

The background features a dark blue gradient with a network of glowing blue nodes and connecting lines, creating a digital or data network aesthetic.

:: csem next

**Predictive Maintenance – Predictive Quality  
Was alles in Anlagedaten steckt!**

CSEM Alpnach - Untere Gründlistrasse 1

5. Dez. 2022, 17.00–18.00 Uhr



# Predictive Maintenance – Predictive Quality Was alles in Anlagedaten steckt!

:: csem

# DEEP LEARNING



- :: 12+ years experience
- :: Support humans
- :: Industry proven

# DEEP LEARNING FOR INDUSTRY

:: CSEM 2008

:: ViDi 2012

:: Cognex 2017

# ViDi

**COGNEX**



# Predictive Maintenance

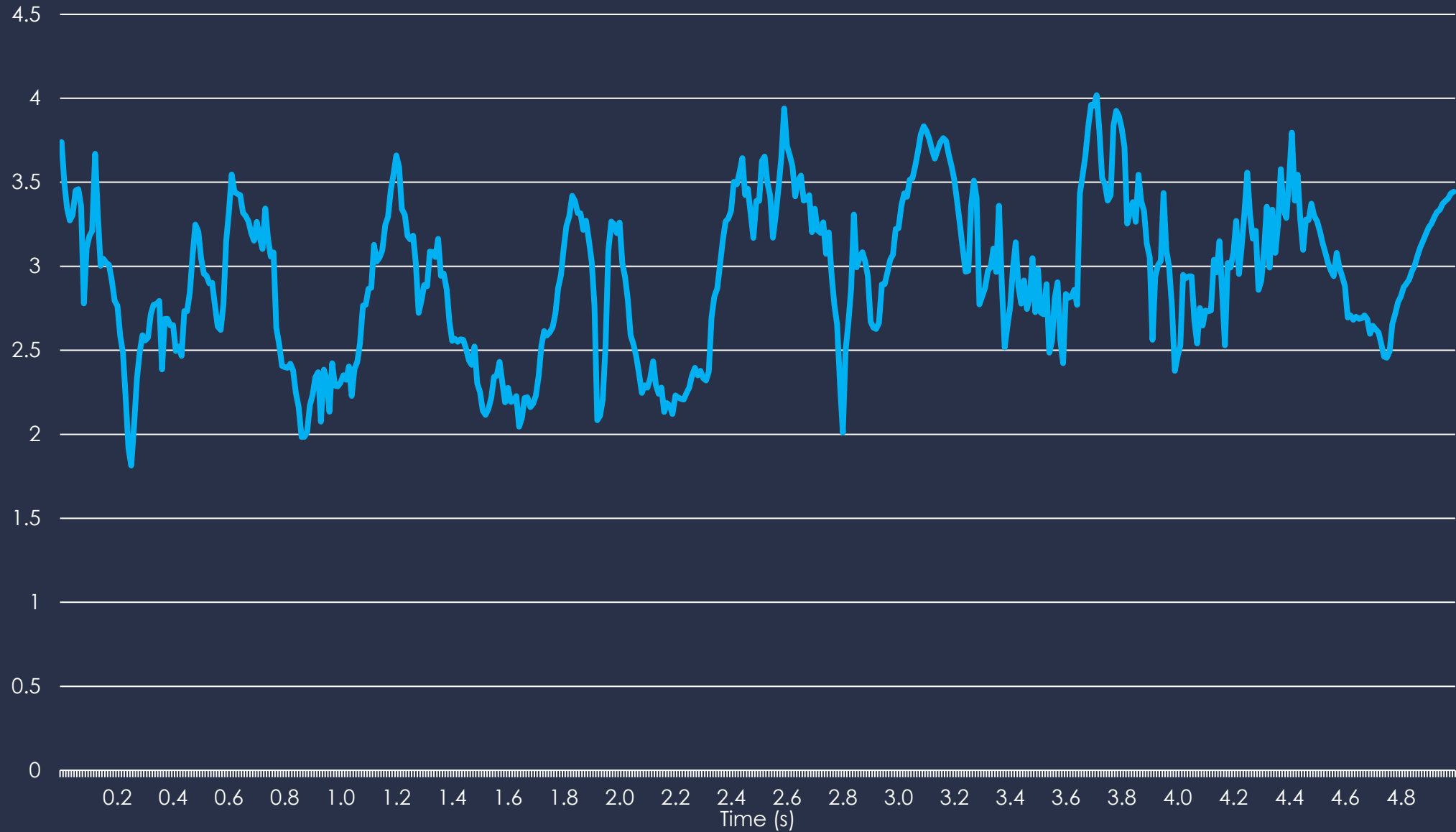
for industrial assets



- Unseen instances
- Interpretability
- Operational parameters



# Time Series Data



An iceberg floating in the ocean. The tip of the iceberg is above the water surface, while the much larger, jagged base is submerged. The sky is blue with scattered white clouds. The water is a deep blue, and the submerged part of the iceberg is a lighter, translucent blue. The overall scene is a metaphor for the hidden components of a neural network.

# Neural Network

Data acquisition

Data Management

Expert Knowledge

Pre-, Post-Processing

Certification

IP-Protection

Deployment

Version Control

Usability

## Predictive Maintenance

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

⌘ **csem**

in cooperation with

**baurovis**  
automation - robotics - vision systems

**maxon**

**SCHURTER**  
ELECTRONIC COMPONENTS

**KTF**

**elekon**

# Data

- AmbientTemperature
