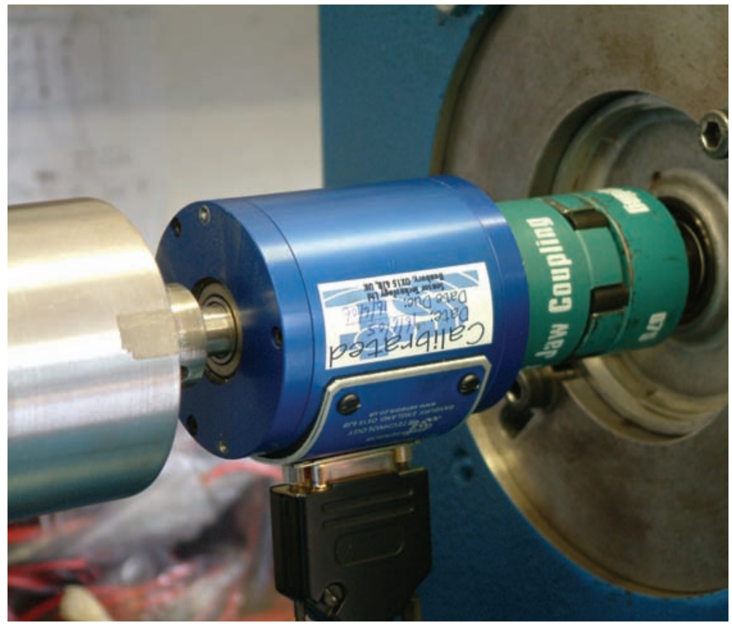
Servo research points the way to improved dynamics

Engineers want to use servos in ever more demanding application, and research and has led to the development of vastly improved dynamics, even with the most challenging of loads



The ease of set-up of modern servo drive systems, combined with steadily reducing costs, has made servo control an attractive proposition across the spread of motion control applications in a wide range of industries. Despite the developments in inverter technology which promise near-servo performance, in the most demanding applications which require a faster response and precise control of position, velocity and torque, only true servo systems can really cut the mustard.

Ready access to servo technology, and the steadily increasing capabilities of servo controllers, has seen machine designs pushing the boundaries ever further, with faster system response becoming an increasingly common industrial requirement.

With a perfect load, this would not represent a problem. But no load is perfect. Practical mechanical drive systems can be complex, incorporating several non-still interconnecting shafts and elastic couplings, all characterised by a dominant resonant frequency. Fast impulse signals from the servo controller excite torsional resonances through the drive train, leading to controller instability – particularly badly as the servo controller bandwidth approaches the resonant frequency of the load. This torsional resonance, then, is a significant factor which limits the ultimate dynamic performance achievable by even the best servo systems. In looking to damp these oscillations, the obvious answer is to measure and control the torsional resonance using shaft torque feedback techniques, but traditionally this has proved a challenge because the lack of reliable, low-noise, low-cost shaft torque transducers that are non-invasive to the mechanical drive system have precluded the use of direct torque feedback in all but a minority of specialises closed-loop servo drive systems.

Simple solution

Now, though, research in the Power Conversion Group at Manchester University, led by Dr Nigel Schofield, is focusing on the use of a non-contact, digital torque measurement system developed by Sensor Technology. Based on Surface Acoustic Wave (SAW) technology, these TorqSense transducers provide a low-cost mechanically simple, torque measurement solution for brushless servo drive-system applications, providing active damping and/or resonance ratio control.

Using the SAW based TorqSense transducer, it is possible to accurately measure instantaneous shaft torque from the various mechanical components of the drive train induced by the fast transients from the controller. Coupling of the signals to the outside world is via an electromagnetic coupling device, allowing non-contact torque measurement. The primary frequency of oscillation can be chosen anywhere from 100 to 1000MHz, with the difference frequency varying up to 1MHz. Operating at such high frequencies, these transducers are much less susceptible to electrical interference than conventional torque sensors, and this high immunity to magnetic fields in particular makes them eminently suitable for use with motors.

The Sensor Technology TorqSense transducers built on SAW technology are designed to operate with a PLC or PC, making it easy to interface them with standard controllers, and so further reducing the overall cost of integration in servo drive systems. Being compact and wireless, they also greatly simplify the mechanical design and so further reduce the overall cost of the whole system.

Easily embedded within the drive system, the TorqSense technology can withstand heat, dirt and mechanical vibration that represent problems for optical sensors in particular and their non-contact coupling between the shaft and the controller eliminates any issues of mechanical compliance.

The system integration and control studies at the University of Manchester are already highlighting major benefits for tomorrow's servo drive systems, offering the potential of servo drive trains that are 'intelligently rigid' and so free from torsional losses. The result could soon be commercial servo products that deliver improved performance and vastly superior system dynamics with even the most demanding mechanical loads.