

iQunet.®

Wireless Asset Health Monitoring



**Winner BEMAS
Digital Innovation Award
2017**
Wireless Vibration Sensor

**Winner BEMAS Professional Jury
Digital Innovation Award
2021**
Edge Anomaly Monitor 4.0

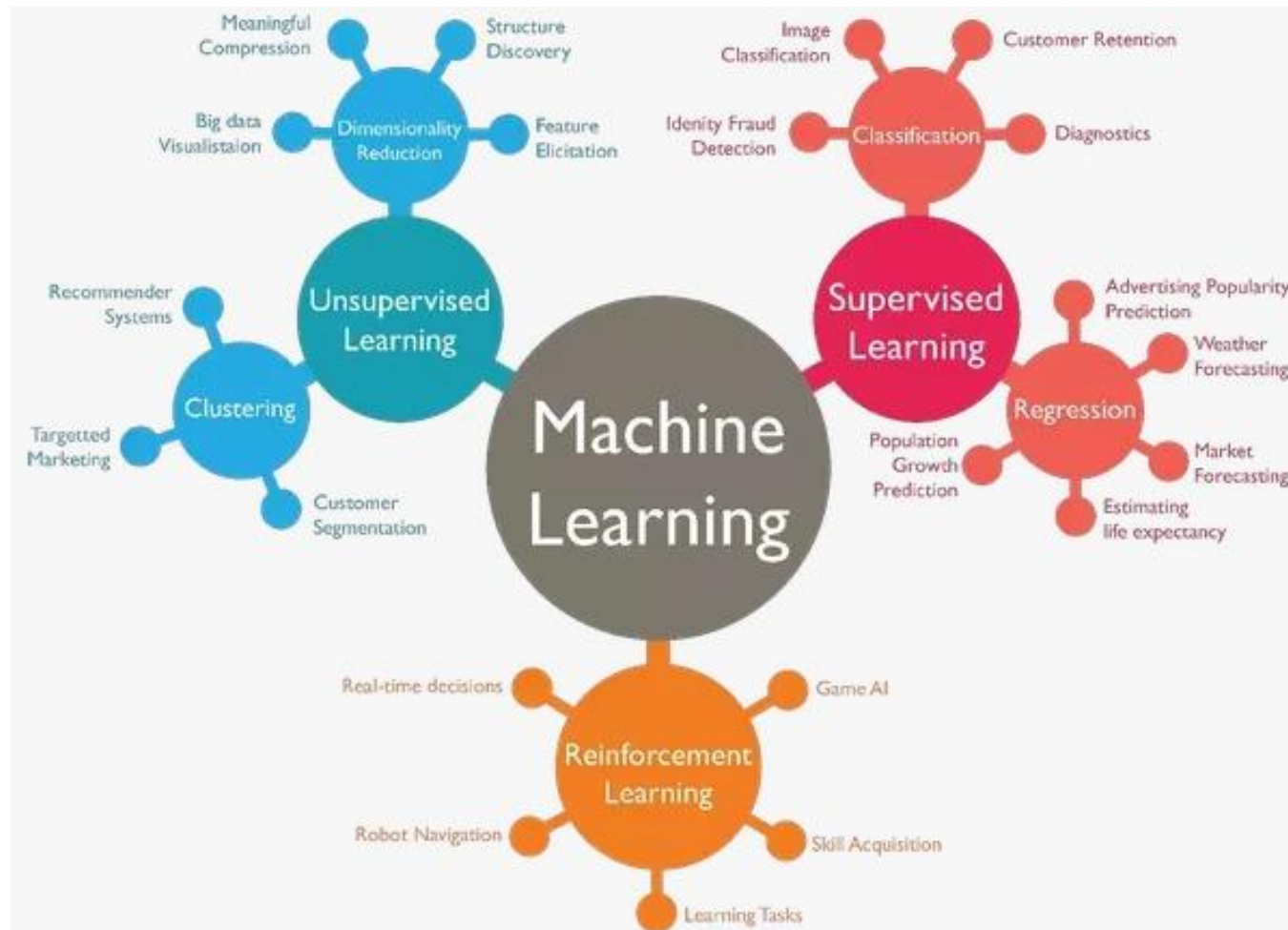
**Finalist BEMAS
Digital Innovation Award
2022**
Wireless Sensor Bridge

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AI Machine Learning
ANOMALY DETECTION