- CpuTemperature
- DurationPickToPick
- DurationRobotFromFeederToTestBench
- DurationRobotFromTestBenchToFeeder
- DurationTestBenchClosed
- EPOSCurrent
- EPOSPosition
- EPOSVelocity
- ErrorFrame
- FeederAction1
- FeederAction2
- FeederAction3
- FeederAction4
- FeederBackgroundIlluminationIntensity
- FuseCycleDuration
- FuseHeatSlope
- FuseIntoFeeder
- FusePicked
- FuseTestResult
- Humidity
- IntensityTotalImage
- IntensityTotalThermolImage
- NumberEmptyFeeder
- NumberFuseDetected
- NumberFuseEstimated
- Pressure
- ProcessCpuLoadNormalized
- ProcessMemoryConsumption
- Running
- SharpnessImage
- SmartMotorSpeed
- Started
- Temperature
- TemperatureThermoCam
- TotalCpuLoadNormalized
- TotalMemoryConsumption
- Vacuum
- VacuumFusePicked
- VacuumValveClosed
- ValidFrame
- ValidFrameOptrisPIRCamera
- WriteTime
- FusePickedEvent
- TestFailedEvent
- CurrentTestPassedEvent
- AllTestsPassedEvent
- FuseNotPickedEvent
- RobotStartMovementAtTestBenchEvent
- RobotArriveAtFeederEvent
- RobotStartMovementAtFeederEvent
- RobotArrivesAtTestBenchEvent
- CloseTestBenchEvent
- OpenTestBenchEvent
- FeederEvent1
- FeederEvent2
- FeederEvent3
- FeederEvent4
- CompressorActivatedEvent
- CompressorDeactivatedEvent
- LightBarrierEvent
- FuseDetectionEvent
- OpenVacuumValveEvent
- CloseVacuumValveEvent
- OpenPressureValveEvent
- ClosePressureValveEvent



**influxdata**<sup>®</sup>



**elasticsearch**

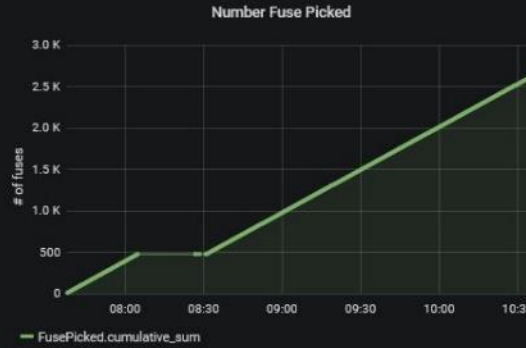
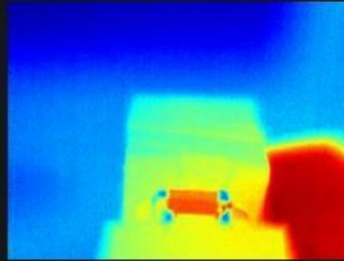
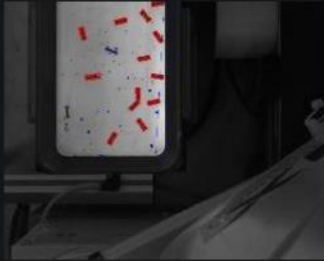
## Data Storage & Search

