Non-contact monitoring of torque output

Previously a fiddly operation, SAW technology has enabled Sensor Technology to develop a low cost, non-contact torque measurement sensor for serial manufacture, easy installation and robust performance

Measuring the torque of a rotating shaft has always been difficult because the necessary contact slip rings tend to be rather fragile and unreliable and they add drag to the load on the shaft so altering the torque and allowances have to be made.

The low cost, non-contact, rotary torque transducer TorqSense from Sensor Technology is said to be proving as robust and simple to use a photoswitch or temperature gauge.

TorqSense is able to withstand the rigours of very hostile environments. The latest version, the RTW 310/320 series, is designed for serial manufacture, easy installation and robust performance. Now, having worked through two or three generations of the technology, the TorqSense RWT 310/320 series is opening up rotary torque measurement to a diverse spread of applications, says Sensor Technologies.

Applications

In many fields a knowledge of torque is critical including variable speed drive systems where direct transmission torque feedback can be measured to minimise torsional oscillations, mechanical resonance and fatigue; condition monitoring, for example on CNC machine tools; highly automated and torque critical tightening processes; and the monitoring and control of viscosity during mixing processes. The take-up of the technology has been impressive, with TorqSense products replacing existing types of rotary torque transducers by providing better performance at more affordable costs while offering the great advantage of being mechanical simple and not having to physically contact the shaft being monitored.

The low-cost, non-contact rotary torque transducer is proving as robust and simple to use as a photoswitch or temperature gauge

The devices are fixed onto a shaft to form part of a high frequency oscillator circuit; each device is angled at +45° to the axis of the shaft. When the shaft rotates under load it deforms by twisting: this compresses one SAW device and stretches the other, each allowing their resonant frequency to alter and thus changing the frequency difference between them. This difference in the two frequencies is a measure of the induced strain due to the twisting moment and from this the torque can be derived (the sum of the frequency signals is a measure of the shaft temperature).

"A knowledge of torque is critical in many fields such as condition monitoring on CNC machine tools"

Rotary torque has historically been difficult and expensive to measure because traditional techniques are typically invasive to the mechanical systems being measured; they have to be mechanically coupled to the test piece through slip rings and thus introduce drag. TorqSense overcomes these problems by using a radio frequency transmission link rather than a mechanical one. Its sensors are essentially two frequency resonating surface acoustic wave (SAW) devices which change their resonant frequency proportionally to the applied torque in the shaft.

Transmission of the signals is via an electromagnetic coupling operating at radio frequency (RF) levels, allowing non-contact, intrinsically safe torque measurement. Significantly the SAWs are piezoelectric so have very small power requirements. This power is delivered over the RF transmission link simultaneously with the transmission of the output signals. Thus, TorqSense allows non-contact monitoring of the shaft. Resonating frequencies can be selected anywhere from 100 to 1000MHz. Operating at such high frequencies, the transducers are much less susceptible to electrical interference than conventional torque sensors. The high immunity to magnetic fields makes them suitable for use in motors, for example. Key characteristics of the SAW based transducer include a resolution to 1 part in 10 million, an extremely linear response (better than 0.1%) and a bandwidth in the order of 1MHz.

Integration

TorqSense transducers are designed to operate direct from a PLC or a PC, removing the need for conventional instrumentation and will interface with standard DPMs. TorqSense transducers require only a minimum shaft length, have low inertia, no physical contact between shaft and housing, wide bandwidth, high resolution and accuracy, are mechanically simple and have excellent magnetic/RF noise immunity.

Mechanically straightforward, the units stand to completely redefine the expectations of machine builders, control engineers and OEMs, who to date have had to put considerable time and expense into obtaining the accurate torque readings essential for modern machine control and production monitoring requirements.

With so many advantages over the traditional rotary torque measurement solutions, it is easy to see why the technology is generating so much interest in industrial applications.

At the same time, the technology is providing a key tool in the development of higher efficiency rotating machines, where development engineers rely on accurate knowledge of torque and rotational speed. The TorqSense RWT 310/320 series features integral electronics with outputs for torque, speed, power and angle.

The RWT 310 provides analog outputs only, while the RWT 320 provides both analog and digital outputs, the latter allowing PC Interfaces such as serial and USB to be used for easy programming. Other features include built-in peak torque sampling, data storage and torque averaging and a self-diagnostics test package. The TorqSense RWT 310/320 series can operate from a wide range of supply voltages.

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