THEORY

AI Machine Learning: types and use

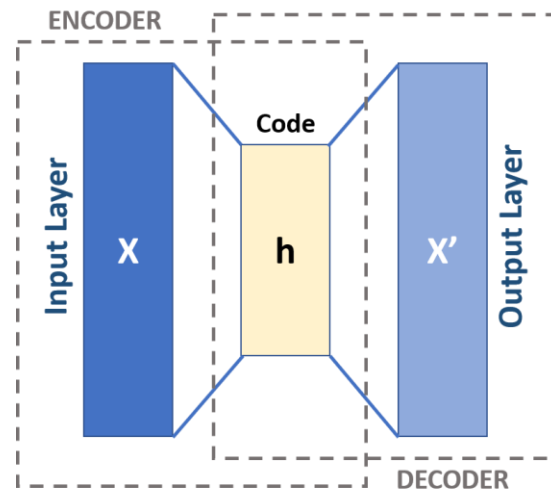


AI Unsupervised learning

- **Unsupervised learning** is a type of machine learning that looks for previously undetected patterns **in a data set** with no pre-existing labels and with a minimum of human supervision.
- unsupervised learning allows for modeling of probability densities over inputs.
- *(In contrast to supervised learning that usually makes use of human-labeled data)*
- It forms one of the three main categories of machine learning, along with supervised and reinforcement learning.

AI Autoencoder

- An **autoencoder** is a type of [artificial neural network](#) used to learn [efficient data codings](#) in an [unsupervised](#) manner.
- The aim of an autoencoder is to learn a [representation](#) (encoding) for a set of data, by training the network to ignore signal “noise”.
- Along with the **reduction side**, a **reconstructing side** is learnt, where the autoencoder tries to generate from the reduced encoding a representation as close as possible to its original input, hence its name.



AI Anomaly Detection

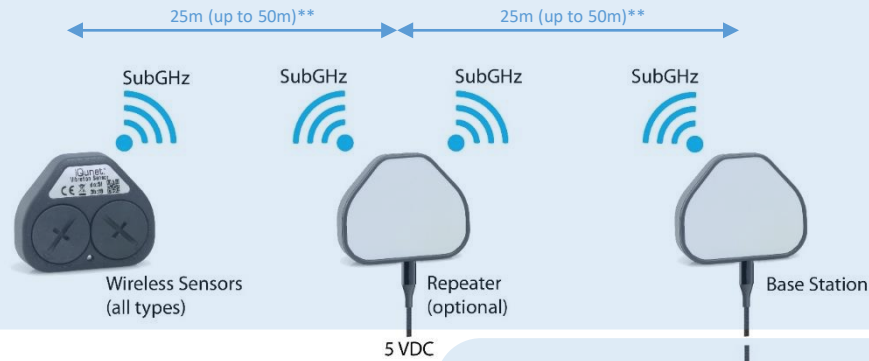
- By learning to replicate the most salient features in the training data under some of the constraints, the model is encouraged to learn how to precisely reproduce the most frequent characteristics of the observations.
- When facing anomalies, the model should worsen its reconstruction performance.
- Only data with normal instances (*) are used to train the autoencoder; in others, the frequency of anomalies is so small compared to the whole population of observations, that its contribution to the representation learnt by the model could be ignored.
- After training, the autoencoder will reconstruct normal data very well, while failing to do so with anomaly data which the autoencoder has not encountered. Reconstruction error of a data point, which is the error between the original data point and its low dimensional reconstruction, is used as an anomaly score to detect anomalies.
- (*) *normal instances: vibration data from all relevant speeds, loads, temperatures, etc. and behaviour from the machine, pump, motor, etc.*

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AI Machine Learning

IQUNET ANOMALY MONITORING SERVICE

iQunet[®] Condition Monitoring Architecture



Wireless Sensor Network

- Local sensor network at SubGHz frequency
- Free ISM band at 868Mhz or 915Mhz center frequency – worldwide use

** Wireless reach depending on plant topology



Web Browser (sensor dashboard & server settings)



Ethernet

iQunet Server (sensor management & local storage)



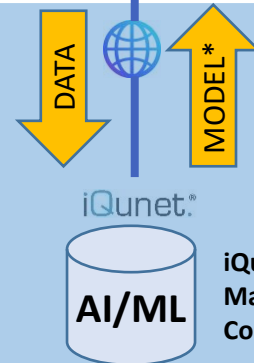
Embedded OPC UA server

iQunet Edge Server

- Edge computer, local storage (no cloud !)
- OPC UA embedded server, free data
- Connectivity: WebRTC, VPN (Hamachi; Wireguard), iQunet CloudLink
- Multiple Dashboards

Network options

- Ethernet network or WiFi network at 2,4GHz or 5GHz free frequency
- Including local hotspot access point (peer to peer with mobile phone,etc)



