Contact-free testing and monitoring

Non-contact torque sensors based on Surface Acoustic Wave (SAW) technology can offer benefits in a wide range of applications, from test facilities to monitoring machine parameters

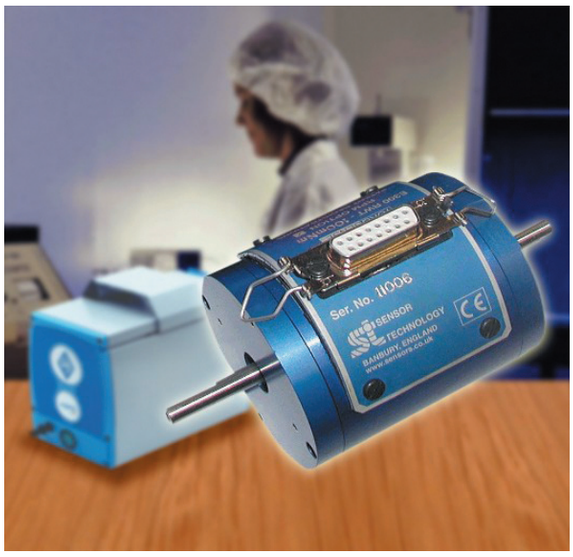
Non-contact measurement technology is beneficial in a wide range of applications, and the development of techniques based on Surface Acoustic Waves (SAW) has offered many advantages. The TorqSense sensors and transducers from Sensor Technology, for example, are based on the patented technology of measuring the resonant frequency change of SAW devices in a non-contact manner when strain is applied to a shaft to which the SAWs are fixed.

TorqSense devices have been fitted to five machine sets at the Dublin Institute of Technology (DIT), replacing an inaccurate method of machine monitoring.

The demonstration equipment in the DIT machines laboratory has a modular construction, which enables experiments with both AC and DC machines to be carried out on the same test bed. Whatever the configuration of the equipment, however, the experiments and demonstrations performed in the laboratory require the monitoring and collection of a number of key operating parameters – including torque, speed and power.

The SAW transducers comprise two thin metal electrodes, in the form of interlocking 'fingers', on a piezoelectric substrate such as quartz. When an RF signal of the correct frequency is applied, surface acoustic waves are set up, and the transducer behaves as a resonant circuit. If the substrate is deformed, the resonant frequency changes. When the transducer is attached to a motor drive shaft, the deformation of the substrate and hence the change in resonant frequency is related to the torque applied to the shaft.

Since the transducers operate at radio frequencies, it is easy to couple signals to them wirelessly, meaning that sensors incorporating the SAW transducer technology can be used on rotating shafts, and can provide data continuously. Of additional benefit to DIT, the devices offer a large safe overload margin, high accuracy and resolution, ability to operate equally well clockwise and anticlockwise, and integral temperature monitoring. As well as measuring torque, the sensors also provide speed and power data. The main benefits for this application, however, were the wireless connection between the transducer and sensor electronics, and because they deliver measurements of all key parameters in real time.



SAW equipment is being used in Charles Austen Pumps' test facilities

Six RTW321 series TorqSense sensors were purchased by the laboratory. In addition to two conventional analogue outputs, these also provide data digitally via RS 232 and USB ports. In this application, the USB ports provide a convenient connection to a PC that is also used to configure the operation of the sensor. The sensors have an integral self-diagnostic feature that ensures the data they supply is trustworthy, and also warns users if the maximum speed or torque ratings are exceeded.

Five of the sensors are currently installed on demonstration equipment, while the sixth is held in reserve in anticipation of use in a future research project.

Terence Kelly, technical officer, said: "I think it's fair to say that the sensors have greatly improved our facilities for demonstrating machine characteristics and for experimenting with them, and that they are, therefore, a great asset for our teaching programme."

Testing

Due to the benefits provided by the technology, Charles Austen Pumps, a bespoke pump manufacturer, has upgraded its test facilities with SAW equipment from Sensor Technology. The company manufactures pumps individually to meet customer requirements, and much of its work comes down to optimising drive dynamics to produce the desired characteristics – ranging from smooth flow in a critical medical situation, or low noise pumps, to long life versions for pumps in inaccessible situations. The cyclic nature typical in pump operation tends to induce torsional oscillations in the drive shaft, which can have an adverse affect on performance if left unchecked.

SAW provides non-contact monitoring of instantaneous rotary torque, allowing accurate modelling of the load changes. For the new test rig, Sensor Technology provided the TorqSense unit and helped with designing and building the rig. According to the company, the new facility makes its drive engineering accurate, predictable and reliable.

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Testing fast rotational machinery

Brüel & Kjaer has released the Laser Tacho Probe, Type MM-0360, an IP64-rated device for performing contact-free measurements on rotating or reciprocating machine parts.

The compact probe works by producing a voltage pulse from each turn of a shaft or cylinder and is positioned to allow its visible laser beam to face the test object, on to which a small strip of self-adhesive retro-reflective tape is attached. This reflective tape then backscatters the laser energy to a receiver that converts it to a jitter-free signal, suitable for a measurement or recording system.

Reflective tape means the probe can be positioned up to 70cm (27in) away from test objects, allowing engineers to be at a safer distance when testing machinery ranging from aircraft turbines to washing machines.

The probe can operate at rotational speeds of up to 300,000 RPM and down to 0 RPM (dependent on analysis system) for wind turbine and ship propulsion applications.

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