



## Active Piezoelectric-sensor Based Condition Monitoring System for Rolling Element Bearings ----Rolling Bearings Condition Monitoring

Wenqu Chen ([wendy.chen@sheffield.ac.uk](mailto:wendy.chen@sheffield.ac.uk))

Rolling element bearings are the most widely used bearings in industries, such as automotive, aerospace, and power generation. The failure of bearings always has serious consequences for the whole systems. Therefore, the project aims to build up a condition monitoring system based on piezoelectric sensors.

### Film Thickness Measurement

Piezoelectric sensors are used to measure the reflected ultrasound from the lubricant layer. The response is governed by the stiffness of the layer, which is related to the thickness of the oil film. Figure 4 shows the investigation on the effect of speed on the film thickness.



Fig.1 Photo of the bearing test rig

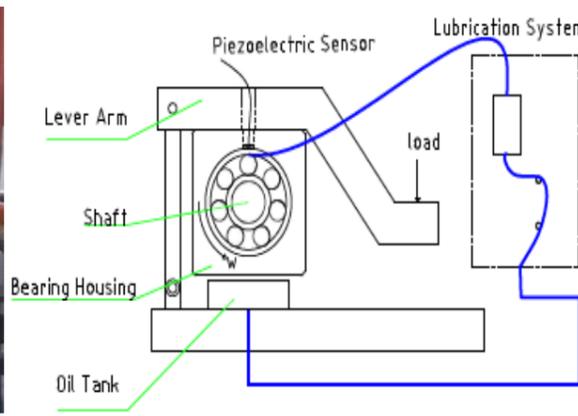


Fig.2 Schematic of the bearing rig

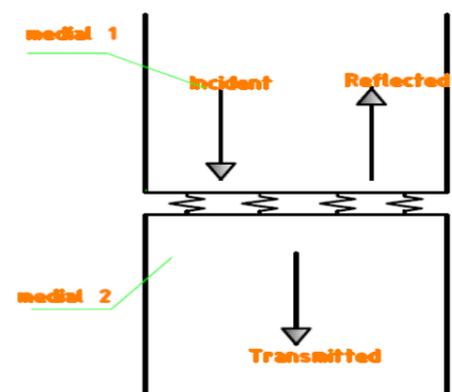


Fig.3 Propagation of ultrasound

### Bearing Contacts Monitoring

The time of flight of the ultrasonic pulse from the sensor to the contact and back depends on the speed of sound in the raceway steel, the thickness of material, and also the state of stress. The latter two parameters indicate how much load the contact is subjected to. Figure 5 gives a reflected signal from the interface between the roller and the flat and figure 6 shows the corresponding contact pressure.

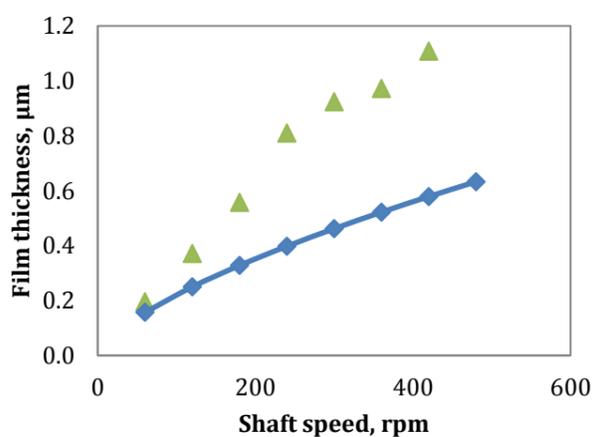


Fig.4 Film thickness Vs shaft speed (P=5kN)

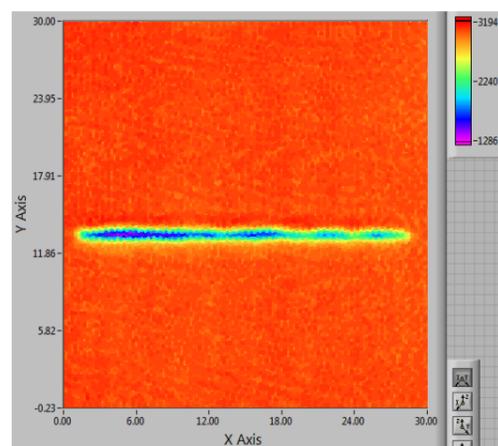


Fig.5 Amplitude of reflected signal (P=10kN)

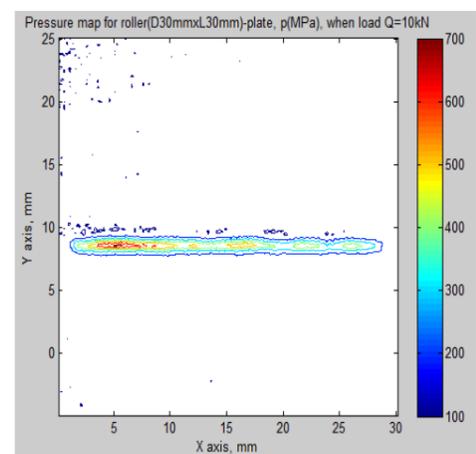


Fig.6 Contact pressure (P=10kN)

### Benefits for Industry:

- Monitoring and controlling the lubricant thickness is helpful to improve the performance of bearings and the service life of bearings.
- Active piezoelectric sensors will be used as they are cost-effective and accessibility-effective.
- Measuring the applied load on bearings helps designers to improve bearings performance and service life.
- Information about the load on the bearing helps to predict the residual service life of the bearing, which is very important for those applications where the load is difficult to know, like wind turbine bearings.