The screenshot shows the 'HealthDBSettingsForm' application window. The interface includes a toolbar with buttons for 'Connect', 'Disconnect', 'Test Connection', 'Select', 'Add New Database', 'Drop Database', 'Create Influx Config', and 'Start InfluxDB Server'. Below the toolbar, there are sections for 'InfluxDB', 'Grafana', and 'Visard' settings. The main area displays a tree view of databases and their contents, including 'myTest', 'HealthTest', and 'HealthTest' sub-items. A table on the right shows the details of the selected database, including its name, description, type, and count.

Name	Description	Type	Count
myTest		Database	0 Measurements
Visard.Events		Measurement	3 Series
Visard.Logs		Measurement	4 Series
CpuTemperature		Measurement	1 Series
Ping		Measurement	1 Series
ProcessCpuLoadNormalized		Measurement	1 Series
ProcessMemoryConsumption		Measurement	1 Series
Test1		Measurement	1 Series
TotalCpuLoadNormalized		Measurement	1 Series
TotalMemoryConsumption		Measurement	1 Series
HealthTest		Database	2 Measurements
HealthTest.Events		Measurement	0 Series
HealthTest.Logs		Measurement	1 Series
HealthTest.CpuTemperature		Measurement	9 Series
HealthTest.CpuTemperature		Measurement	9 Series
HealthTest.CpuTemperature		Measurement	11 Series

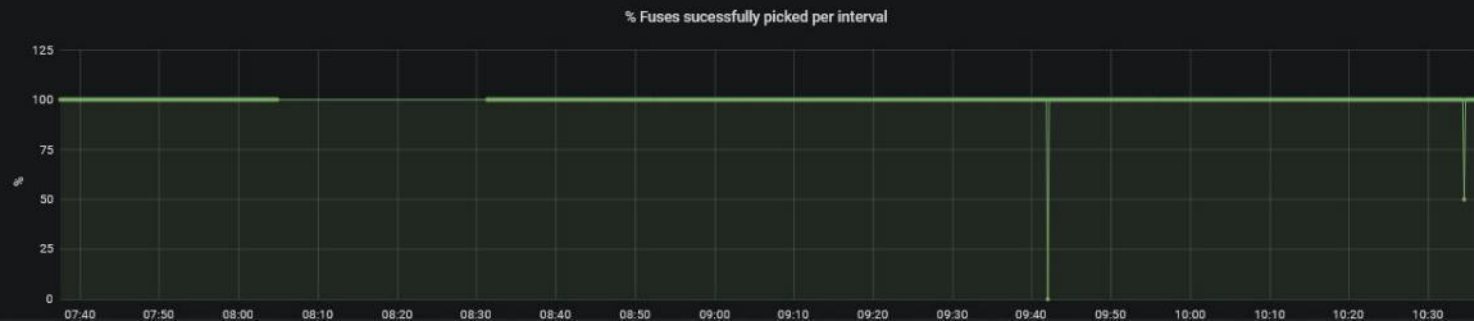
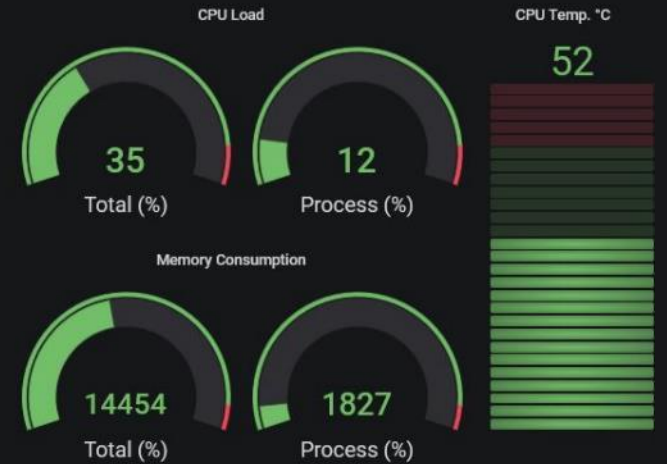
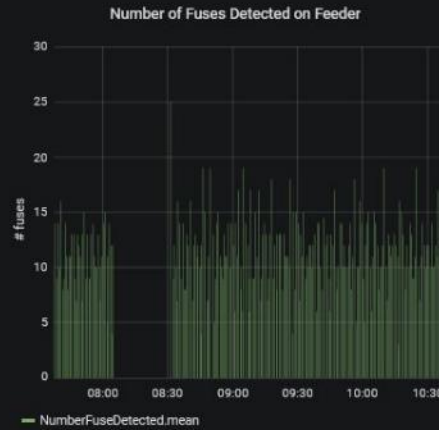
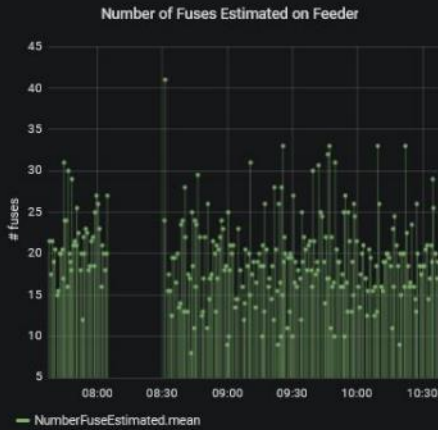
## Process

