SHIRATECH KNOWTION

Elevating

Industrial Efficiency

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About Us | Next-Gen Software Solutions

SHIRATECH KNOWTION

We are your **one-stop technology partner** for developing cutting-edge software solutions tailored to meet your specific needs.

2011 founded in Karlsruhe out of **KIT**

200+ scientific publications in **innovative research**

100+ successful customer **projects**

SME to Corp customer **range**

Since 2021 a subsidiary of **Shiratech Solutions Ltd.**

PhD & Master degrees build our development **team**

ICG ISO 9001 zertifiziert
Knowtion GmbH, Karlsruhe
certified since 2012

Allianz für Cyber-Sicherheit
Teilnehmer

Mitglied im AMA Verband für Sensorik - Messtechnik
Innovatoren verbinden

OPEN INDUSTRY 4.0 ALLIANCE

Our Expertise

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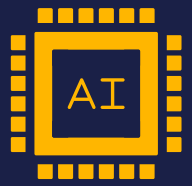
Defence & Aerospace

Aviation Software

Power Technologies

Industrial Applications

Sensor Technologies



Smart Products

Public Projects

Medical Technologies

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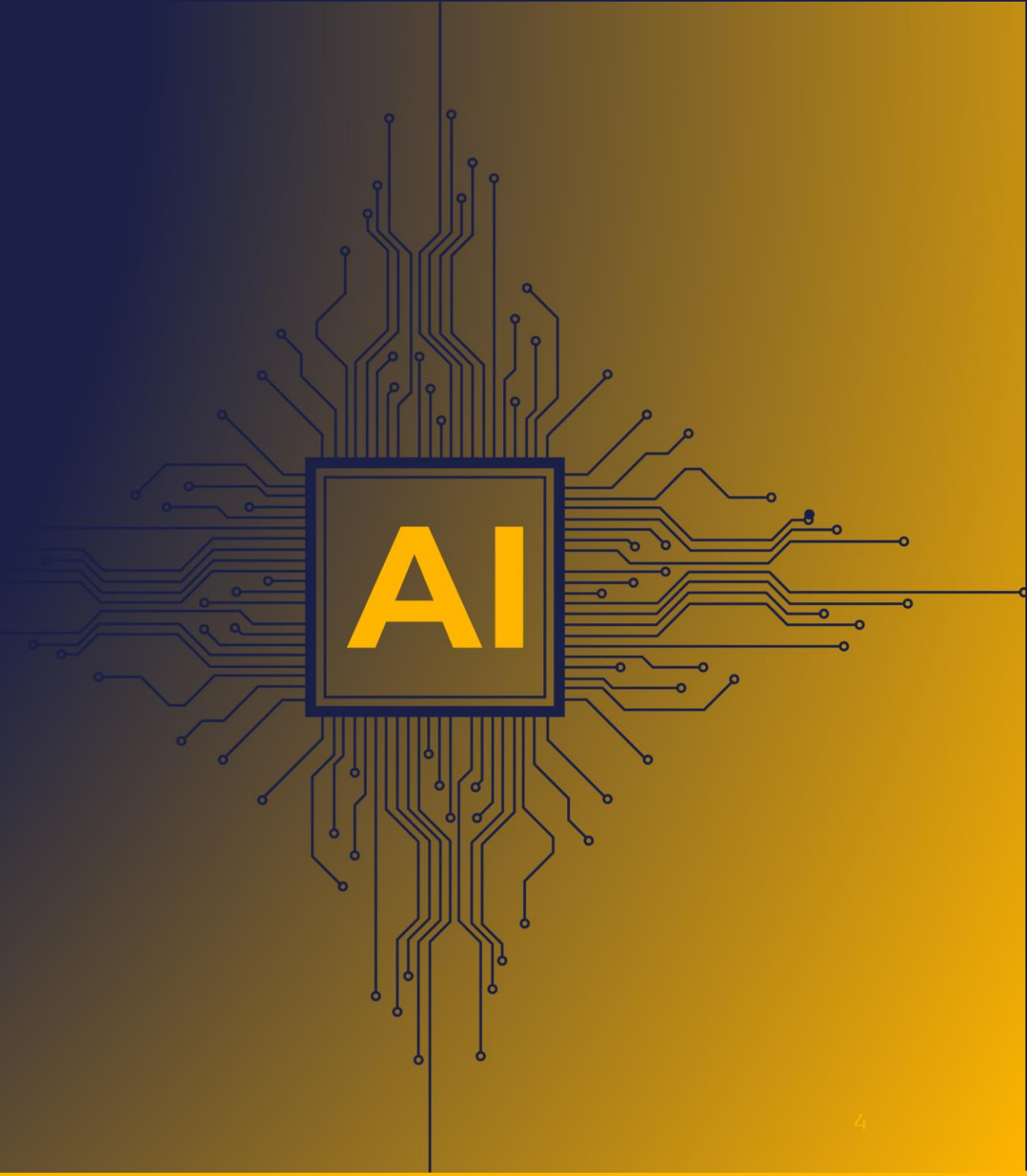
Models/Algorithms **for IoT Applications**



Models/Algorithms

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With the right **models / algorithms**, higher-value information can be extracted from

