Graz University of Technology
Institute of Technical Informatics
Cognitive Products

Acoustic Anomaly Detection for Machine Condition Monitoring

Industrial sound analysis plays a crucial role in monitoring and maintaining the health of machinery in manufacturing processes. By attentively listening to the sounds produced by industrial machines, operators can often predict operating status, identify problems, and detect errors. The human auditory system is adept at distinguishing individual sounds even in noisy environments. These methods involve analyzing sound patterns, identifying anomalies, and using machine learning algorithms to automatically detect issues such as contamination, leakage, rotating unbalance, rail damage, and other malfunctions. These insights enable timely maintenance and prevent costly breakdowns, contributing to efficient and reliable industrial operations. Furthermore, audio data can be synergistically combined with other machine-related parameters such as energy consumption, rotational speed, torque, or vibration data. In this thesis, the goal is to analyze one such dataset from the EMCO Maxxturn 45 CNC machine. The student should develop an algorithm/model that is able to detect anomalies in both audio and “normal” data.

Maxxturn45 CNC machine with the position of the sensor and edge device

Goal and Tasks:

- Analyze Audio Data: The primary goal is to analyze audio recordings from industrial machines. The data set consists of audio data from normal operation and when anomalies occur.
- Develop Anomaly Detection Algorithms: Student will design and implement machine learning algorithms capable of identifying abnormal audio signatures. These algorithms will learn to differentiate between typical operational sounds and those associated with faults or malfunctions.
- Integration with Multimodal Data: While audio data provides valuable insights, combining it with other sensor data (such as energy consumption, rotational speed, and torque) can enhance accuracy. The goal is to integrate audio features with these parameters to create more comprehensive predictive models.

Recommended Prior Knowledge:

- Understanding or high interest in working with single-board computers such as Raspberry Pi.
- Basic programming skills, such as Python.
- Experience or a high interest in machine Learning and anomaly detection.
- Experience or a high interest in signal Processing and acoustics. Students should be able to understand the basics of audio signal processing, including time-domain and frequency-domain representations.

Start: a.s.a.p.

Duration: 6-12 months

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