## Annotations

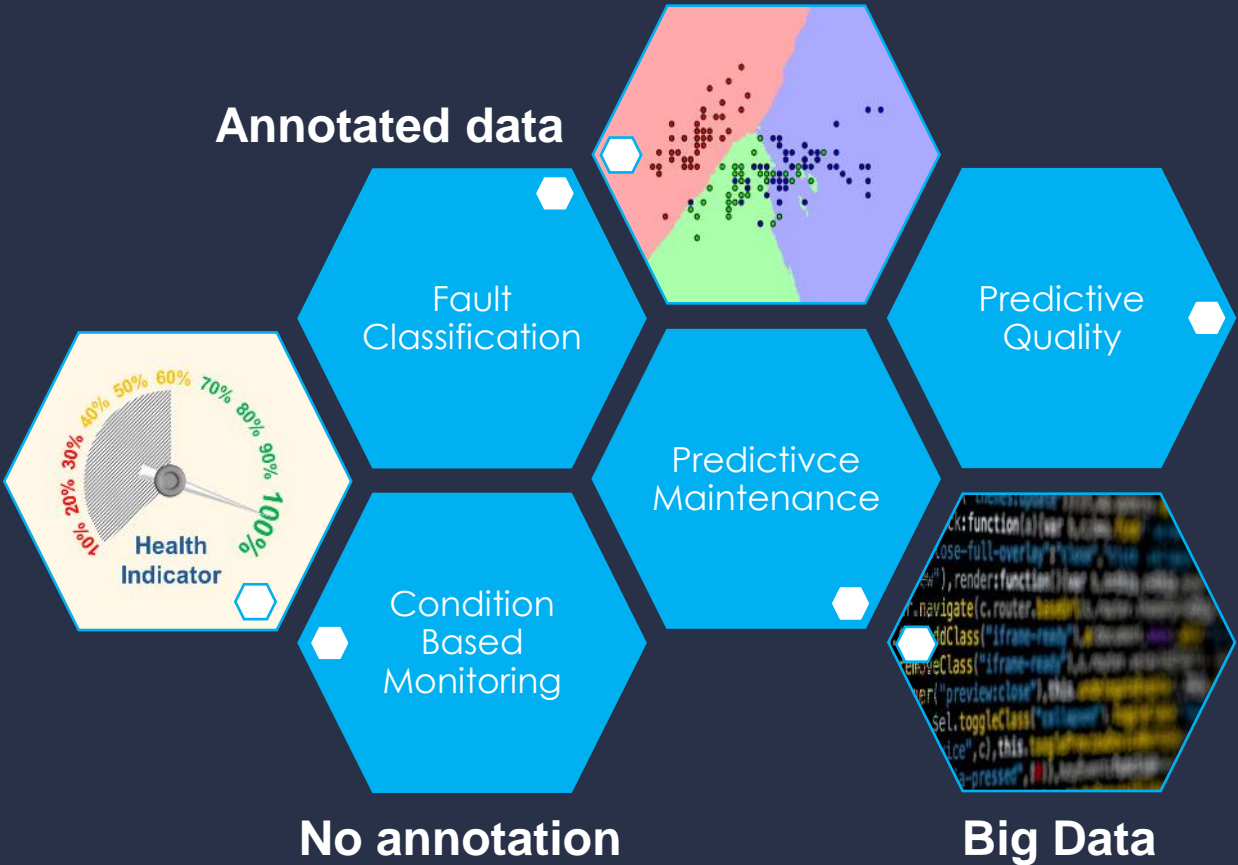


No data to show

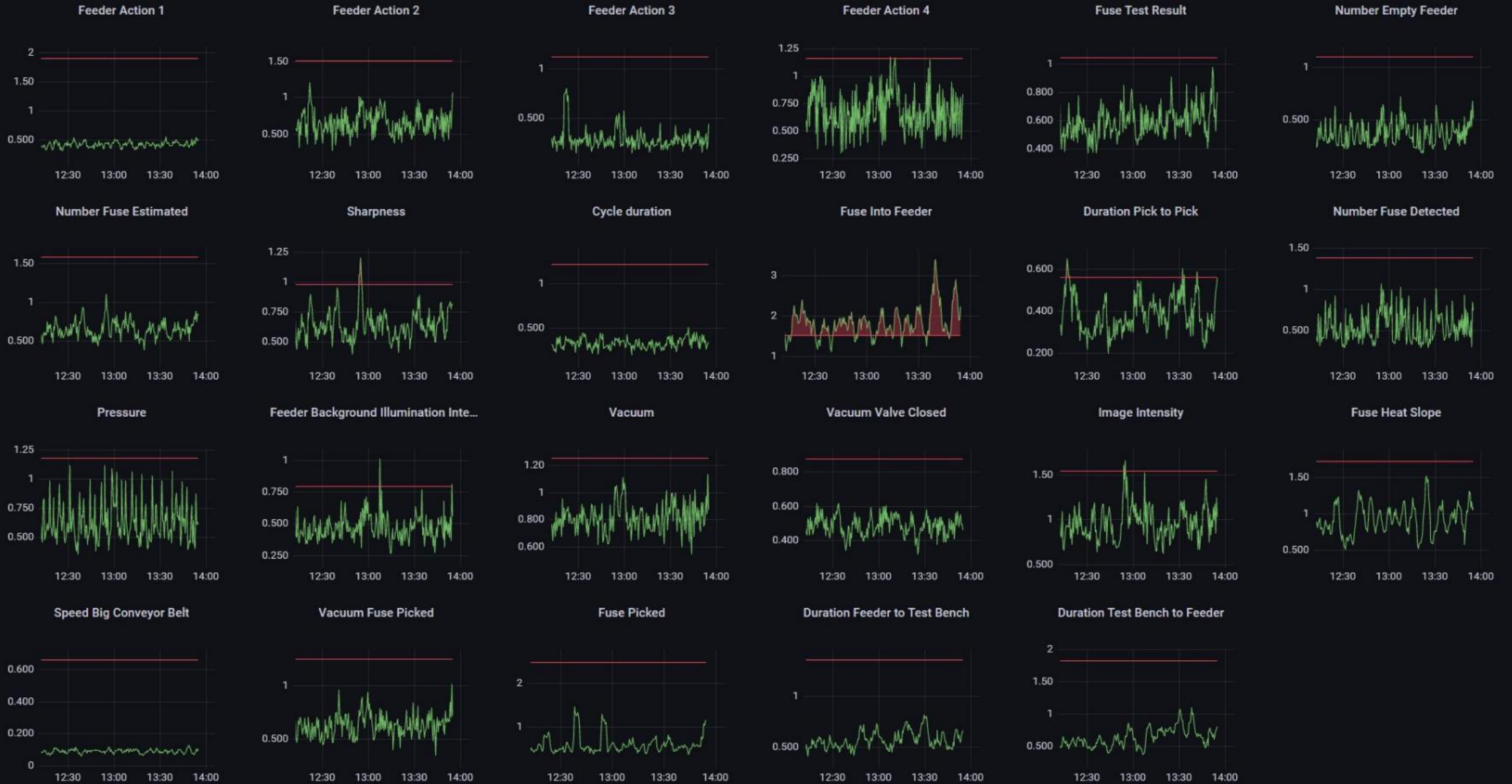
## Computer



# Predictive Maintenance



# Condition Based Monitoring for Industry 4.0



# Failure Use-Cases

- Change fuse positions on feeder