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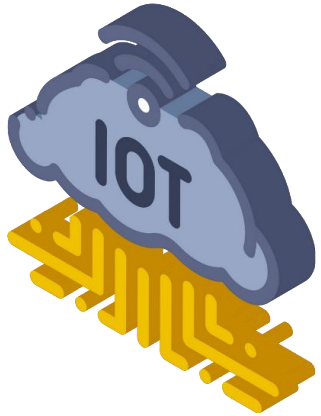
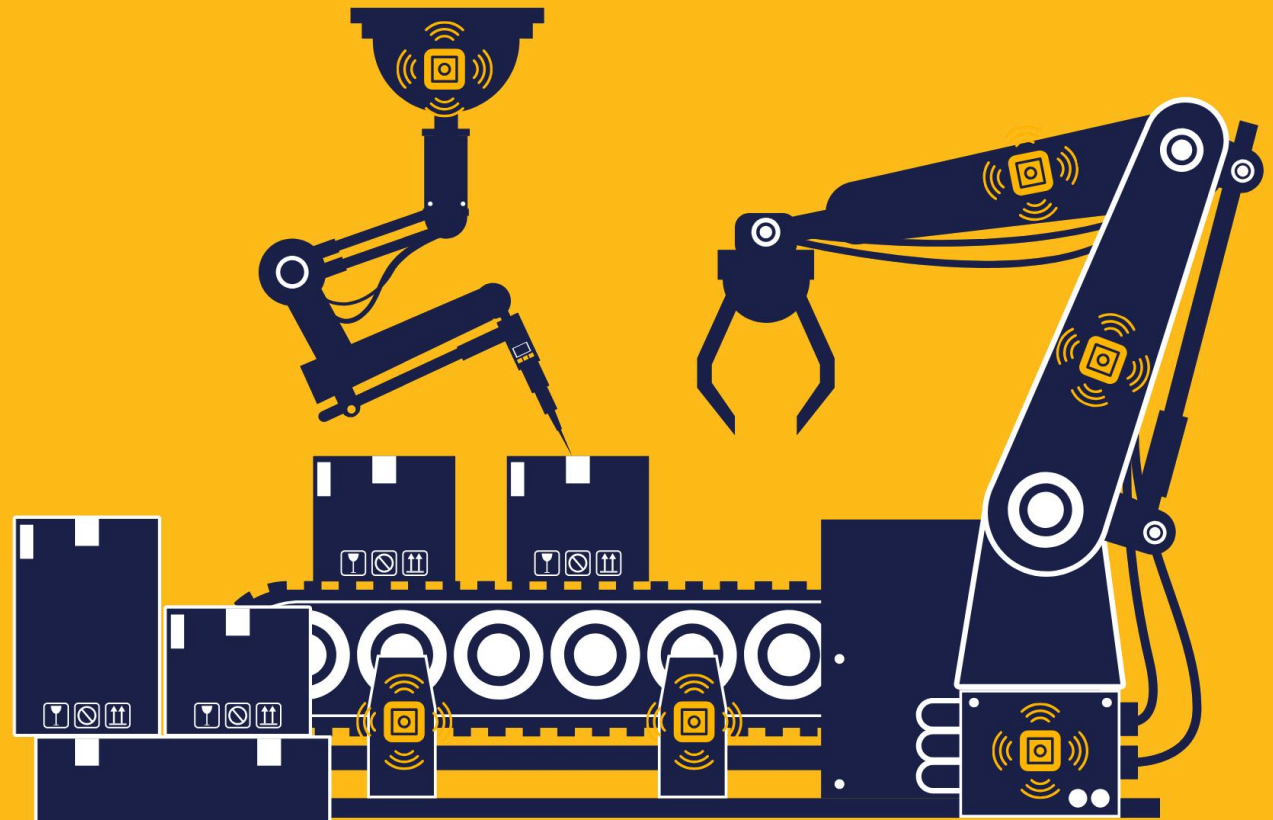
Cloud Analytics



Edge Analytics



Local Analytics

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AI-powered **Predictive Maintenance**

Typical Development of Machine Failures

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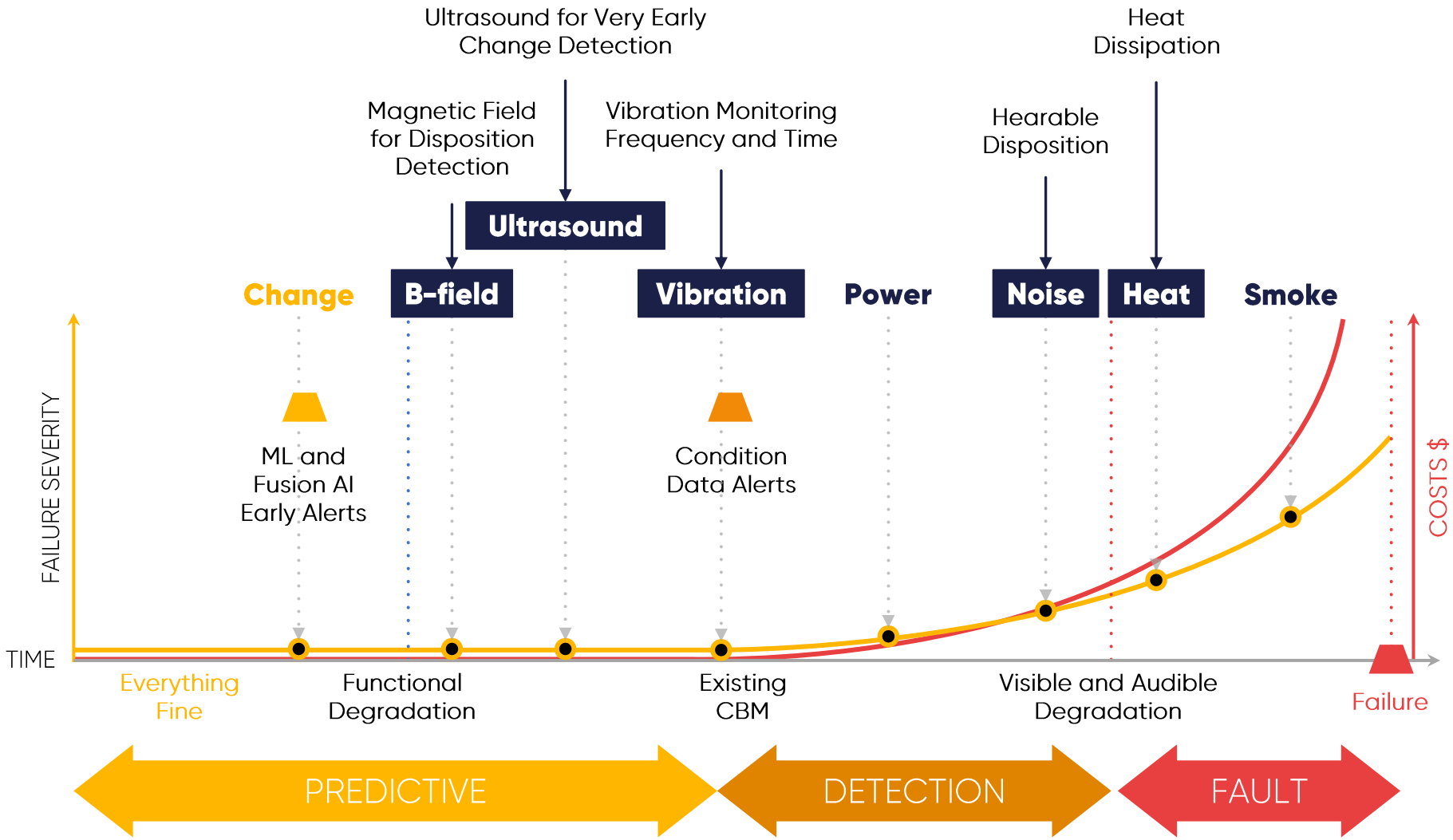