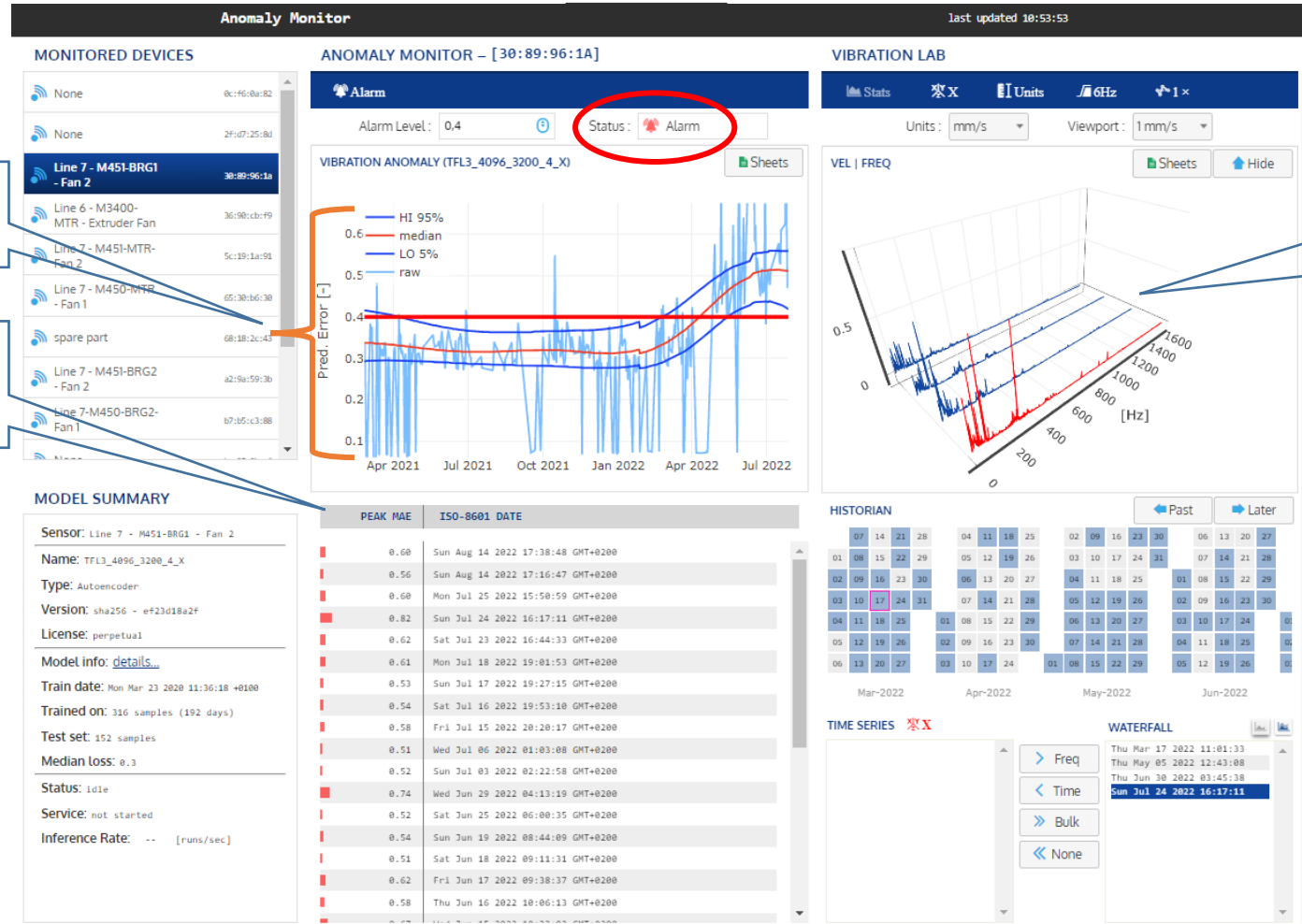
iQunet Machine Learning Computer

AI Anomaly Monitoring Service*

(* optional service: AI models are licenced)

- Free Embedded Software
- One time transfer of historical data set (“equipment footprint”)
- ML Model transferred and stored back in iQunet Edge server
- Continuous real time processed Edge Anomaly Monitoring

iQunet.® Anomaly Monitor Dashboard

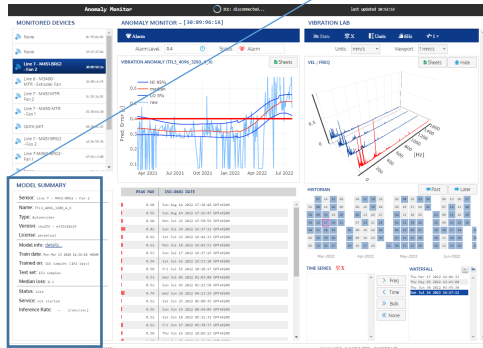


Anomaly Score (predicted error; see vertical ax)

Listed Relevant Anomaly Scores per measurement

Quick reference to related

- Time series
- FFT
- 3D graphs



MODEL SUMMARY

Sensor: LAGERBLOK NAZ

Name: TFL3_2048_3200_2_Y

Type: AUTOENCODER

Version: SHA256 - 3DB92C1647

License: PERPETUAL

Model info: [details...](#)

