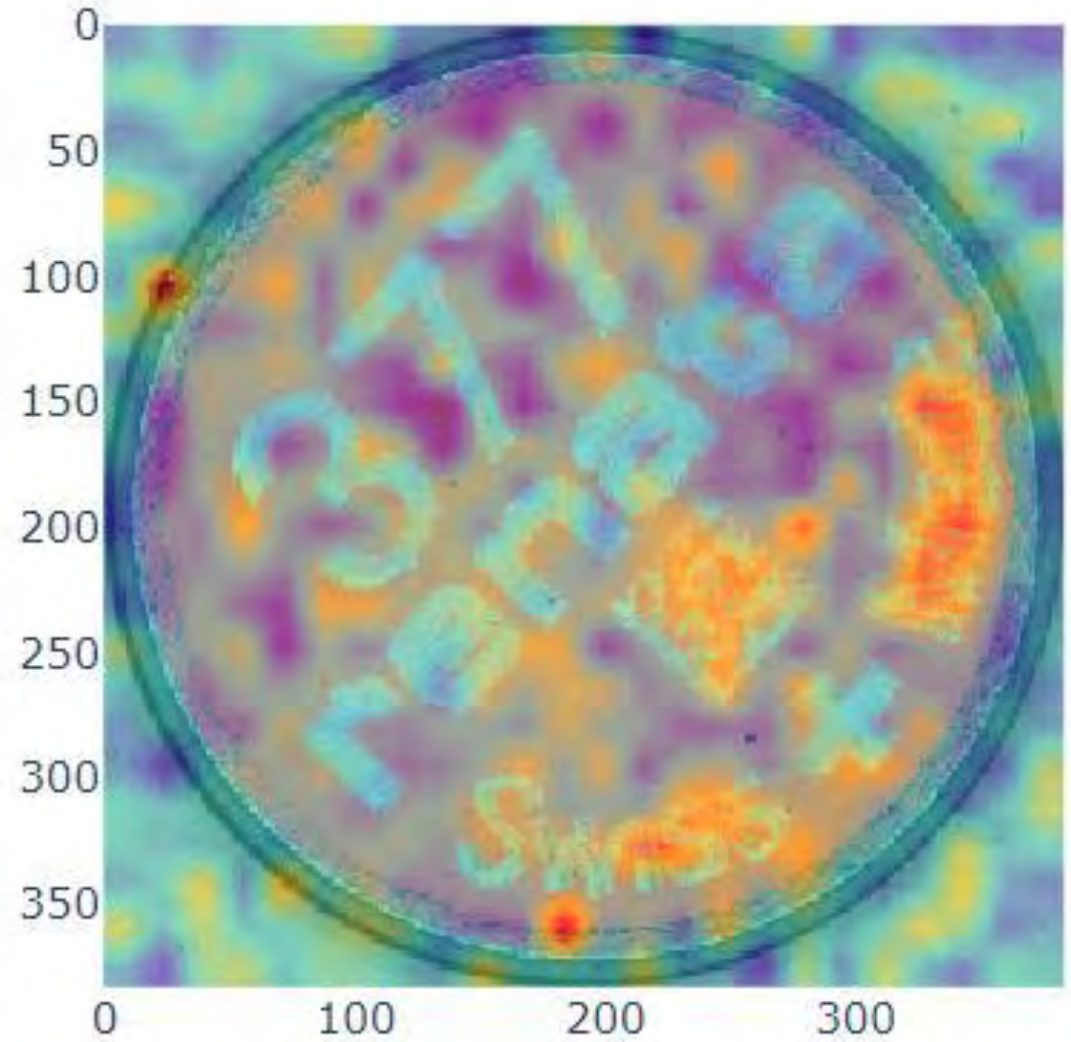


HDR Bild für
menschliche Experten



Falschfarbenbild für
das Neuronalen
Netzwerke

OPTIMIERTE NEURONALE NETZWERKE





<https://www.renata.com/de-ch/innovation/hochleistungs-knopfzelle/>

PREDICTIVE MAINTENANCE FOR INDUSTRIAL ASSETS



Predictive Maintenance

- ⌘ Deep learning for system monitoring
- ⌘ Full integration with lifelong learning
- ⌘ Reducing downtime of industrial assets