Benefits of Predictive Maintenance

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What Predictive Maintenance Can Provide:

- Increase in equipment efficiency and availability (Overall Equipment Effectiveness; OEE)
- Reduction of operating costs
- Reduction of maintenance costs

State-of-the-art technologies are cleverly applied in the process:

- Artificial intelligence (AI), neural networks (NN) and machine learning (ML)
- Smart, non-invasive add-on sensors
- Data from existing machine controls and enterprise software

→ **Detection of smallest changes and precise predictions about failures & actionable recommendations**

→ **Serves as a reliable & transparent basis for decision-making to avoid failures**

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Smart Handheld Device

CASE STUDY

Smart Handheld Device

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Automated Condition Monitoring of a Hand Tool with Motor & Gear

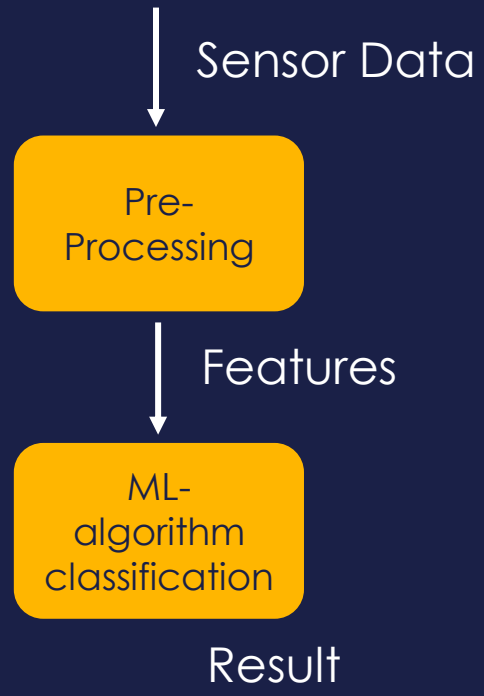
→ **Detection of error states such as**

- ✓ Engine failure
- ✓ Gearbox damage

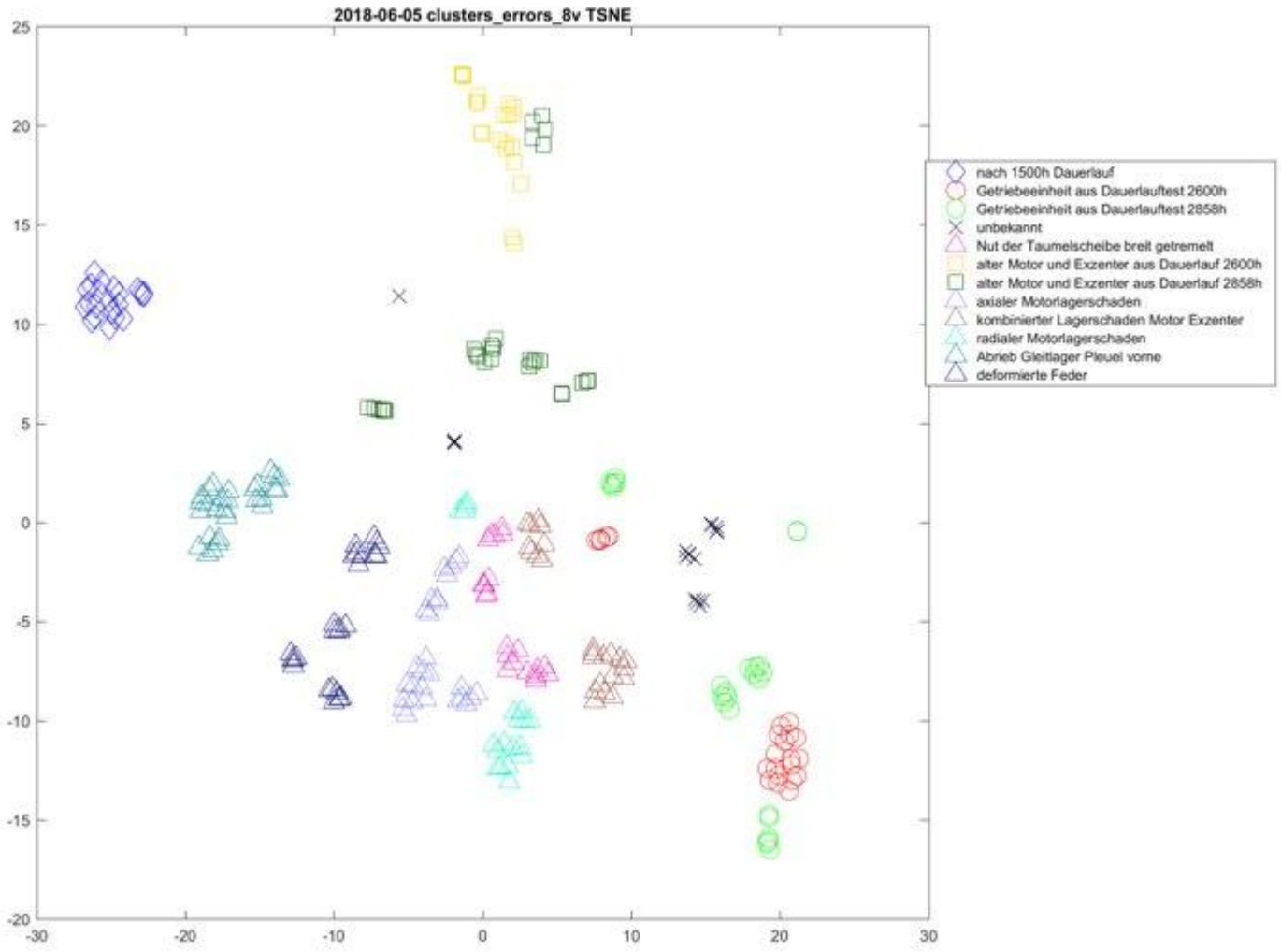
→ **Development of an Aging Model that**

