Physics with Industry workshop 2022
Title: Concept development of an optical monitoring system for journal (glijlagers) bearing in Wind Turbine and Marine applications.

1. Company information

Push the boundaries of sustainable rotation, Sensing360 is a start-up with 4 employees and a turnover of 400kE in 2022. We focus on the optimization of rotation for Wind Energy and Marine applications like E-motors, gearboxes, Drive lines and propulsion systems. We use optical sensors and have development sensor solutions and algorithms to help our customer to improve their rotation!

2. Problem

The background and urgency of the problem;

In Marine and Wind Energy applications more and more journal bearings are used, due to the fact they are easier to install, cheaper and require less maintenance. The drawback the design of these bearings is harder and there is currently no satisfactory way of monitoring these bearings on condition; predict failures and prevent unexpected downtime. When condition monitoring is possible systems can be optimized on design, maintenance, and operation and currently for 95% of the time, the user is not aware of the status of their (rotating) equipment.

Why you need help from the physics community;

To determine monitoring parameter to predict condition and remaining useful life of these crucial components for Wind and Marine. We would like to see what relevant parameters of these bearings and drive line can be measured and how it can help with condition monitoring. The measurements need to be optical and the "standard" parameters these sensors can measure are Strain, Temperature, Pressure, Vibrations.

Which physics disciplines you expect to be relevant to solve this problem;

Material science, data analytics, optics/photonics and experimental physics

Graphs, pictures, references etc.;

The two focus applications are:

1. The bearings in (wind) turbine gearboxes → there is a trend towards smaller bearing footprint due to the fact turbines are getting bigger and bigger, but the weight is not allowed to increase as much. Therefore, more and more journal bearings are used in for instance wind turbine gearboxes, but there is no satisfactory solution to monitor there on condition. In the two images below both the application is shown and the bearings type

Figure 1: Typical 2 MW wind turbine one 3-stage planetary gearbox and two spur gear systems

Figure 2: Examples of different journal bearings (glijlagers).

2. The driveline of a ship, these drivelines are used are propulsor of a ship and are crucial for operation. The journal bearings are crucial for these drivelines and extremely hard to replace. Furthermore, it can be point to measure crucial operation parameter like trust and torque (power). These parameters can be used to reduce fuel consumption, downtime, and misalignment by automatic alignment. In figure 3 a typical ship driveline is shown, what can we measure on the journal bearing which helps ships availability and operation efficiency?

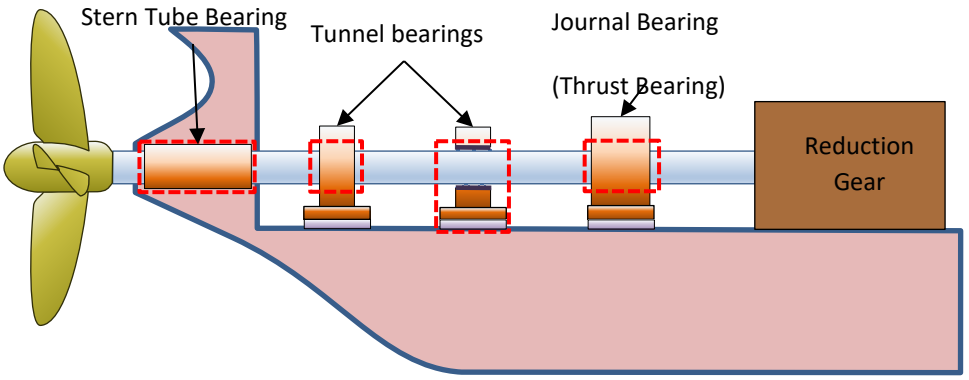

Figure 3: Typical ships driveline

Possible solutions or directions toward solutions to the problem;

The simplest way is to monitor the temperature since the rise of temperature indicated increased friction and is direct related to the thickness of the coating/sliding material. Temperature on it's own is just to late, when temperature is rising, the bearing will probably break down in days and that is to short to plan maintenance, especially offshore. What can be added to temperature measurements?

Boundary conditions (e.g. technical, organisational, or budgetary requirements).
The monitoring solution needs to consist of fiber optical sensors; fiber bragg gratings. Our budget is limited, but "Friday" afternoon experiments can always be accommodated when needed and appropriate.