Fraunhofer IDMT

Fraunhofer Institute for Digital Media Technology IDMT

Industrial Media Applications

Industrial Acoustic Monitoring – Audio Signal Analysis meets AI

Who we are

We are the experts of audio signal analysis using trustworthy AI. Together with our contracting partners, we develop cutting-edge solutions consistently designed to meet user requirements and expectations. The business unit Industrial Media Applications IMA at Fraunhofer IDMT combines the institute's long-standing expertise in the fields of intelligent acoustic measurement technology, audio signal analysis, machine learning (ML) as a part of AI, and security-related technologies in order to generate new solutions for industrial applications.

What we contribute

We improve industrial quality assurance by detecting faults in machinery, production processes, or products faster, more reliably and safely. We provide know how on audio hardware and setup for data recording; we add audio signal processing and analysis with state-of-the-art AI algorithms to deliver robust results for acoustic monitoring in industrial applications.

What we are looking for

We are looking for new use-cases to challenge and improve our acoustic analysis systems. To create innovative solutions for acoustic monitoring systems we are looking forward to working closely together with business and development partners on their unsolved problems.

What we aim for

- AI based acoustic monitoring solutions
- robust algorithms for industrial audio data analysis
- adaption of existing ML models to new use cases
- experimental design and data acquisition
- detection of anomalies in audio data
- reduce dependence on annotated data with semi-supervised learning solutions
- automate the ability of experienced machine operators to hear errors of a product or produc-tion process and make this knowledge usable for AI

What we do

We develop AI algorithms for the analysis of industrial audio data. We are experts in the combination of audio signal processing with ML models. Our main fields of research regarding industrial sound analysis are anomaly detection, robust audio classification, semi-supervised and federated learning. Further research topics include explainable audio AI, sound source separation, and energy efficient AI.

How we do it

For the recording of audio data and its analysis, the selection and correct setup of the best possible sensor technology is a decisive factor which we address in our research. Data collection and thorough labeling (annotation) of this data build the basis for successful data analysis using AI techniques. Since data protection plays a major role in the transfer of measurement data, we also provide privacy and security technologies.

If only examples of well-functioning products or machines are available, this can be solved by anomaly detection. Here, ML models are fed with good data to subsequently detect deviations from the normal state. For a deeper evaluation of the fault, we use methods for robust audio classification. This enables us to distinguish between different faults or product states. Since silence is rare in industrial halls, it is important to ignore the ambient sound and focus on the sound of the machine. This can be done by clever placement of microphones, advanced audio pre-processing, and robust AI algorithms.

In times of sustainability and »green production«, we are taking on the challenge of making our AI algorithms as energy efficient as possible, so that they deliver reliable results even on devices with limited computing power and energy consumption. We have already been able to achieve enormous savings in memory requirements by compressing ML models. Thus, the models are particularly suitable for the use on energy-saving or energy-autonomous devices.

Where it derived from

The human auditory system detects and distinguishes individual sounds, even in noisy environments. In industrial manufacturing processes, it is often possible to predict operating status of a component, engine or even an entire machine by attentively listening. The experienced machine operator can hear problems or errors. However, so far it is quite difficult to detect these indications of faulty processes or products in any other way. Our basic premise: everything that is audible is also measurable as an indicator for quality.

Where we apply it

- acoustic event detection (AED)
- process monitoring
- in-line quality control
- end-of-line quality control
- predictive maintenance

Using our AI algorithms in acoustic monitoring systems can provide additional and precise information about the quality and condition of products or processes. In order to continue the use of existing but technically obsolete machinery, our customers can equip their plants with our technology (retro fit) to increase its productivity and achieve a better quality of products.

Further information

Fraunhofer Institute for Digital Media Technology IDMT
https://www.idmt.fraunhofer.de/en.html

Business Unit Industrial Media Applications
https://www.idmt.fraunhofer.de/en/business_units/ima.html

Datasets
https://www.idmt.fraunhofer.de/en/business_units/ima/research.html#19954920

»We are listening!«

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