# Gearbox Condition Monitoring Using Structure-Borne Acoustic Noise Signals

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The durability of technical systems is often limited by wear-induced gearbox failure. For a service life extension and effective maintenance, acoustic methods are widely used in non-destructive testing and online monitoring. In the face of noisy environments and the vast volume of data generated during acoustic monitoring, the development of highly efficient and robust evaluation routines becomes of crucial importance. This work aims to establish a foundation for the permanent condition monitoring of gearboxes through structure-borne noise measurement. Critical signal features, essential for discerning characteristic differences in conditions, were systematically researched and newly defined. The defined features are subsequently evaluated, visualized, and tested using suitable algorithms. These features help to reduce the data and serve as input parameters for machine learning methods and artificial neural networks (ANN) identifying the condition of the monitoring object. To identify and validate an appropriate set of features a gearbox demonstrator featuring a three-speed bicycle hub, loadable via a disc brake, was continuously monitored using an piezoelectric sensor to collect long-term acoustic data. Using the appropriately selected features as input for machine learning methods enables the identification of both the current gear state and the load state. This research underscores the critical importance of features exhibiting self-normalized properties, which enhance reliable outcomes and resilience against wear-induced deviations. These features may provide a robust and enduring solution for sustainable gearbox condition monitoring in real-world applications.