- ✓ detects changes over time
- ✓ predicts emerging engine failure

Approach: Data-Driven



Clustering Error Pattern



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→ The same errors are "close to each other"

→ Different errors are distinguishable

"Time of Failure" Prediction

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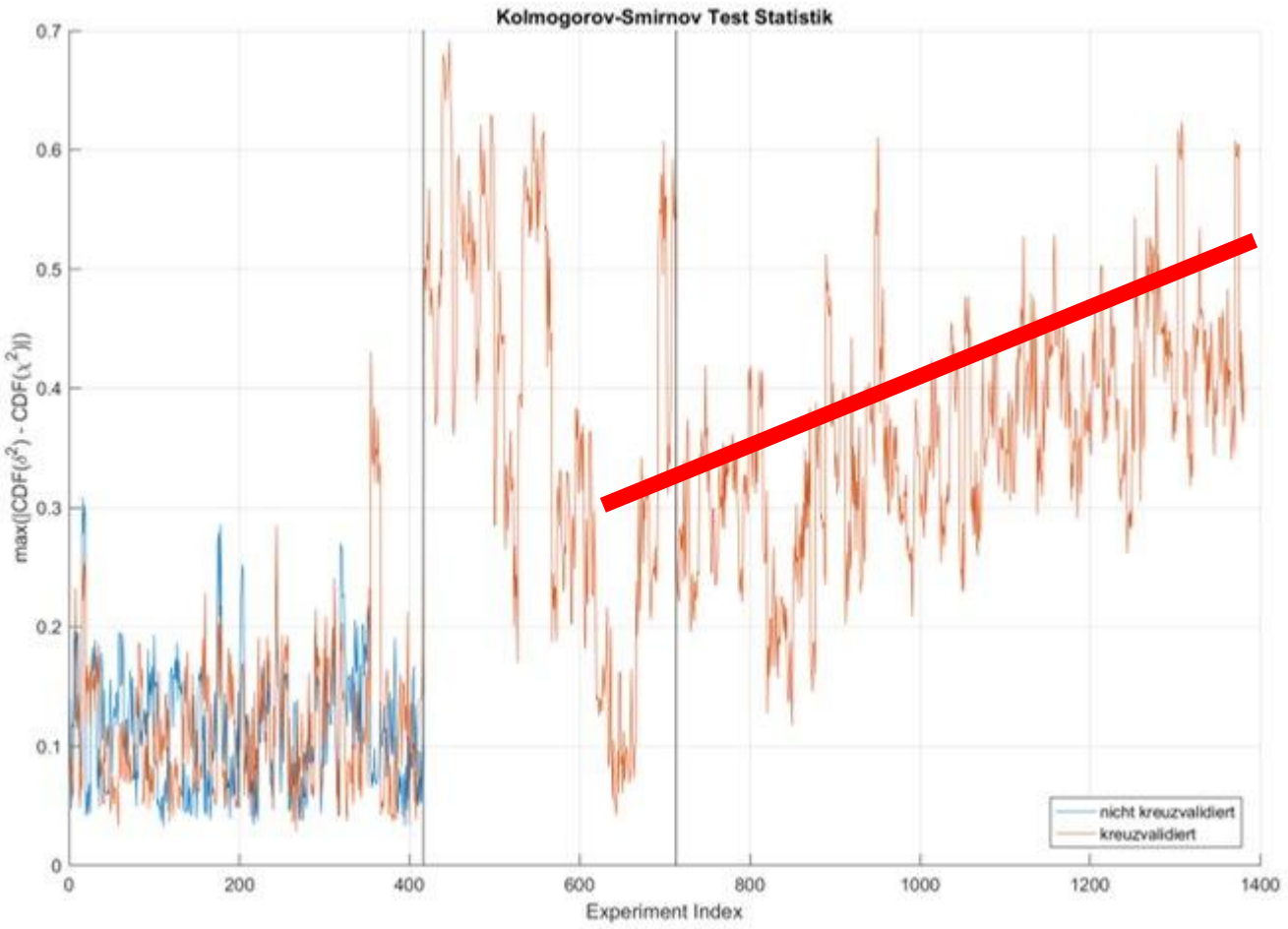

Aging Model

- **Test statistics:**
  Deviation of the distribution of the differences across all features from the expected distribution
- **Signification increase recognizable over time**
- **Allows prediction of the time of failure**

→ **Predictive Maintenance**

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CNC-Machine **Monitoring**

CASE STUDY

The Experiment Setting

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1. **Regular milling to smooth the surface and to capture a reference of the working machine (= Reference)**
2. **Part two and three are the same milling pattern with a different milling head**
   - A NEW 10 mm head (=**New head**)
   - A blunt 8 mm head (=**Blunt head**)
3. **Two iCOMOX™ sensors for data collection**
   - On the side of the spindle
   - On the base plate

