

# Project: Rolling Bearing Sensor System Development

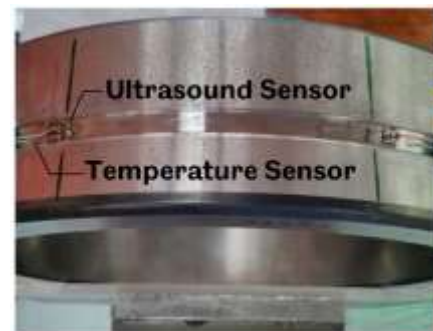
**Key focus:** rolling element bearings, bearing lubrication, drivetrain, condition monitoring, reliability improvements

**Researcher:** Ben Clarke / Gary Nicholas

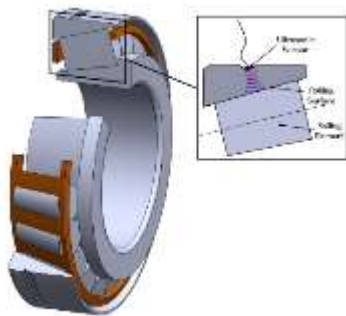
**Supervisor:** Ampea Boateng

## Background

Bearing failures in wind turbines have been amongst the most common seen in the industry. Gearbox bearing failures have been prevalent in the past and main bearings have recently been highlighted as an area of concern due to their high loading and susceptibility to transient events. These bearings are costly to replace, particularly when offshore crange is required. The trend in increasing size of wind turbines is also pushing bearing technologies to their limits, requiring validation of new designs and understanding of the environment and performance of these new bearings. Sensors that measure the performance and characteristics on rolling bearings could help in their operation and condition monitoring.

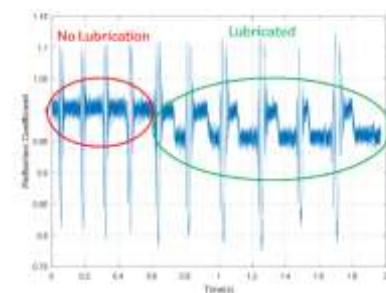


## Project description



Current sensors measure temperature, torque, and sometimes vibration or acoustic emissions. These provide useful indications of machine performance but cannot give information about what is happening inside a bearing, where the grease or oil is, how oil films form and how much contact is occurring.

PhD students at the Leonardo Centre at the University of Sheffield have been developing ultrasonic techniques to monitor rolling element bearings. Ultrasonic pulses can be sent through a bearing raceway to directly monitor roller-raceway interfaces. Measurements of ultrasonic reflection from each roller can give an indication of lubricant film thickness and the presence of grease or oil.



1. Monitoring lubricant between roller passes.

Recently these sensors have been installed on the high-speed shaft bearing of a 600 kW turbine in the Barnesmore field in Ireland. Early work has shown the capability of measuring conditions at each individual roller in the bearing and how oil films varied from roller to roller.

This project will investigate new aspects of ultrasonic sensing in bearings including:

- Improvements in data richness: arrays of sensors across the contacts
- Resolution improvements: post processing techniques, array and mechanical focussing

- Using different ultrasonic waveforms: mixed film measurement with combined longitudinal and shear sensors
- New lubricants: monitor bearing performance across a range of oil viscosities, grease measurements, and particulates
- New hardware: cost and functionality

## Research outcomes/impact

Understanding how a bearing is lubricated helps design lubricants and lubrication systems. Measuring the amount of solid contact in a bearing helps indicate the likelihood of wear and fatigue failure.

### ***Project Sponsorship:***

This research is sponsored by the Powertrain Research Hub, a collaboration between ORE Catapult and the University of Sheffield.