⌘ **csem**

in cooperation with

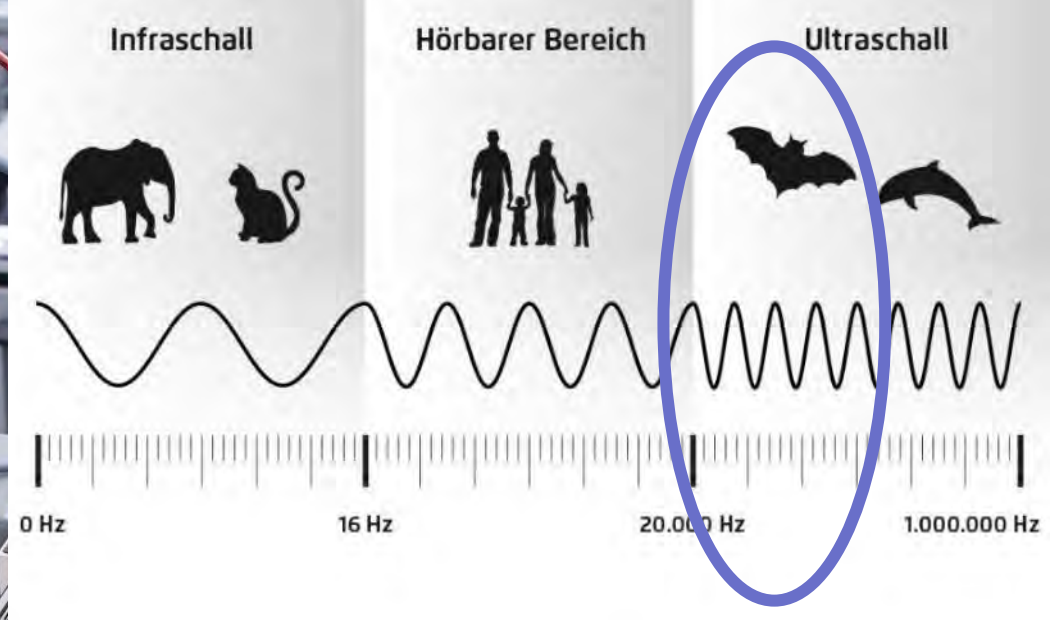
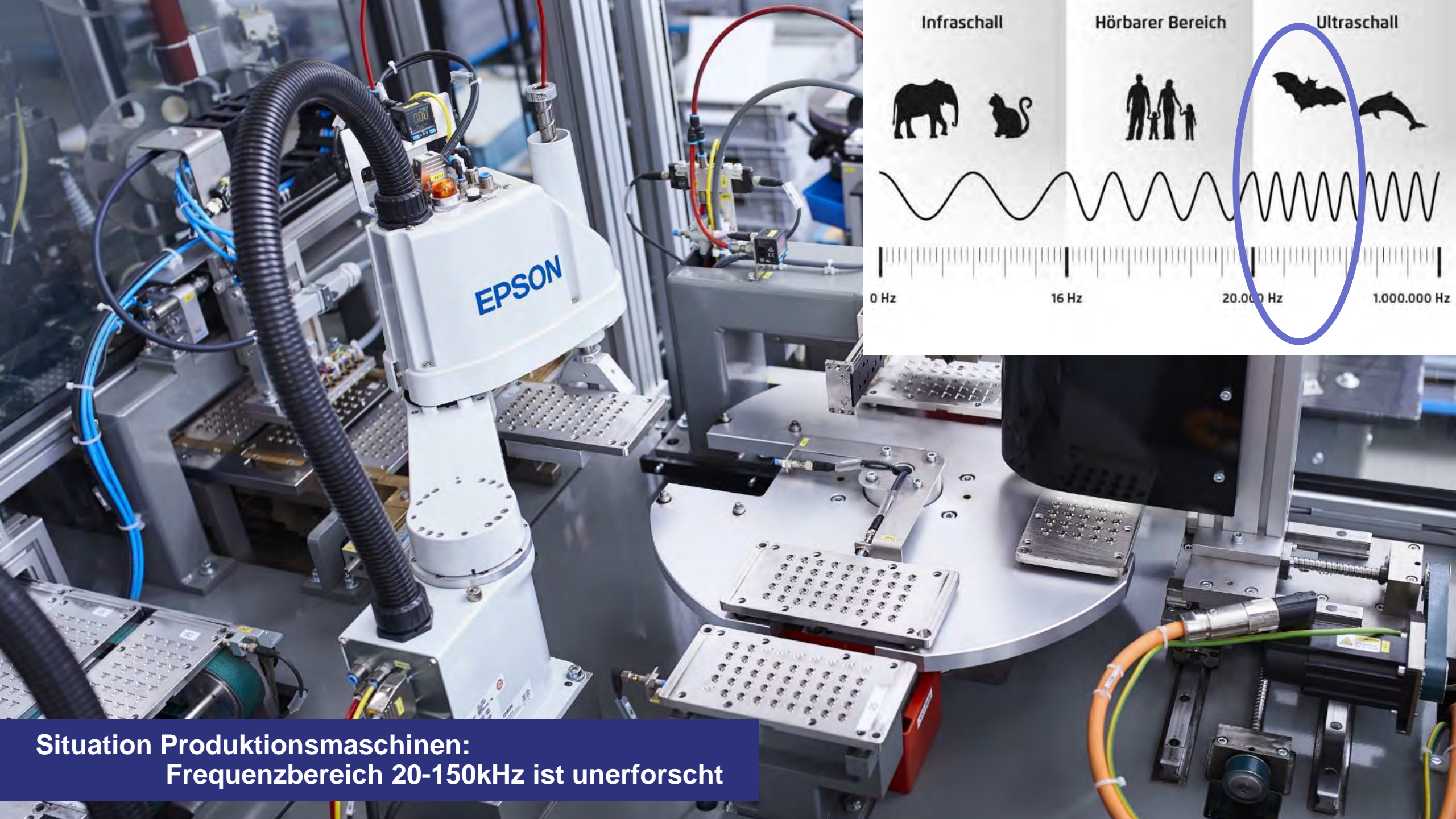
aurovis
automation - robotics - vision systems