Sensors used:

- ✓ Analog accelerometer
- ✓ Microphone
- ✓ Temperature data available but unused
- X No magnetometer
- X No digital accelerometer

iCOMOX™ on Spindle

Acceleration Data Spectrogram + RMS-Vibration Level

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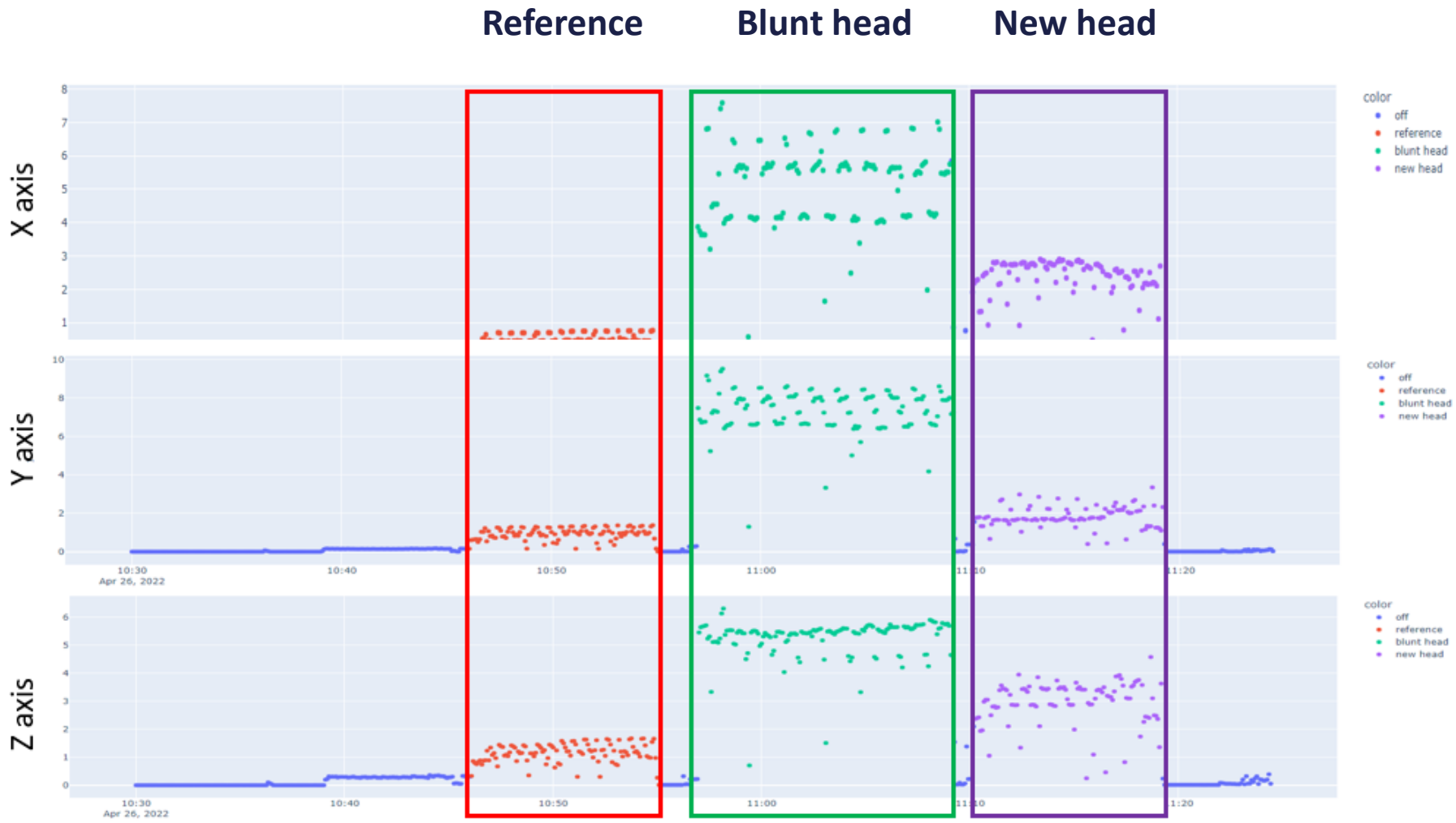