- Speed small conveyor belt
- Speed big conveyor belt
- Block light barrier
- Reduce amount of fuses on feeder
- iDS cam sharpness
- iDS cam illumination
- iDS cam cover FoV
- Pressure leakage
- Vacuum leakage



## Predictive Maintenance

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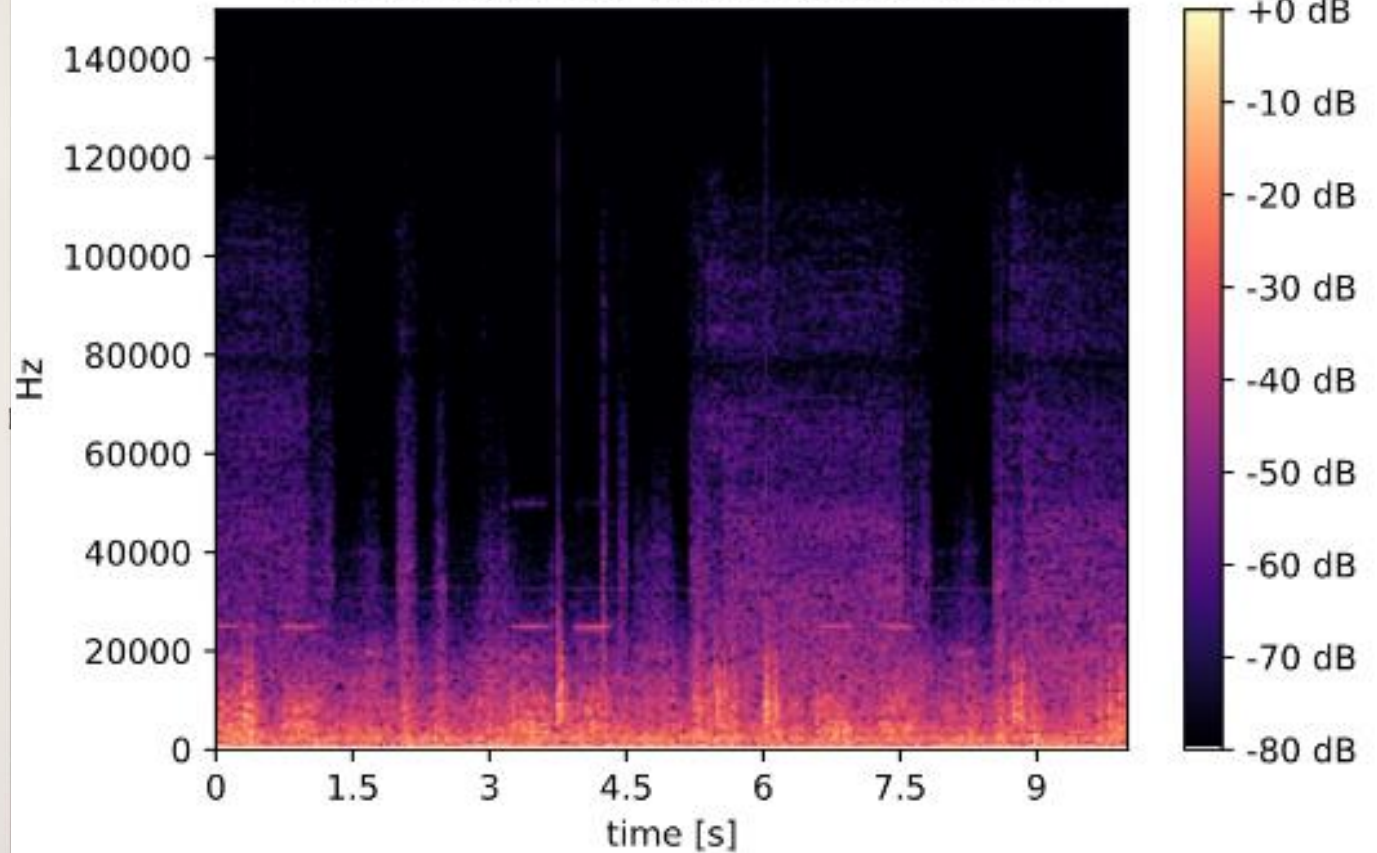
**maxon**

**SCHURTER**  
ELECTRONIC COMPONENTS

**KTF**

**elekon**

Linear-frequency power spectrogram





Yellow warning label on the central motor component.