Train date: SAT MAR 21 2020 09:38:50 +0100

Trained on: 1302 SAMPLES (31 DAYS)

Test set: 408 SAMPLES

Median loss: 0.5

Status: IDLE

Service: NOT STARTED

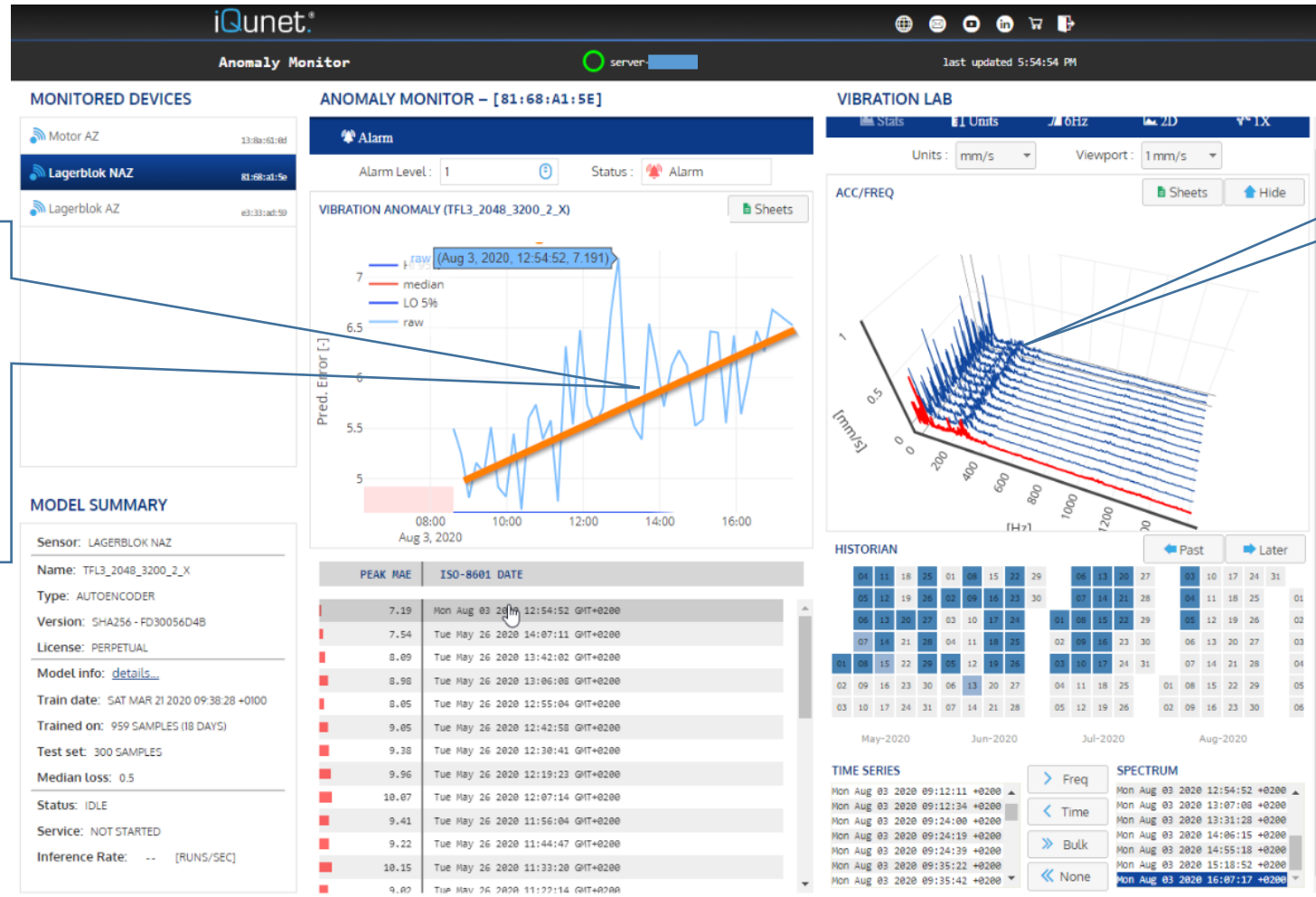
Inference Rate: -- [RUNS/SEC]

Model information

Training information

Run time information

iQunet Anomaly Monitor Dashboard



Fast raising anomaly trend !
(although no change in RMS !)
Anomaly Score (Predicted Error) raising per hour due to bearing failure (stage 8)

Imbalance + bearing failure
(scratch outer ring)





Customer Use Case

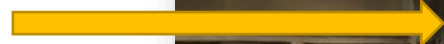
Condition Monitoring with AI

Condition Monitoring on conveyors (International Airport)

