## Popular scientific abstract

The work in this PhD dissertation addresses vibration-based condition monitoring of rolling element bearings. The detection of faults in rolling element bearings is an important task as the bearing is often the most critical component of the machine. Especially, in large machines, it is desired to monitor the condition of the bearings to prevent a sudden breakdown. This is the case at Lindø Offshore Renewables Center (LORC) which has been the collaborating company in this PhD project. However, the detection of the fault in a rolling element bearing is usually not straightforward as noise and harmonics (discrete frequencies) may mask or hide the signal originating from the fault. A higher degree of signal contamination relates to the complexity of the system in which the bearings are located. This comprises the various components inside and outside the machine which may add to the signal measured at the bearing. Especially, in large complex machines, such as the ones at LORC, the level of signal contamination is usually high. To obtain the signal originating from the faults when signal contamination is present, signal processing techniques may be required. Two areas of signal processing that improve fault detection greatly in case of harmonics and low signal-to-noise ratio (SNR) of the signal from the faults are; the removal of harmonics and band selection for band-pass filtering.

The work in this PhD dissertation aims to improve fault detection of rolling element bearings by adding new improved methods in these two areas of signal processing.

The harmonics have high energy which tends to disturb the detection of faults. The signal generated by the faults in the bearing is stochastic which means it can be separated from the deterministic signal of the harmonics. The method developed in this PhD thesis uses the ratio between two periodograms originating from the same time-domain signal smoothed with different lengths of windows to separate the stochastic signal from the harmonics.

Even with no harmonics present in the measured signal, the signal originating from the faults may still have a low SNR causing it to be hidden. Band-pass filtering at a suitable band in which the signal from the fault has a high SNR, is desired. The natural frequencies of the system are usually suitable locations for band-pass filtering as the natural frequencies are excited by the impacts generated by the faults resulting in an amplification of this faulty bearing signal. This is utilized in the method developed in this PhD thesis by using operational modal analysis to locate the natural frequencies and afterward determining the optimal natural frequency that enhances the signal from the fault the most. Furthermore, another method for band selection is proposed in this dissertation based on the 1/3-binary tree used in the fast kurtogram method.

The developed methods were examined using a variety of signals with the majority being real-world signals, as the research in this thesis was conducted with the industrial application at LORC in mind, with the purpose of using it in a condition monitoring system. The methods were applied to signals from LORC’s test benches as well which were acquired by measurement campaigns conducted in this PhD project.

The developed methods show good performance to enhance fault detection for rolling element bearings.