All 3 experiments are clearly identifiable

Differences in vibration levels clearly visible

iCOMOX™ on Spindle

Acceleration Data Spectrogram + RMS-Vibration Level

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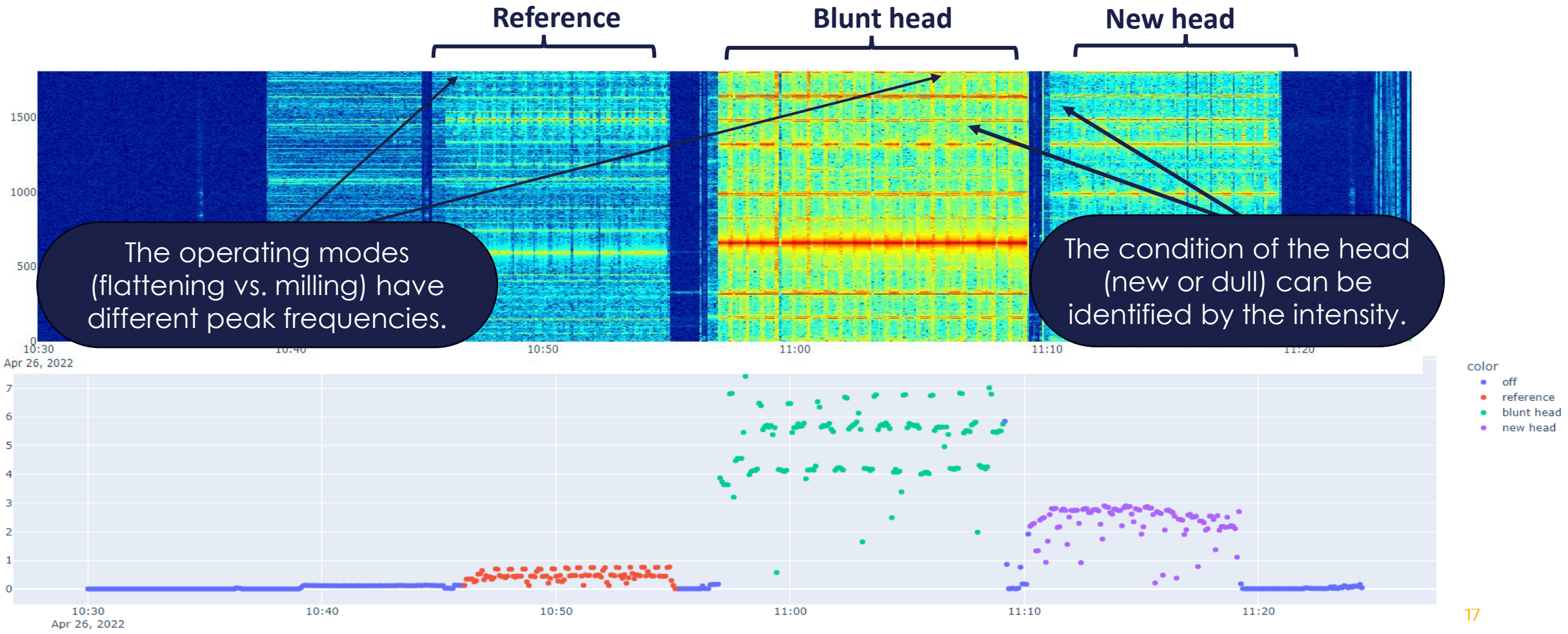

iCOMOX™ on Base Plate

Accelerometer, RMS-Vibration

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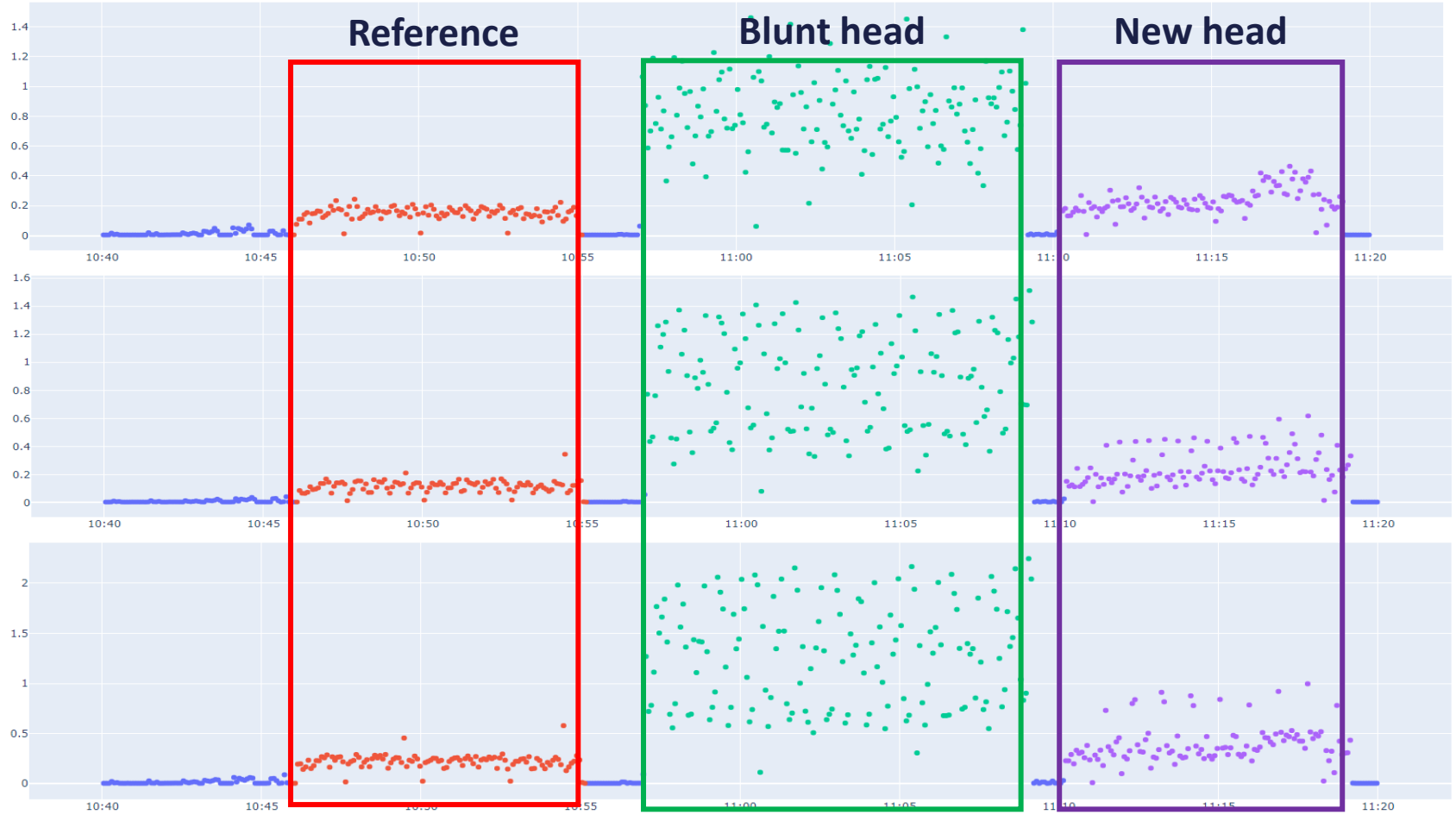