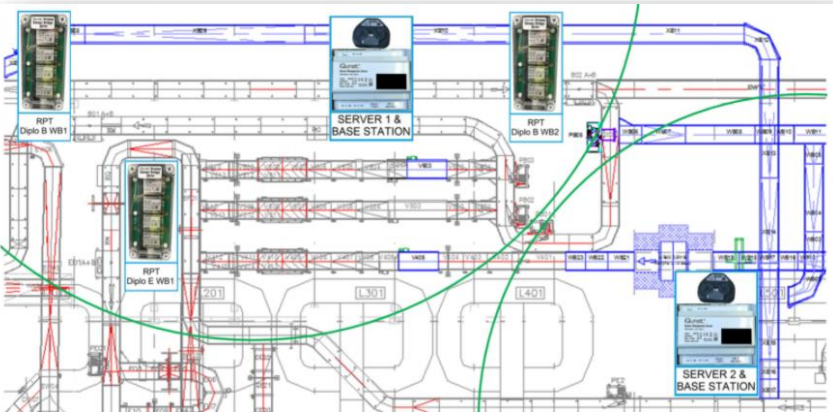
- Wireless Vibration monitoring (motor + gearbox + chain)
- Wireless Current waveform monitoring – MCSA (Var. Speed Drives)

iQunet.® Wireless Setup

Sensor Base Station



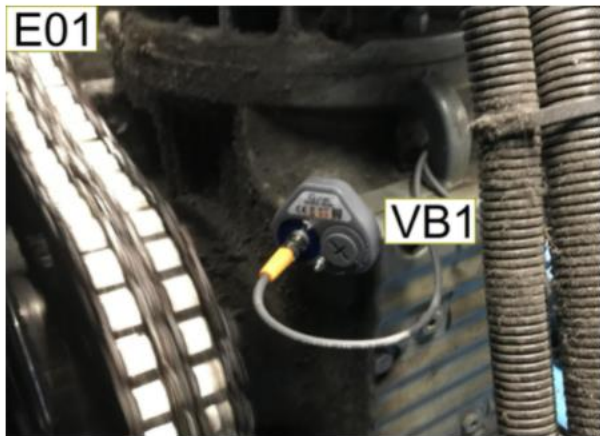
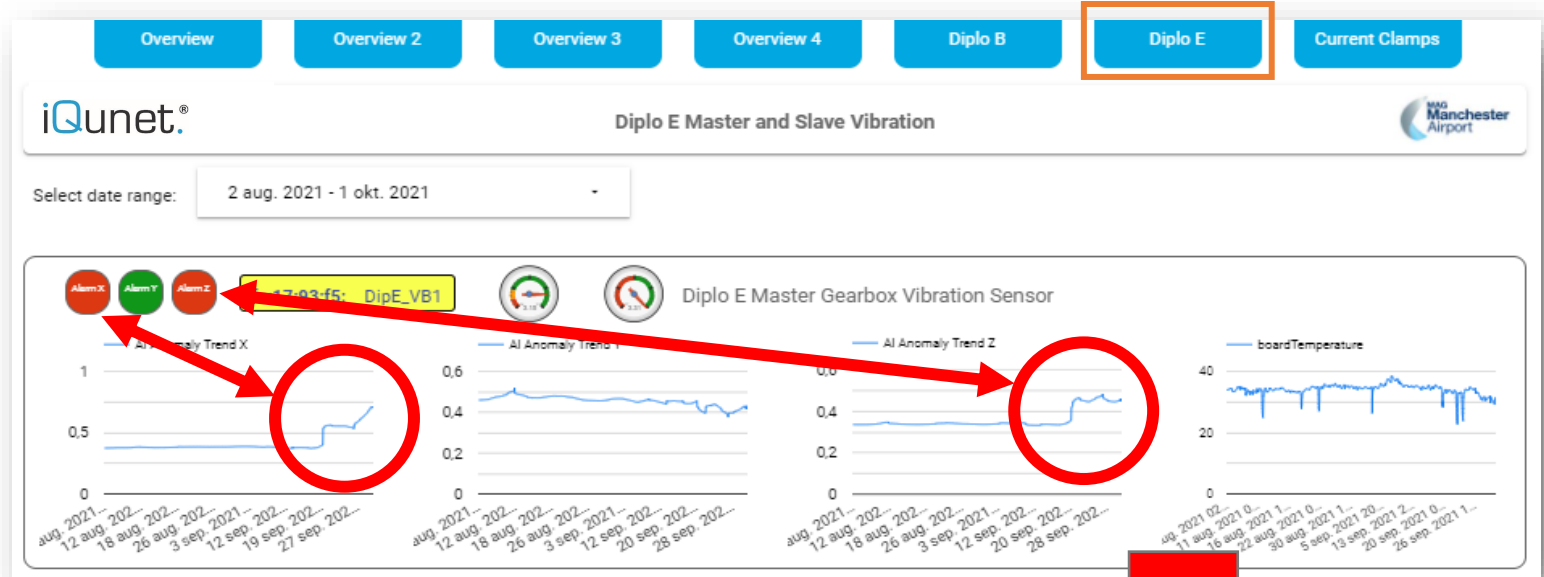
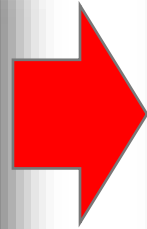
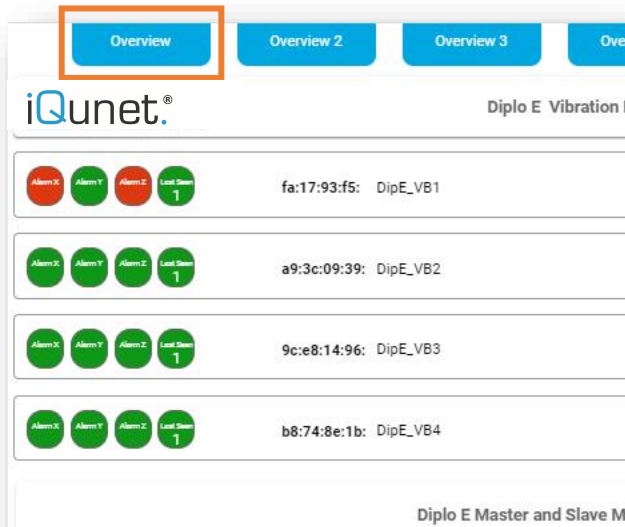
iQunet Edge Server



