Wirelessness reaches for the skies

Sensor Technology, creator of the TorqSense wireless torque sensor, has an ever-growing portfolio of applications on both civil and military aerospace development projects

Aerospace development is a strategic industry within the British economy. It creates a lot of high value jobs, while numerous technological advances spin out of it.

Many aerospace engineers work in the sector their whole career, while others take aeronautical developments and rework them for other uses. These are seen as the main technological and economic benefits of the industry.

But there is another aspect that is often overlooked: mainstream engineers supplying their expertise and insight into the aeronautical sector.

The aerospace boffins constantly learn from the more general engineering sector. For instance, there is a long-running drive to improve productivity in aerospace design, test and manufacture. Techniques such as simultaneous engineering, design for manufacture, robotics and automation, in common use in many other industries, are now being adapted and adopted.

The use and reuse of equipment and procedures is also becoming the norm, and one company that has benefited from this is Sensor Technology, based in Bicester. Commercial manager, Tony Ingham says: "We make a torque sensor that is wireless. Instead of a fiddling about to install a complicated mess of slip rings, we just line TorqSense up with the shaft to be tested and use radio waves to capture the live performance data as it is generated."

He continues: "The aerospace industry is very much one of our markets for TorqSense, so I was pleased when word got out and we now have an ever-growing portfolio of applications on both civil and military projects.

"One of our first transducers was supplied for a simple test rig for British Aerospace. It must have been military, because nobody would confirm or deny anything! But this led to a rather more open requirement, the re-engineering for the Nimrod."

The Nimrod MRA4

This year the new Nimrod MRA4 will replace the Nimrod MR2 which has been used by the military since the 1960s. The MRA4 is a maritime reconnaissance and attack aircraftthat can be configured for multiple roles.

TorqSense was instrumental in endurance and integration testing of the aircraft's mechanical systems. The torque test rig is built around a reclaimed Nimrod MR2 fuselage. Flight forces are simulated by an electro-mechanical system attached to the moving elements of the aircraft.

TorqSense uses two surface acoustic wave (SAW) devices which have embedded tiny ceramic piezoelectric combs. The SAWs are fixed onto the surface of the shaft under test and are excited to resonant and different frequencies. As the torque increases, the combs open and close which changes the resonant frequency each SAW. In effect the combs are frequency dependent strain gauges and the difference in resonant frequency is a measurement of torque. A wireless radio frequency coupling is used to transfer the data signal to a pick-up head.

The same coupling is used to supply power to the SAWs, made possible because the gauges are based on piezo technology so need less than one milliwatt of power. This arrangement does away completely with the difficulties of fitting slip rings and maintaining their contact quality throughout an extended test run.

Test data are gathered through a variety of sensors, which must have as little effect as possible on the system under test. TorqSense, being non-contact, causes no drag whatsoever, so there is not even any need to allow for a constant offset when analysing the data.

The Falcon 7X

With this success under its belt, Sensor Technology has picked up several projects including one for the new Falcon 7X fly-by-wire business jet.

A test rig was built using 22Nm and 200Nm TorqSense transducers for the development and qualification testing of three flap system actuators.

Each actuator is tested with a servo hydraulic motor input drive in closed loop control of position against torque which is monitored using the smaller 22Nm TorqSense; the load to the ball-screw lateral motion is applied via a servo cylinder, again in closed loop control of position against load.

Like all aircraft components, the Falcon 7X flap systems were subjected to rigorous and repeating test regimes during their development, and similar tests will be rerun throughout their operating life. The use of a non-contact transducer therefore saves considerable time over the lifecycle of the Falcon 7X.

TorqSense does away completely with the difficulties of fitting slip rings and maintaining their contact quality throughout an extended test run

An unmanned aerial vehicle

The TorqSense system also provided a solution when Selex Sensors and Airborne Systems (S&AS) was developing a vertical take-off and landing unmanned aerial vehicle (UAV).

Using a jet engine on the UAV was considered impractical; a 'cold fan' solution was required. This fan is driven, via a drive shaft, by a minuscule yet powerful two-stroke engine. Developing this technology required a unique test rig, with an in-line torque sensor so that there were no out of balance forces coming into play.

A thorough review of available sensors showed that only the TorqSense system met all the needs of the application. Other requirements included ease of mounting, so that the drive system could be taken on and off the rig frequently, and a need to interface with a PC, so that real-time performance data could be logged and analysed.

Development time was speeded up because of the ease with which the drive could be lifted on and off the test rig, and the fact that data capture and analysis could be automated. This kept the project on time and within budget; a slip in either could have led to cancellation.

In fact, TorqSense may be adapted to become a permanent feature of the UAV, allowing the operators to monitor the drive conditions in flight.

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Enter 211