A special non-contact torque sensor is helping researchers in their project to develop an intelligent automotive engine lubrication system, which aims to reduce emissions and improve fuel economy

Torque measurement is central to development of 'intelligent' lubrication

With engine efficiency under the spotlight like never before, automotive companies are exploring all avenues for improving performance. Car engines are the *betê noir* of the environmental lobby. There is no doubt that they are major emitters of carbon dioxide, but equally they are fundamental to modern life. A true replacement is decades away, so for the time being we have to make them as efficient as possible.

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Engine lubrication systems are essentially dumb. They include a simple mechanical pump which is sized to ensure an adequate supply of oil under the worst operating condition - typically, a hot engine at idle. The pump is thus hugely over-sized for most of the rest of the speed range and, as a consequence, nearly 60% of its output is dumped straight back into the sump via the relief valve. It will also deliver the same amount of oil to every part of the engine regardless of what that system might actually need. The pump is also insensitive to engine load and thus the bearings will receive the same oil supply at a given speed regardless of the load. In addition the pump forces nearly a ton of oil per hour through the filter, and when the oil is cold this takes a huge amount of energy. By any standard, this is clearly a very inefficient system.

With this in mind, a major UK company asked Powertrain Technologies of Snetterton, Norfolk, to design an intelligent lubrication system and to analyse its effects on engine friction and parasitic losses. A rig was subsequently built for motored friction tests - essentially a 6,000rpm 32kW electric motor driving a standard diesel engine. Andrew Barnes, a director at Powertrain takes up the story.

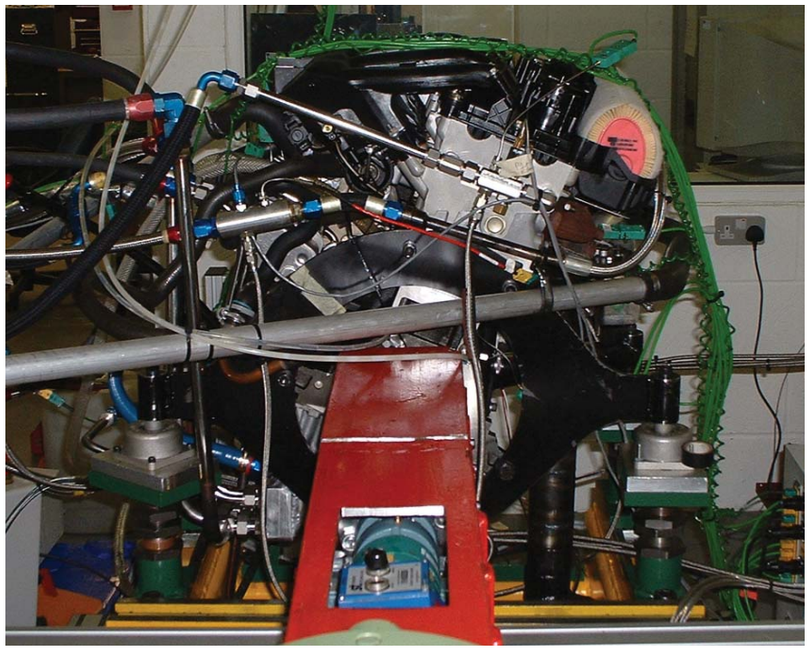
"We completely re-designed the engine lubrication system and installed a bank of five computer controlled oil pumps to our own design. Each is capable of supplying individual parts of the engine with oil under conditions appropriate to that part of the engine, and sensitive to the engine operating conditions. For example, we can supply the head with oil at pressures different to the block and supply the bearings with more oil when the engine is under high load."

The purpose behind this project is to profile the performance of the engine under various lubrication conditions and to derive optimum configurations of the intelligent systems for best performance, as Mr Barnes explains.

"Both petrol and diesel engines run far cleaner than they did 20 or 30 years ago. However, the need to operate efficiently under a wide range of speeds and loads and environmental conditions from -40°C to + 40°C remains the Achilles heel. Intelligent lubrication has the potential to improve performance no end, although quantifying the best configuration is painstaking work."

Accuracy in measuring small changes in drive torque reliably and repeatably is a key requirement. The object of the exercise is to measure the effect on friction of a range of different oil supply strategies and oil types, and these changes in friction are represented by changes in the motored drive torque of the engine. Clearly, choosing an appropriate torque sensor was always going to be critical to the success of the project.

TorqSense sensors from Sensor Technology are particularly appropriate for development work because they operate wirelessly in a non-contact mode, so there is no



Engine torque measurement is a vital aspect of Powertrain Technologies' test bed, which is being used to develop intelligent automotive lubrication systems. The TorqSense torque measurement sensor can just be seen within the red enclosure at the foot of the picture

requirement to wire up slip rings for each new measurement. The device senses and measures the radio frequency waves generated by two surface acoustic wave devices (SAWs) fixed on a rotating shaft. These RF signals are converted to a torque measurement using two tiny SAWs made of ceramic piezoelectric material with frequency resonating combs laid down on their surface.

The SAWs are fixed to the drive shaft at 90 degrees to one another. As the torque increases the combs expand or contract proportionally to the torque being applied. In effect the combs act similarly to strain gauges but instead measure changes in resonant frequency. The adjacent RF pickup emits radio waves towards the SAWs as well as collecting the reflected resonant changes and it is the change in frequency of the reflected waves that identifies the applied torque.

Powertrain's research has now progressed to the next stage where the engine is removed from the test bed and installed in a car to quantify the effect on fuel economy. Mr Barnes says it is now a matter of driving the car under all sorts of conditions on a mixture of test tracks and rolling roads to build up profiles of the fuel consumption.

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HANNOVER MESSE
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Sensor Technology has chosen the Hannover Messe platform to unveil its latest innovation. New for 2009 is TorqSense RWT 330/34 (shown here), designed for use in applications where space is limited. Like other units in the TorqSense family, the RWT330/340 provides non-contact measurement of torque, speed, power and position of rotating shafts. Increasingly varied applications for TorqSense are surfacing, as Sensor Technology's Tony Ingham explains:

"TorqSense can be applied to virtually any size of system where precise yet simple torque monitoring is required. We thus get requests to fit it into very small spaces, so the design team has come up with a system that separates the sensing head from the control electronics to form a two-part unit. The head is very compact, so it can be fitted into the tiniest of spaces, while the electronics can be sited at a convenient place further from the shaft under test.

"Our larger sensors are used in many applications at the heavy duty end of industry, while our smaller ones are used in applications such as fine chemical dosing and lab-based research. At both ends of this spectrum are applications where splitting the sensing head from the control electronics is desirable. What TorqSense is about is reliably collecting high speed real-time torque data. With that captured and secure, our special TorqView software can display it via on-screen virtual instruments so users can perform a full range of analysis."