Wireless Bridge (Current Clamps)

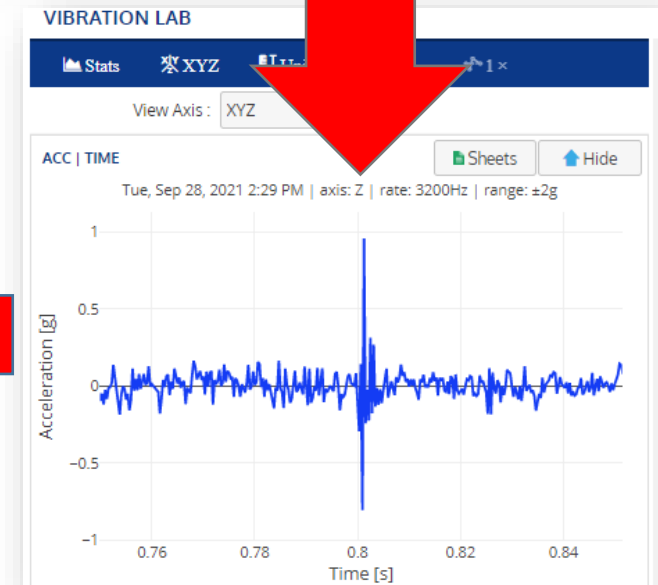
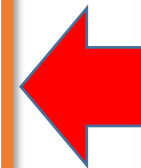