R1

# Vorgehen

## Datenakquise

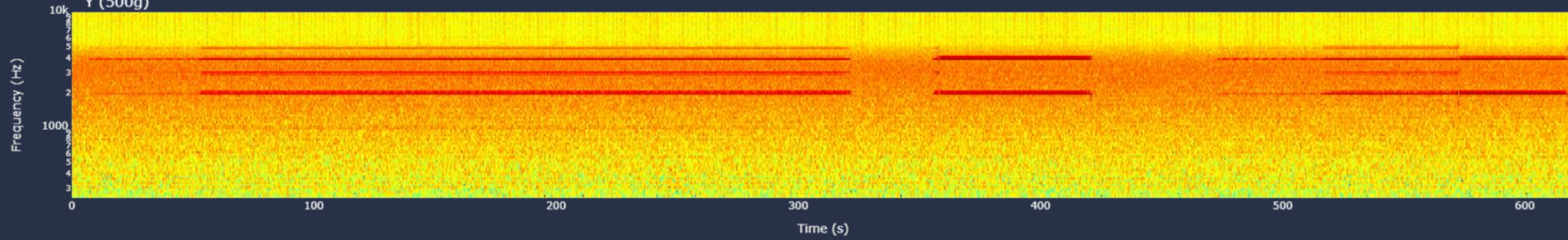


Sensor	Measurement Range	Resolution	Sampling Rate
Gyroscope	2000°/s	0.06 °/s	0 (off) to 200 Hz
Magnetometer	± 1300 μT	0.3 μT	0 (off) to 10 Hz
Temperature	-40 to 85 °C	0.01 °C	0 (off) to 10 Hz
Pressure	1 to 200 kPa	1.6 Pa	0 (off) to 10 Hz
Humidity	0 to 100 %RH	0.04% RH	0 (off) to 10 Hz
Light	0 to > 20 μV	<100 mlx	0 (off) to 4 Hz

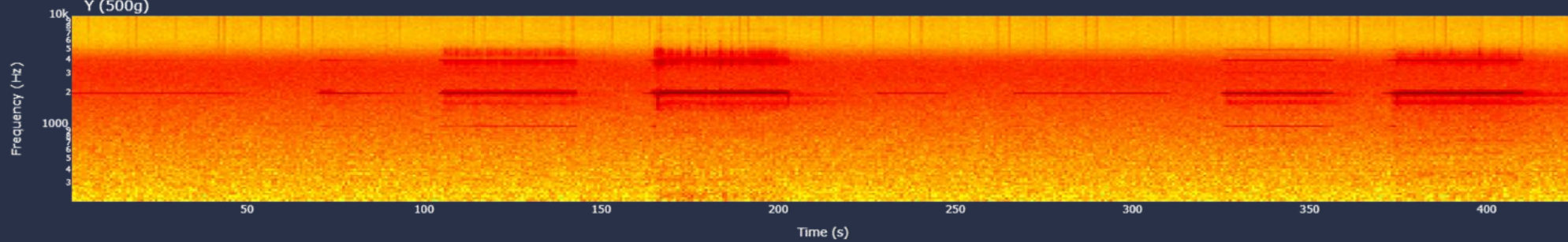
*Spezifikationen des ausgewählten Datenloggers (Auswahl auf Basis der Voranalyse)*

