Anwendung von (Luft-)Schallanalyse als ein Verfahren der berührungslosen Qualitätssicherung für die vorausschauende Wartung

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Dortmund, 23.05.2019
Initial Situation:
Digitization and Automation of Industrial applications

Motivation: Increase efficiency, product flexibility

Challenges: Complexity, investments, security issues
Individual solutions: Development of monitoring systems for the customer's requirements

Quality Assurance: Predictive Maintenance, End-of-Line Testing

Acoustic control: non-destructive, contactless, retrofittable
Motivation & Goal

Sound > Hearing > Consideration > Decision
Motivation & Goal

Sound → Sensor → Appraisal → Processing → Decision

Data pattern
Elements of acoustic condition monitoring @ FhI IDMT

Measurement of
- Structure-borne
- Air-borne
- Ultrasonic
sound in noise-free
and noisy surroundings.

Signal analysis
- Signal processing
  - Embedded
  - In networked
    systems
  - Cloud

- Secure distribution
- Storage
- Analysis
  of measurement results.

Scalable methods
- Supervised
- Unsupervised
- Deep learning
  on various sensor data.

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Competencies (1/2)

- Spatial localization of events
  - Microphone array technology (2D/3D)
  - Beamforming microphone technology

- Digital signal processing: auditory scene analysis
  - Source separation algorithms
  - Echo reduction
  - Acoustic fingerprints
Competencies (2/2)

- Machine Learning
  - Various techniques like Gaussian Mixture Models (GMM), Support Vector Machines (SVM), Deep Neural Networks (DNN), ...
  - Supervised, semi-supervised, unsupervised learning
  - Validation and visualization of classification results

- Secure data acquisition, storage, distribution
  - Techniques for avoidance of data corruption (sensor identification)
  - Decoupling real and pseudonymous identities (pauth)
Lead Project (1/2)

Projekt »LidEO«
Airborne sound analysis in the end-of-line test of the automotive industry
[German: Luftschallanalyse in dem End-of-Line Test der Fahrzeugindustrie]

- Quality inspection of electric motors in car seats
- Client: GÖPEL electronic GmbH
- Benefit: Reduction of cycle time in production

Follow: Website
Lead Project (2/2)

Projekt »City Noise«
Self-learning system for the detection, prediction and presentation of urban noise
[German: Selbstlernendes System zur Erfassung, Vorhersage und Darstellung von städtischem Lärm]

- Networked sensors
- Detection of noise sources (event detection & classification)
- Calculation of noise levels according to TA Lärm

Follow: Website
Lead project »City Noise«

- Machine learning based system for collection, prediction and visualisation of city noise
- Government-funded (Free state of Thuringia)
- Sensor network with embedded and cloud based analysis
- Beneficial for
  - Urban planning
  - Noise prevention
  - Smart city applications
Selection of experiences (1/2)

<table>
<thead>
<tr>
<th>Bearing damage in industrial fans</th>
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<tbody>
<tr>
<td>▪ Appears after delivery but can be recognized at EOL</td>
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<tr>
<td>▪ Creeping process</td>
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<tr>
<td>▪ Air-borne sound</td>
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<tr>
<th>Error detection during industrial welding</th>
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<tr>
<td>▪ Welding robots in the automotive industry</td>
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<tr>
<td>▪ Detection and differentiation of error images</td>
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<tr>
<td>▪ Airborne-sound &amp; Ultrasonic</td>
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<th>Malfunction of air conditioners</th>
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<tr>
<td>▪ Start-Up-Cycle</td>
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<tr>
<td>▪ Early detection of damage to components</td>
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<tr>
<td>▪ Structure-bone analysis</td>
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Selection of experiences (2/2)

**Crack detection in turned parts**
- Hairline cracks
- Automated individual part testing in the line
- Airborne-sound

**Detection of faulty transmission components**
- End-of-line testing for the automotive industry
- Noise test before delivery to the customer

**Detection of cavitation in fluids**
- Mainly airborne-sound analysis
- Also in the ultra- & structure-borne sound range
- Relevant for e.g. hydraulics, power generation etc.
Cooperations

**Sensors**
- Water & heat resistant
- Directional characteristic
- Miniaturisation
- Sensor fusion

**Automation & Integration**
- System design
- Retrofitting
- Control loops
Overview Committee Work

- Membership at Sensors Industry Group, OPC Foundation
- Collaboration with Bitkom
  - AK Cyber-Physical Systems
  - AK Markt und Strategie
  - AK Interoperabilität
- Collaboration with Fraunhofer Big Data Allianz
- Collaboration with Task Force “Trusted Computing”

- Participation in events of “Münchner Kreises”
Hot topic

Artificial intelligence as basis for decision-making

Human machine interface (HMI)

References:

Ref.: pwc.de

Ref.: pixabay.de
Contact

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CALL FOR CONTRIBUTIONS
bis zum 31. Mai 2019