iQunet.® Vibration Monitoring

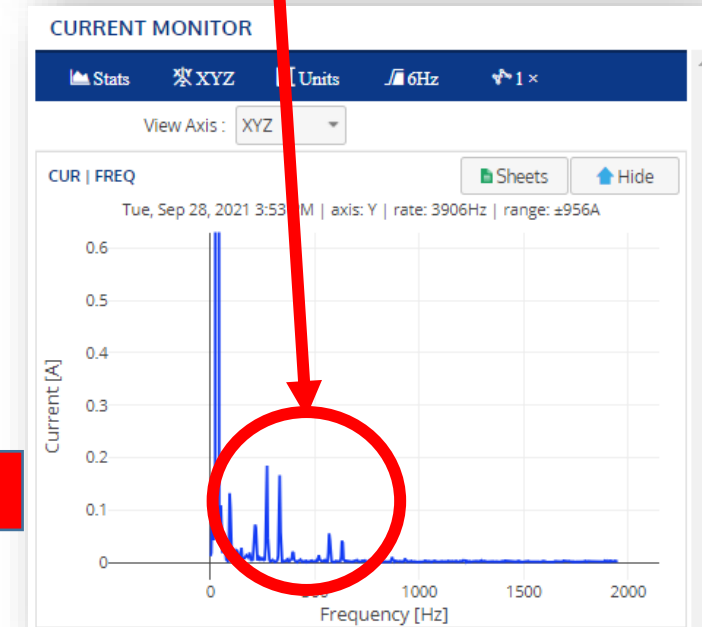
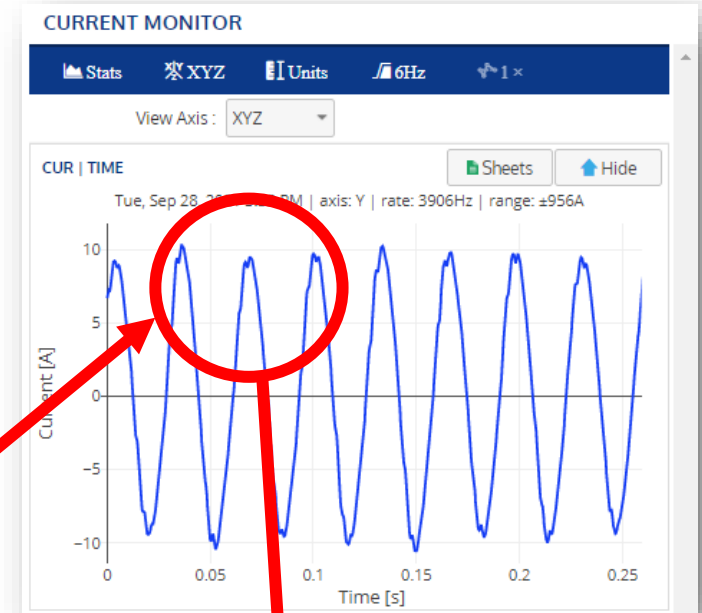
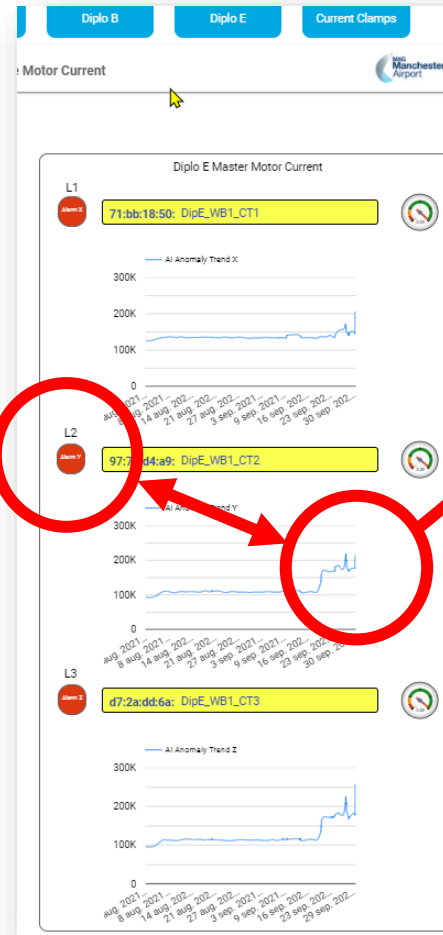
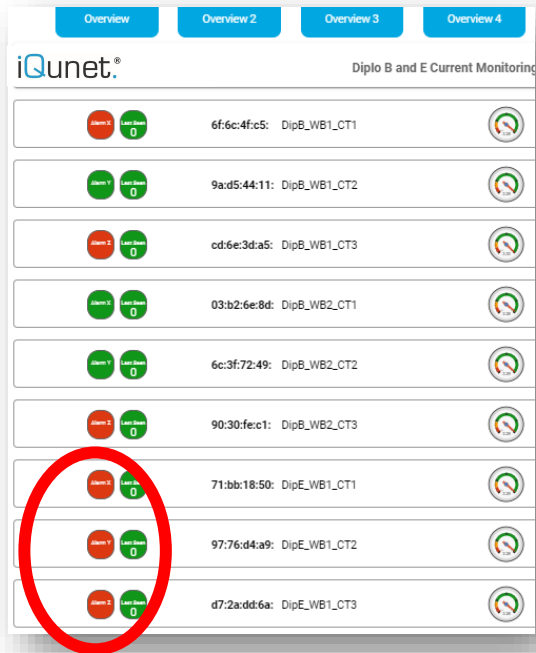
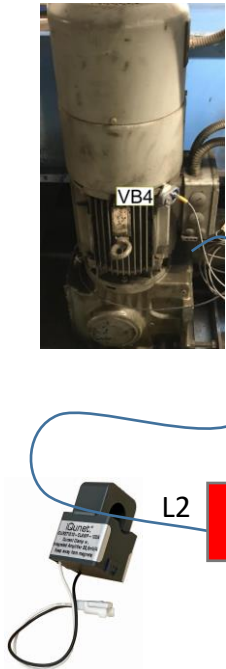


Impact detected (early warning)