maxon

SCHURTER
ELECTRONIC COMPONENTS

KTF

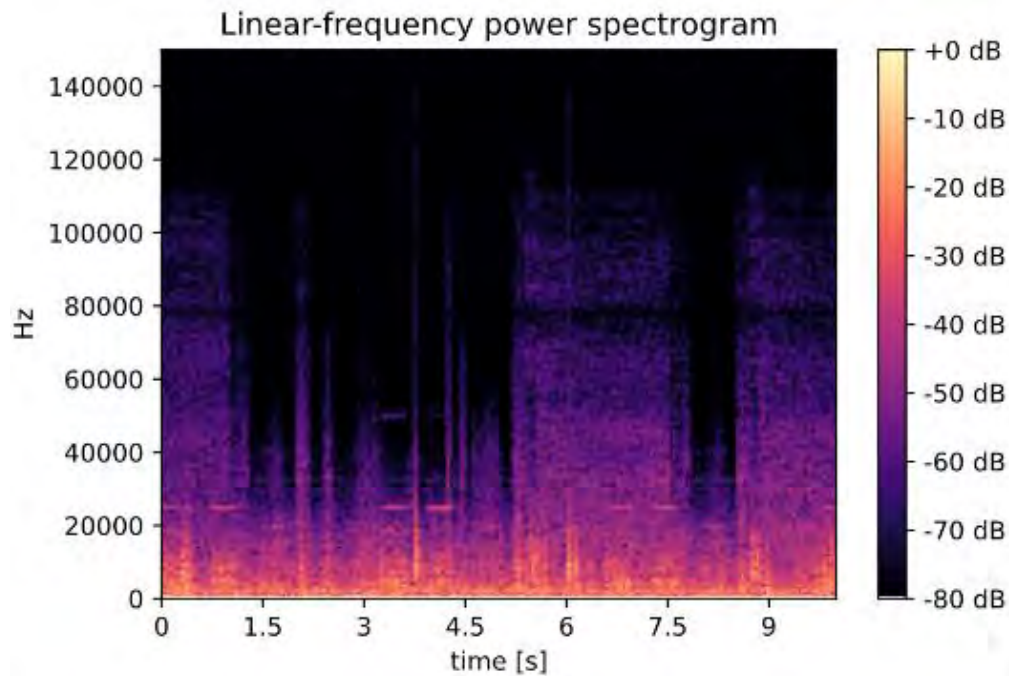
elekon



**Situation Produktionsmaschinen:
Frequenzbereich 20-150kHz ist unerforscht**

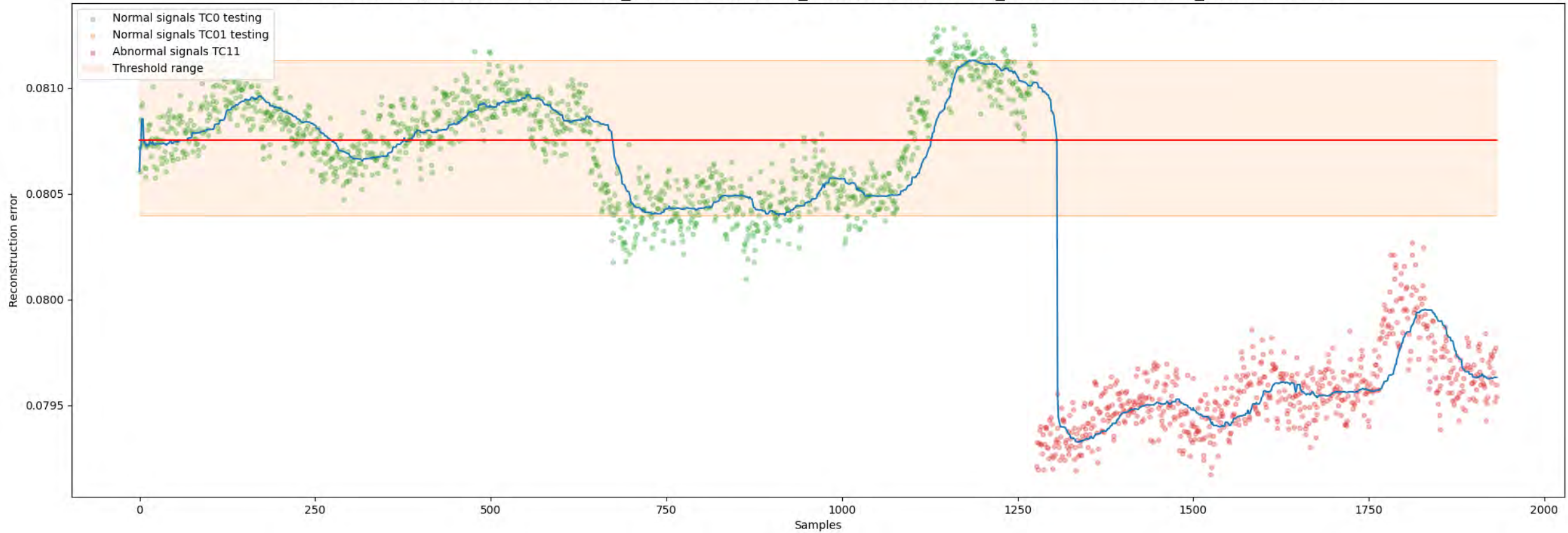
SPEZIAL AKUSTIK

- Einfache Installation an jeder Maschine
- Kompakte und mobile Sensorik
- Jede Maschine verursacht Geräusche
- Kein Eingriff in Maschine



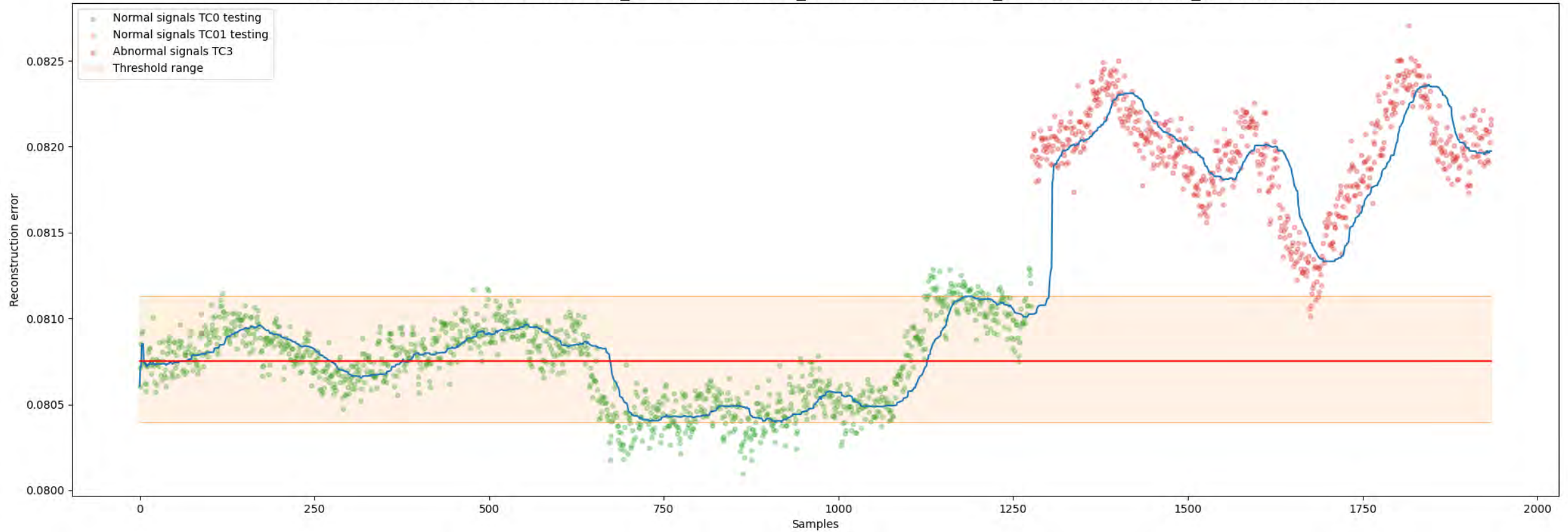
CONVEYOR BELT FAILURE

Threshold range exploration, correct_normal: 1.00, false_normal: 0.00, correct_abnormal: 0.95, false_abnormal: 0.05



CAMERA FAILURE

Threshold range exploration, correct_normal: 1.00, false_normal: 0.00, correct_abnormal: 0.96, false_abnormal: 0.04





CS&M

FACING THE CHALLENGES OF OUR TIME

Photo by Pilatus Aircraft Ltd

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