

Machine learning-based signal processing on vibration data from building mechanical system for system health monitoring

An analysis of plant vibration is critical in the maintenance practices of mechanical services within a building. Early detection of equipment problems through vibration analysis is a crucial step toward preventing equipment failure. Monitoring equipment vibrations allows facility managers or building owners to identify and address potential issues before they lead to catastrophic failures and expensive replacements.

Why the study:

- To detect and monitor the vibration data of mechanical services in building, such as plant, time waveform (TWF) and the *fast fourier transform* (FFT) are most useful tools and widely used in the signal processing. With the increasing integration of machine learning with signal processing, this poses some **challenges**, such as the need for extensive training data, potential overfitting and increased computational complexity.
- Addressing the abovementioned challenges requires a thoughtful approach to data collection, model design and optimization techniques.
- To advance the current vibration data direction performance, an intelligent and adaptive signal processing machine learning approach is needed.

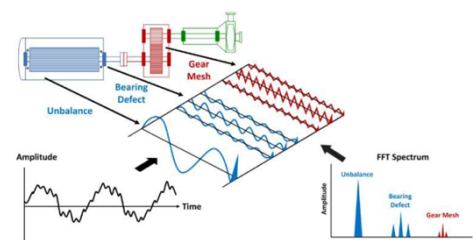
What we found:

- We transformed vibration time series data into power spectrum images, which are then analyzed by deep learning algorithm to predict future signal behaviour. This transformation converts temporal changes into special patterns, allowing the model to identify spatial relationships and patterns that may contain important information from our sensors.
- Our approach refines and optimizes the model parameters to enhance forecasting performance.

What this means:

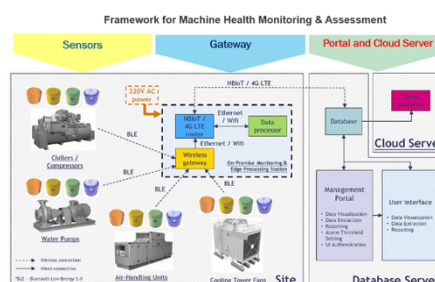
- The proposed machine learning-based signal processing model can be implemented to process data in real-time, allowing online monitoring of the mechanical system conditions and, consequently, early detection of potential faults.
- Our approach effectively extracts and enhances the signal features, leading to improved forecasting performance. It also helps avoid high computational loads.

Signal Processing by Fast Fourier Transform (FFT) for Vibration Analysis



What we did:

- We investigated the applicability of supervised machine learning classifier and digital signal processing on vibration response in the detection of various kinds of defects present in mechanical services in buildings.



IoT-enabled Sensors for Machine Health Diagnosis