- Recommended actions:
 - Check chain links
 - Check sprocket teeth
 - Lubricate and check change
- Follow behaviour to exclude gearbox inside teeth damage
- Follow up anomaly trend graphs



iQunet.® Wireless Motor Current Monitoring



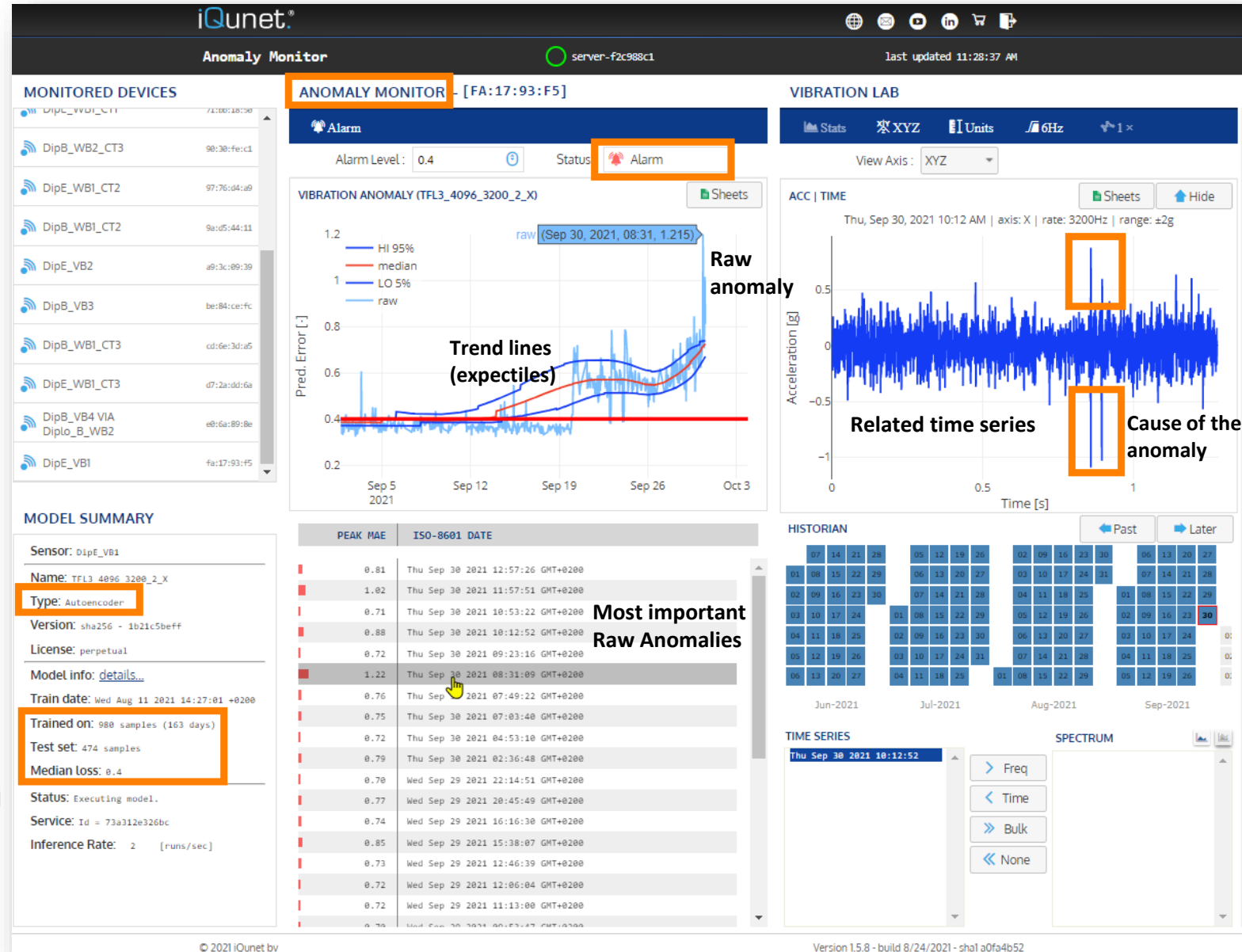
Motor Current [A] harmonics detected

- Recommended actions:
 - Follow up anomaly trend in time
 - Follow up harmonics in freq. domain
 - If quick sustainable increase, prepare for motor repair

iQunet.® Anomaly Monitor (“engine” behind the dashboards)

Sensor list

- 3ax vibration sensors + T°
- Current clamps (waveform)



ML type

Machine Learning (unsupervised learning)
Trained on data from ±1000 initial sensor measurements

Historical data

Spectrum graphs
Spectrum 3D graphs
RMS graphs
Kurtosis graphs

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Asset Health Monitoring Made Easy



Please contact us for a live demo (via online meeting)

www.iQunet.com

Contact:

Dirk Van den Branden

CEO / co-owner

T: +32 9 52 86 00 25

M: +32 478 44 66 20

dvdb@iqunet.com



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