SUCCESS STORY

InTribology1
Excellence Centre of Tribology

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Programme line: COMET-Centre K2

Type of project:
Data-driven discovery
04/2020 – 03/2024
strategic research

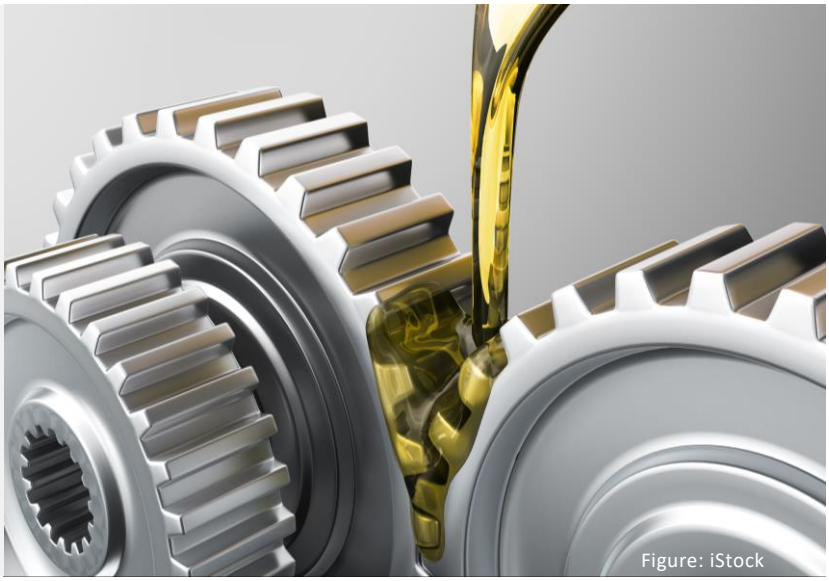

Figure: iStock

TRIBOACOUSTIC PIN – UNRAVELING THE SECRETS OF LUBRICATED TRIBOSYSTEMS

HIGH PERFORMING FUTURE-ORIENTED GREEN LUBRICANTS WILL BE OPTIMIZED BY THIS NEW CLASS OF PHYSICAL SENSORS.

The European Green Deal aims at cutting EU's greenhouse gas emissions by 55% by 2030. By these standards, lubricating oils must be made from at least 32.5% renewable resources. According Holmberg and Erdemir ~20% of world's energy is lost through friction. Therefore, a balance between "green" oil formulation and its performance needs to be achieved. The development of novel lubricants is a time-consuming task for industry, and the challenge is further exacerbated by fast-changing regulation scenarios. Therefore, to optimize the lubricant's frictional performance, tribological characterization plays a crucial role. These tribotests replicate the performance of oils undergoing shear, load and temperatures that are characteristic of real machine elements such as gears or bearings. As physical testing of components is always a costly undertaking, sensors should maximize the knowledge gain of experiments. Thereto, the metrology group of AC²2T has developed a new class of online sensor for tribo-testing called "the tribo-acoustic pin". This sensor looks like a standard test pin for tribological testing, but it is a complex laboratory on a chip device that measures oil performance in real time and non-invasively.

In standard tribological testing, the real contact situation of a machine component is modelled by a spherical pin rubbing on a counter body. A lubricating oil is interleaved between the two bodies, thus recreating a model of the real contact. A tribo-acoustic pin consists of a similar spherical pin instrumented with ultrasonic sensors and uses high frequency ultrasonic waves (vibrations generated at

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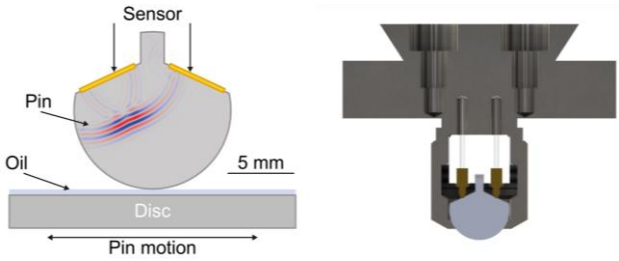
frequencies above the human audible limit) to measure oil properties in the contact non-invasively and in real time. The ultrasonic sensors are miniaturized to fit the small pin geometry. Connection to receiving electronics is done wirelessly, thus being easy to use for technical personnel as very little training has to be provided for the utilization of the device.

Impact and effects

This non-invasive sensor allows monitoring of the oil film thickness in the contact during the tribological experiment, being the most crucial physical performance parameter in lubricated contacts. A high film thickness corresponds to good lubrication, while a thin lubricant film might break and cause wear. Additionally, the viscosity of the lubricant in the contact region can be derived from the measurement data. Thereby, the tribo-acoustic pin helps achieving an optimization and provides valuable insights on the physical parameters affecting oil performances in a contact.

Validation tests conducted on the tribo-acoustic pin have shown high reliability in the quantification of the film thickness and viscosity. Thereby a maximization of the information gained in experiments is achieved. With thousands of tribotests being executed yearly a significant reduction of tests is foreseen, reducing the overall costs for tribological research. Thus, this device has a high potential to optimize existing test procedures and efficiently corroborate the decision-making processes in industry.

The tribo-acoustic pin technology IP is currently being registered, and the team working on this device has already been awarded for the tecnet/accent Innovation Award 2021/2022 and the GfT Förderpreis 2021.



Left: Working principle of the tribo-acoustic pin with the ultrasonic wave propagating toward the tribological contact;
Right: Schematics of the sensor assembled in a standard specimen holder (Images: AC²T)

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Project partner

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