Zustandsüberwachung von Maschinen mit Wireless Sensoren

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Agenda

• Introduction
• Value of Condition Monitoring
• Monitoring System
• Sensor types
• Condition Monitoring Example
• Summary
Neratec Solutions AG – a Swiss KMU

**Industrial WLAN Products**

- **Wireless LAN Stations**
  - Very robust, for mobile use, railway certified

- **WLAN Access Points**
  - For outdoor use, railway certified

- **WLAN Modules**
  - high performance, long distance

**Wireless Sensor Solutions**

- **Wireless Sensors for Industrial Applications**
  - Condition Monitoring, Predictive Maintenance

- **Customized products**
  - tailored to your application

- **Connectivity Management: IoT, M2M, Cloud**
Condition Monitoring & Predictive Maintenance
Monitoring & Optimizing Cycle

Optimization

Data Acquisition

Prediction

Data Analysis
Condition Monitoring & Predictive Maintenance – Benefits

For the End User:
• Reduce unexpected downtime
• Increase asset availability
• Optimize performance
• Improved planning of O&M services
• Convenience and safety

For the Device / Machine Supplier:
• Increase value of machine
• Machine health monitoring
• Optimize business processes (e.g. spare parts stock, service interventions)
• Enable new service offerings & revenue streams
Potential Applications

• Intra-Logistics
  commissioning, warehouse and automated logistics applications

• Motors, Pumps, Drives …
  Vibration sensors for mechanical components and drives

• Industrial Process Monitoring
  wireless sensors for temperature, humidity, flow, pressure, …

• Optimization of Cold Chain
  monitor the conditions to save energy and reduce life cycle costs
Condition Monitoring System
Condition Monitoring System

Sensors
Condition Monitoring System

Gateway

- Sensor drivers
- Edge processing
- Cloud connection

Sensors
Condition Monitoring System

Gateway
- Sensor drivers
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Server / Cloud
- Data integration
- Device management
- Connectivity management

Sensors
- 3-axis
- 1-axis
Condition Monitoring System

Gateway
- Sensor drivers
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LAN, WIFI 3G/4G

Server / Cloud
- Data integration
- Device Management
- Connectivity Management

Web API

Applications

Sensors

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Wireless Sensors
Why wireless?

- Easy to retrofit – no cables
- Connection to moving or rotating parts
- Easily expandable
- User Interface from mobile terminals
Wireless Sensors – What can be measured?

- Temperature
- Vibration, Shock
- Acceleration, Movement
- Humidity
- Light detector
- Air quality
- Analog and digital inputs/outputs

➢ Important design criteria for wireless sensors:
  - Low power consumption
  - Small size and optimized form factor
  - Efficient antennas
Condition Monitoring: an example
Example: Centrifugal Pump

- Different types of bearings:
  - Rolling element bearings
  - Plain bearing
  - Fluid bearing
- Medium to high rotation speeds

- Required sensors on every bearing
  - Vibration / Shock
  - Temperature
Solution: Wireless Vibration Sensor

- **MEMS based Vibration/Temperature Sensor**
  - 3-axis MEMS accelerometer
  - ±2g …±16g per axis
  - usable bandwidth up to 1.6kHz
    - 1’000rpm → 16.7Hz
    - 20’000rpm → 333.3Hz
  - accurate Si temperature sensor integrated (±0.1°C)
  - 2.4GHz ISM band communication protocol
  - Screw or magnet mountable
  - Very low operating current
  - Average current consumption
    - (60sec measurement interval): < 0.2 mA
Condition: Motor/Shaft Unbalance

\[ a \text{ in mm/s}^2 \]

\[ f_n \]

\[ f \text{ in Hz} \]
Condition: Motor Unbalance and Shaft Misalignment

\[ a \text{ in mm/s}^2 \]

\[ f_n \quad 2f_n \]

\( f \text{ in Hz} \)
Condition: Ball Bearing Damage

![Graph showing acceleration (a in mm/s^2) against frequency (f in Hz). Peaks at fn, f1, f2, and etc.](image)
Condition: Heavy Ball Bearing Damage
Condition: Motor Stator Field Asymmetry / Damage

![Graph showing vibration analysis with frequencies fn and 2f_mains]
Condition: Motor Rotor Field Asymmetry / Damage
Condition: Plain / Fluid Bearing Damage
Summary

- Condition Monitoring & Predictive Maintenance Systems offer manifold benefits

- Wireless Sensors promise easy integration for retrofit or mobile/moving components

- With a simple sensor, a variety of possible damage-types are detectable
Thank you for your attention!

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