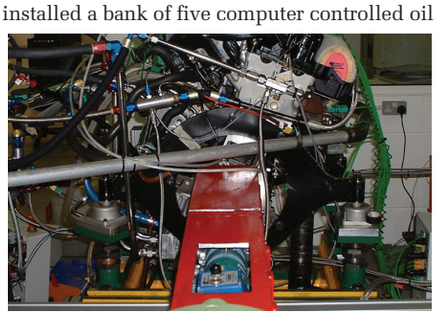
Rig tests intelligent engine lubrication systems

Although car engines are major contributors to carbon build up, they are fundamental to modern life – so ensuring they are as efficient as possible is essential.

One area of inefficiency is the engine lubrication system. These have a simple mechanical pump which has been sized to ensure an adequate supply of oil in the worst operating condition. The pump is therefore hugely oversized 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; and is also insensitive to engine load, so the bearings will receive the same oil supply at a given speed regardless of the load. The pump also forces nearly a ton of oil per hour through the filter, and when the oil is cold this takes a huge amount of energy.

As an alternative, a UK company asked Powertrain Technologies to design an intelligent lubrication system and to analyse its effects on engine friction and parasitic losses. To meet requirements, the company built a highly specialised test rig featuring a TorqSense transducer from Sensor Technology.

The engine under test was a current production diesel and the test bed was configured for motored friction tests with a 6,000rpm 32kW electric motor. Powertrain completely re-designed the engine lubrication system and installed a bank of five computer controlled oil



pumps. Each is capable of supplying individual parts of the engine with oil under conditions unique to that part of the engine and sensitive to the engine operating conditions.

The idea was to completely profile the performance of the engine under various lubrication conditions and to derive optimum configurations of the intelligent systems for best performance.

The torque sensor is critical to the project since the object of the exercise is to measure the effect on friction of a range of different oil supply strategies and oil types. Thus the changes in friction are represented by a change in the motored drive torque of the engine.

Andrew Barnes, a director at Powertrain, said: "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 speeds, 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."

TorqSense sensors are particularly appropriate for development work because they are wireless fit-and-forget, non-contact, digital sensors, explains the company.

Powertrain's research has now progressed to the next stage in which the test rig is forsaken and the engine installed in a car to quantify the effect on fuel economy.

"It's now a matter of driving it under all sorts of conditions on a mixture of test tracks and rolling roads to build up profiles of fuel consumption," concluded Barnes.

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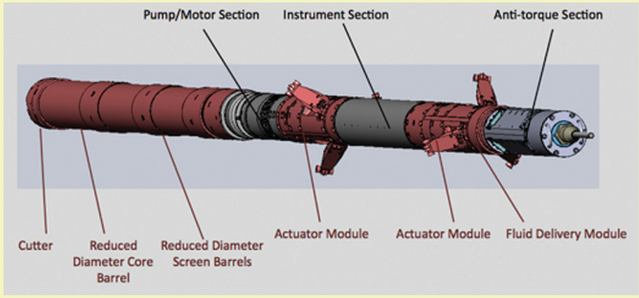

The U.S. Deep Ice Coring Project, which is currently being conducted in the West Antarctica Ice Sheet (WAIS), is examining approximately the last 100,000 years of the Earth's climate history by drilling and recovering a deep ice core. An ice core 3045m into the ice sheet was recovered in December 2011, so the Replicate Ice Coring System will re-enter the existing bore to extract additional ice related to areas of scientific interest.

Using an electromechanical drill system, scientists hope to extract 250m of new ice cores, going down to depths of about 4000m. While initially following the course of the parent bore hole, the Replicate Ice Coring System will slightly alter its course to create a second path to collect ice samples.

The drill of the Replicate Ice Core System uses two steering actuator sections to tilt itself in the parent borehole at a targeted trajectory. Located along the shaft of the drill, the actuators apply lateral pressure against the side of the borehole to alter the orientation of the drill head. The actuators tilt and guide the drill into the replicate borehole where ice samples are collected. Six Macro Sensors CD series miniature LVDT linear position sensors serve as part of the replicate actuator modules that push the drill out of the original hole at a targeted trajectory. Providing feedback on drill orientation, the AC-operated LVDT linear position sensors work as part of a closed-loop system, controlled by an onboard IC, with set points provided by an operator.

With a diameter of just 3/8in, the sensors are ideal for the small space of the actuator system. In addition, the sensor's resistance to pressures up to 20 kpsi proves essential to withstand extreme forces present as the drill travels two miles deep into the ice at temperatures below -30°C. To accommodate the high pressure, the sensor case is vented to equalise pressure inside and outside the sensor.

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Mission critical sensors head to Mars

Standard and customised load cells, load pins and force sensors from Strainsert Company are being used for demanding applications in research, testing, weighing and control in the aerospace, military, marine and automotive industries.

In one example, over 40 customised sensors have been deployed across NASA's Mars Science Laboratory mission which recently landed its Mars Rover Curiosity mobile laboratory in the Gale Crater area on the Red Planet.

The company designed and manufactured mission critical sensors for various functions including the major spacecraft separations – cruise stage, heat shield, descent stage, ballast masts and rover – as well as the retention of the mobility (wheels), high gain antenna, camera mast, robotic arm and mechanisms retaining two spare drill bits.

Over several decades, the company has worked closely with NASA on major space programs and has developed patented transducer designs for many other challenging applications.

The sensors are available in the UK from Ixthus Instrumentation, which works closely with Strainsert, providing cost-effective solutions for tough load measurement applications where this internal or 'down-hole' strain gauging technique offers considerable protection benefits for high accuracy force measurement from 100N to 5MN.

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