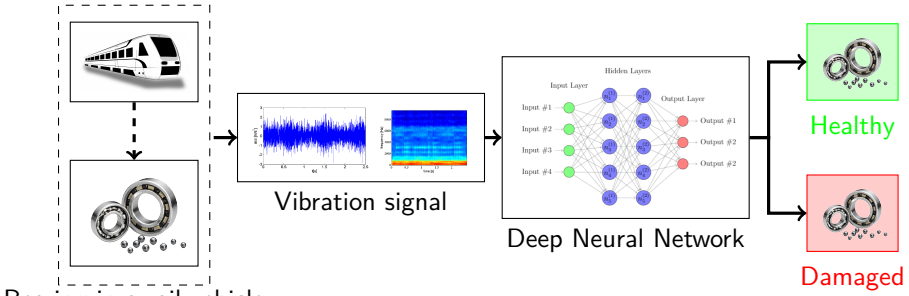
Chair of Multimedia Communications and Signal Processing
University Erlangen-Nuremberg

Proposal for a Master thesis

Topic: **Deep Learning Methods for Bearing Fault Detection**

Description: The measurable vibrations of machines during operation contain much information about the machine's condition. During normal operation a machine exhibits a characteristic vibration signature which is directly linked to periodic events in the machine's operation. However, when a fault arises in one of the machine's components this vibration signature is altered. By applying learning-based algorithms the operating condition can be classified and monitored. Vibration analysis is extremely important for monitoring machine parts that are difficult to access as it is the case for wind turbines or rail vehicles.



In the case of a rolling element bearing (see Figure), high-frequency resonances are excited every time a local fault, e.g., a crack, is hit by the rolling elements, which is not the case for a bearing in normal condition. Consequently, the vibration signals differ for different bearing conditions.
Starting with a literature survey and the investigation of promising network architectures for the classification of faults in rolling element bearings, the aim of this thesis is the implementation and evaluation of end-to-end deep learning methods for the detection of bearing faults. The selected approaches are to be trained and validated with data that was gathered from real locomotive bearings. Comprehensive reviews of state-of-art network architectures with application to condition monitoring of bearings are given in [1, 2] and shall serve as a starting point.
As prerequisites, the student should have interest in signal processing, affinity to math and Matlab or Python programming experience.

[1] Hamadache, M., Jung, J. H., Park, J., and Youn, B. D., "A comprehensive review of artificial intelligence-based approaches for rolling element bearing PHM: shallow and deep learning," *JMST Advances*, pp. 1–27, 2019.

[2] Zhang, S., Wang, B., and Habetler, T. G., "Deep learning algorithms for bearing fault diagnostics–a comprehensive review," *IEEE Access*, vol. 8, pp. 29857–29881, 2020.

Supervisor: Matthias Kreuzer, M.Sc., room 05.018 (Cauerstr. 7), matthias.kreuzer@fau.de

Professor: Prof. Dr.-Ing. Walter Kellermann

Available: Immediately