Similar results to iCOMOX on spindle

Difference between "reference" & "new head" is less clear

Final Classification

Spectral features + focus on extrema (no RMS)

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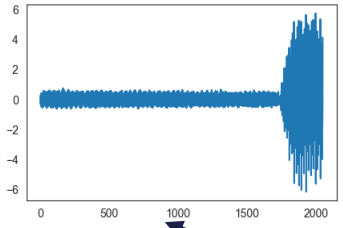
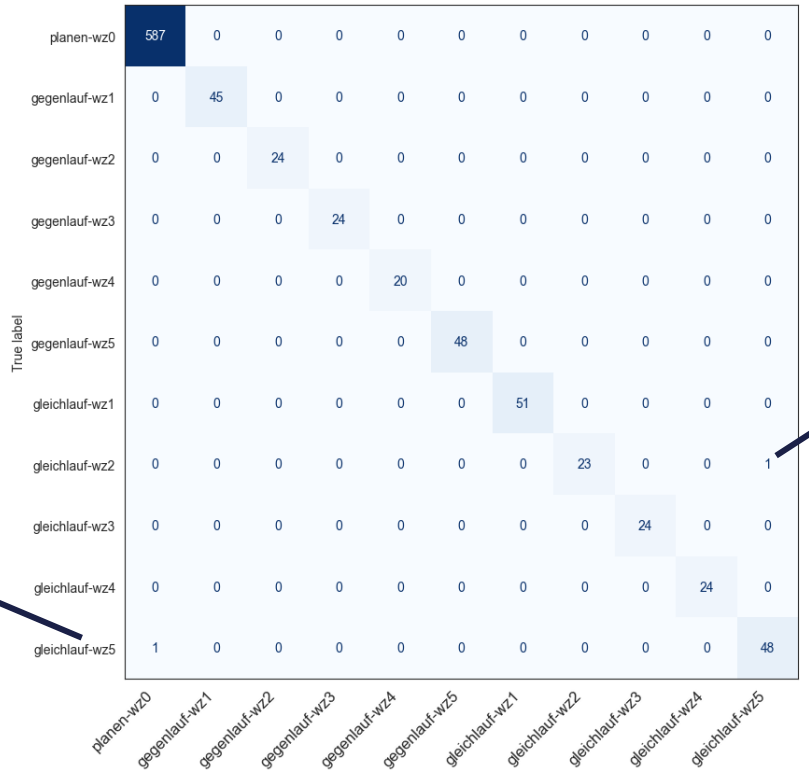
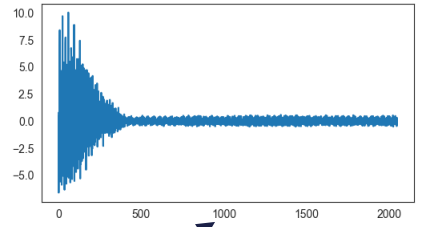
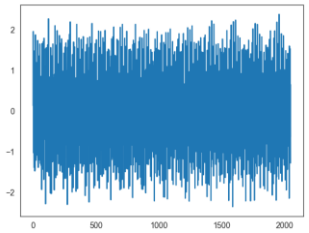


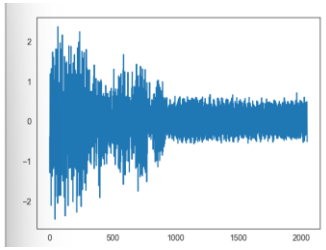




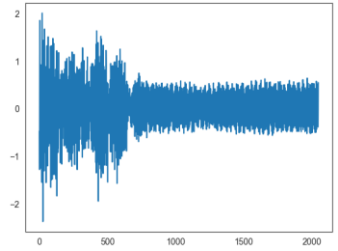
→ 99,8% Accuracy

→ 2 Misclassifications





Train/Test:
99.2% Acc.
97.4% F-Score



Conclusion

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Three different experiments that are clearly distinguishable in the iCOMOX™ data

- Type of application: Flattening vs. milling
- Tool condition: new head vs. blunt head

Both sensors, accelerometer and microphone, are suitable

- Accelerometer provides slightly better data

Mounting the iCOMOX™ on the spindle provides higher quality data compared to the iCOMOX™ on the base plate

- Blunt head is identified more clearly due to the high noise and vibration generated at both attachment points

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Condition Monitoring **of Electrical Motors**