# Datensatz - Spektrogramme

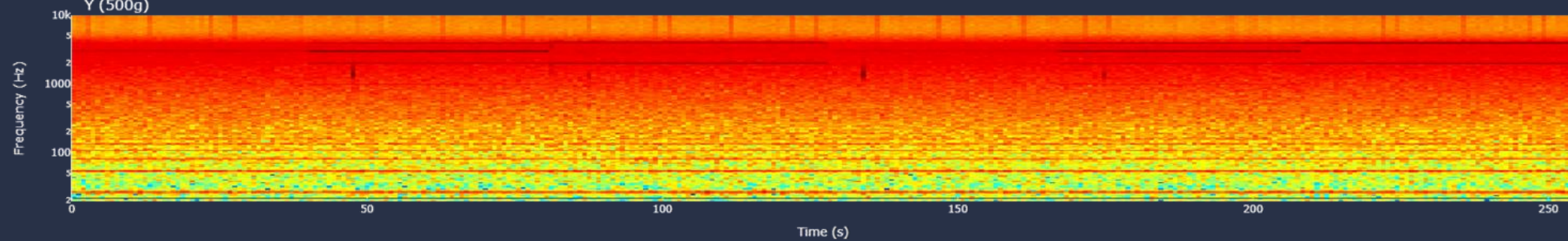
ID: 2, Oil [1-5]: 5, cogwheel degrad.: 7.0%  
keine auffälligkeiten  
Y (500g)



ID: 1, Oil [1-5]: 1, cogwheel degrad.: 74.0%  
starke kratzgeräusche Welle 1  
Y (500g)



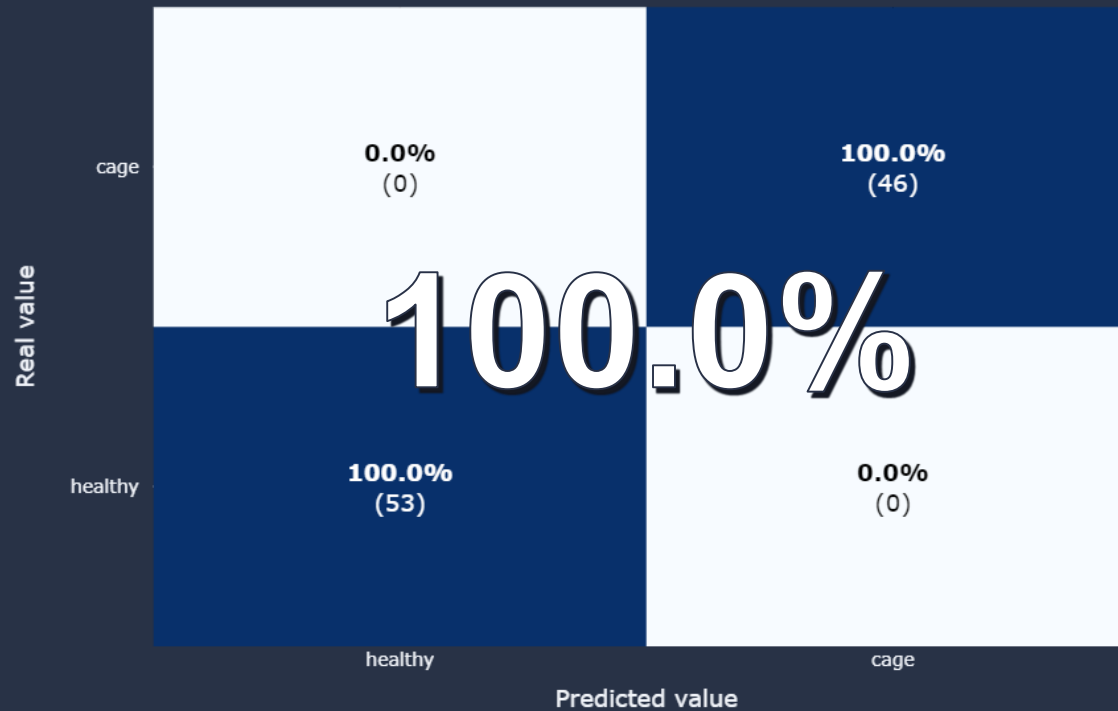
ID: 49, Oil [1-5]: 4, cogwheel degrad.: 50.0%  
Stufe 2 Klopfen hörbar  
Y (500g)



# Resultate



Lagerkäfigschaden



# Forschung



# Industriestudie



# Vision



# 5 Punkte Plan



1. Sensoren
2. Daten
3. Experten Wissen
4. Algorithmik
5. Business Case





# cesem



## Kontakt

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