Example

Embedded AI | Experimental setup

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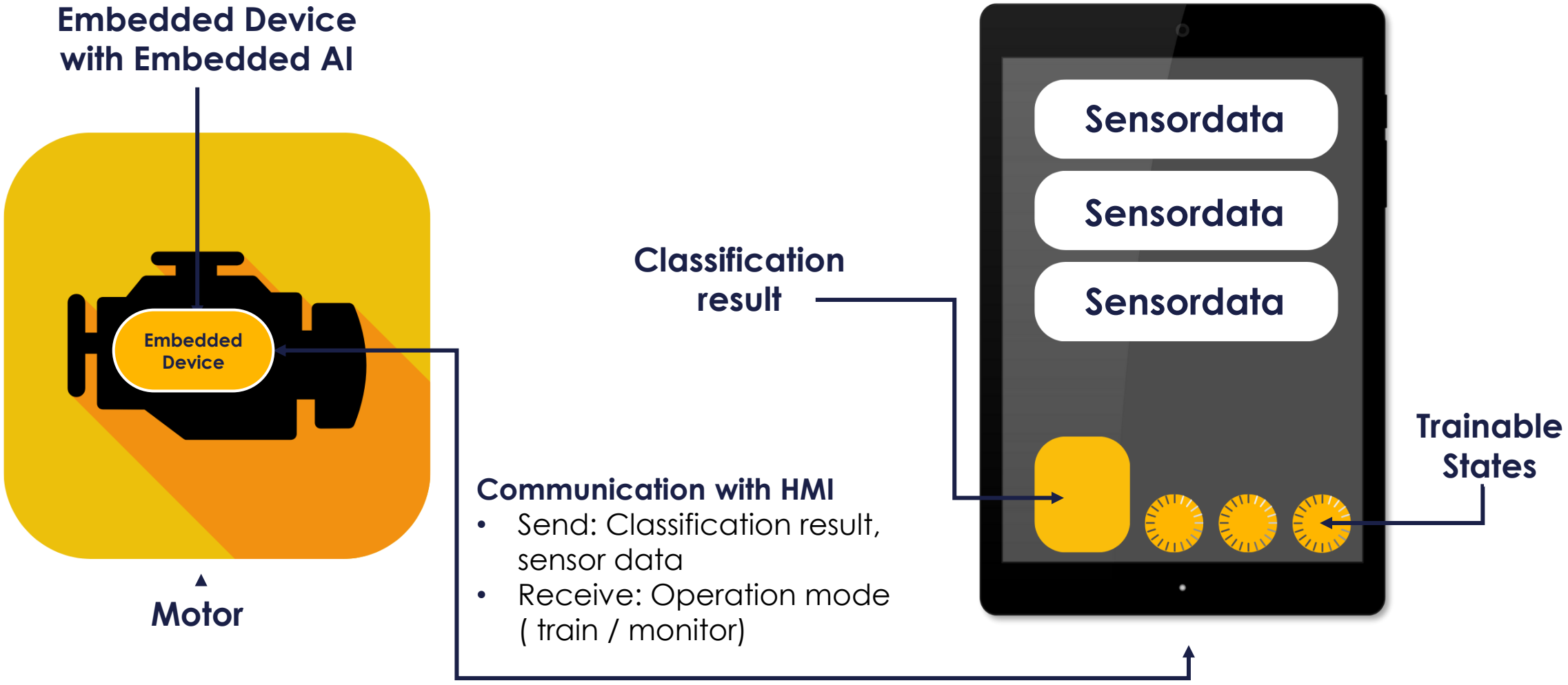

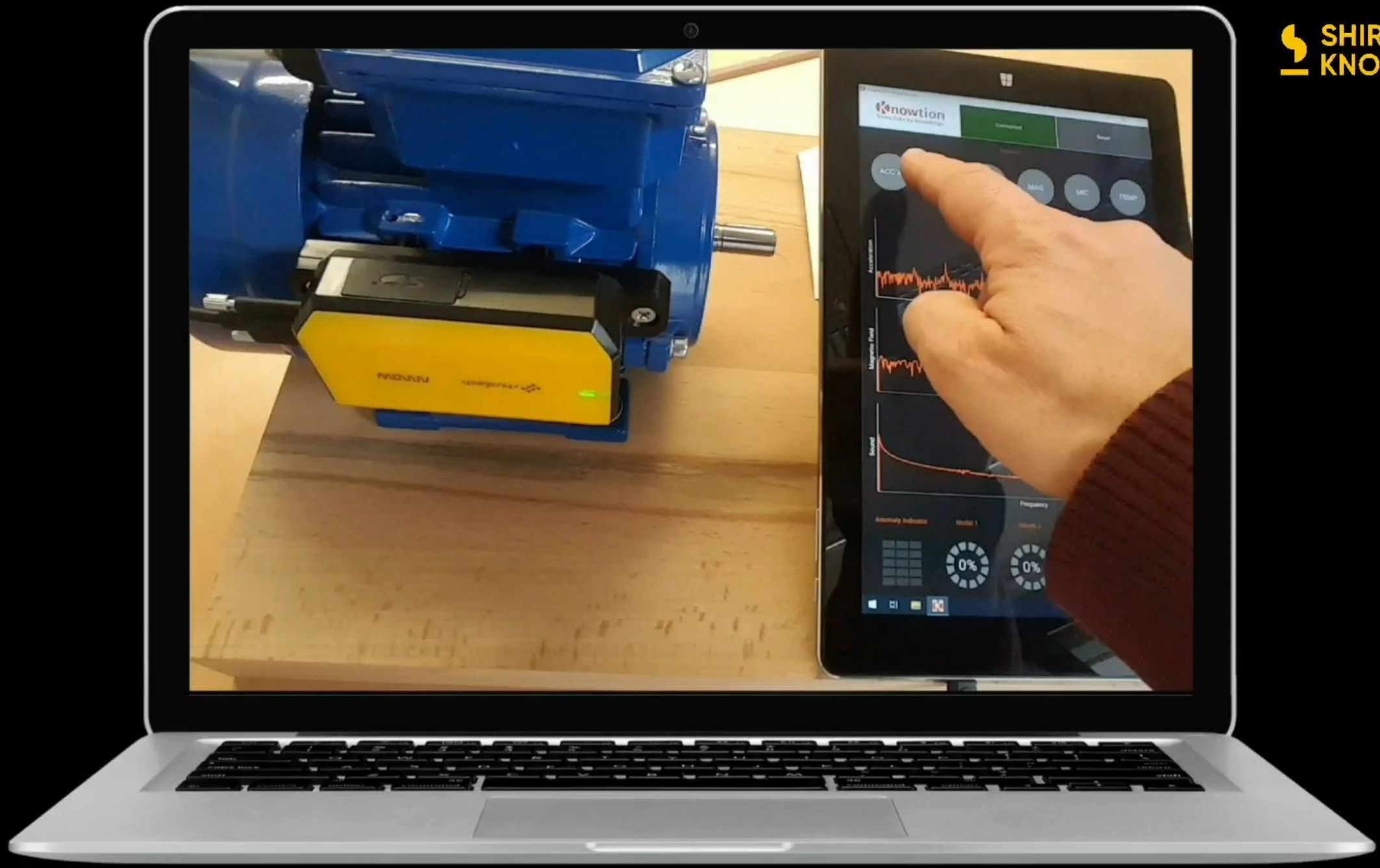
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Knowtion
Acceleration
Magnetic Field
Sound
Frequency
0%
0%

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