Joint venture has a new take on hull monitoring

Fibre optic firms target tanker sector

Gas carriers are likely to provide the main market for a new hull stress monitoring system

HULL stress monitoring technology first came to the attention of the shipping industry in the late 1990s in response to a growing number of much-publicised casualties involving bulk carriers.

Several research projects were set up to investigate the potential application of hull stress monitoring technology, perhaps the best known of which was the HULLMOS project, and international research project funded by the EU under the umbrella of the Eureka programme.

The thinking behind the Eureka HULLMOS projects was that shipbuilders and shipowners would be motivated to make greater use of advanced materials if they had the technology to accurately measure and monitor the stresses and loads on a ships structure.

Classification societies insist on certain types of vessel carrying structural monitoring equipment, but current monitoring systems – which usually consists of electrical sensors positioned around a ship which feed data back to a bridge-based computer for processing and analysis – have a number of drawbacks.

Not least of these drawbacks is that the sensors must be protected from getting wet, whilst the large size of many vessels means that huge quantities of cabling – which require shielding from electrical machinery – have to be used. The sensors themselves are often large and bulky, and thus incompatible with application on board small, light fast craft.

Light weight option

Having being a key player in the HULLMOS project, Rouvari in Helsinki in Finland recently teamed with Smart Fibres of Bracknell in the UK to offer shipyards and shipowners an alternative to this kind of heavy bulky technology.

Having registered HULLMOS as a trade name, Rouvari and Smart Fibres have developed a new type of hull stress monitoring technology that uses fibre optics and small, lightweight sensors based on optical fibre Bragg grating sensors (or Fibre Bragg Gratings – FBGs), which are widely used for monitoring stress and temperature in the aerospace and civil engineering markets.

As Smart Fibres' managing director Chris Staveley explained, being based on fibre optic technology rather than electrical cables, the HULLMOS sensors are completely resistant to electrical interference, and considerably less cabling is required to install a HULLMOS-type hull stress monitoring system.

Compact and cost saving

Staveley and Rouvari's managing director Risto Rouvari believe HULLMOS also offers yards and owners consid-

erable potential cost savings because the sensors are very small – just 250 microns in diameter and a few millimeters long – and a large number can be fitted on a single optical fibre. Being factory calibrated the sensors need no maintenance either.

This leads to another important advantage in as much as because the sensors are very small and many can be fitted on a single fibre, large numbers of sensors can be used in any required location, providing increased coverage of areas of a ship that are of critical importance whilst ensuring the integrity of the data measured at such locations. Being small, the sensors can also be embedded in composite materials, if required, and used to pick up data on stresses and strains in this kind of material too.

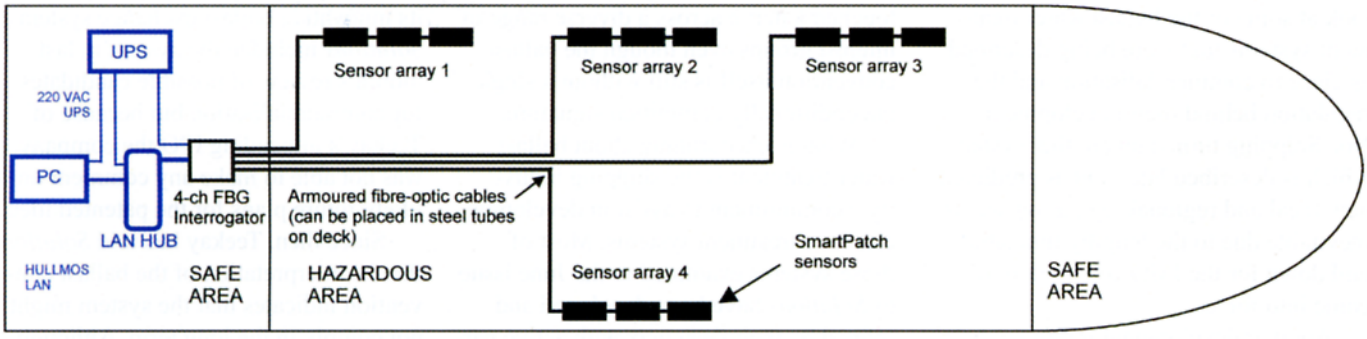
Smart Fibres' role in the joint venture has been to develop the sensors and the equipment used to 'interrogate' them, so that the technology can be integrated into Rouvari's hull stress monitoring equipment.

Good for gas carriers

Ironically, given that much of the research work that prompted the development of hull stress monitoring technology was prompted by the need to monitor stresses and strains in bulkers, Rouvari says the two companies anticipate that their main market lies not bulk carriers, but in tankers. In particular LNG tankers, vessels with very stringent requirements for stress monitoring and of which there are now a large number on order.

Crude oil tankers and product tankers – vessels that are also subject to hull stresses due to wave loading or loadings induced by cargo - form another part of the JV's 'target market,' as do very specialised vessels such as high speed craft – including those constructed from composites – and also military vessels.

Fitting hull stress monitoring technology can make ships safer, note the two companies, but can also help to maintain the re-sale value to a vessel, with the data-logged history of the vessel utilized to demonstrate that it has been properly run and operated, a hull that has been kept in good condition having reduced requirements for repair and maintenance and an extended life S



Example FBG sensor layout for hull monitoring

HULLMOS and FBGs - the benefits

Smart Fibres describes FBGs as optical sensors 'recorded' in the core of a standard optical fibre that reflects a narrow bandwidth of light which responds faithfully to changes in temperature and strain. Hundreds of FBG sensors can be recorded onto a single optical fibre and interrogated simultaneously, thus forming a low cost mechanism for distributed monitoring of strain within structures.

Hundreds of FBGs can be 'written into' a single optical fibre, and several hundred can be simultaneously interrogated by a single multi-channel instrument, thus providing a low-cost mechanism for densely instrumenting very large structures (compared with conventional technology where every sensor has a dedicated instrument).

Optical fibre is a very efficient signal carrier. Because of this, the electrical interrogation unit can be sited many hundreds of metres or even kilometres from the sensing location, whereas conventional electrical strain gauge systems require regular amplification to avoid signal to noise degradation. FBG sensors are also passive and require no electrical power, are intrinsically safe and can be used to instrument hazardous environments. Being passive, FBGs have 'zero drift' and can be used for many years without the need for recalibration.

Chris Staveley at Smart Fibres, highlights the following advantages of using fibre optic technology in HULLMOS:

- Multiplexing
- East and cost of installation
- Signal integrity
- Electrical immunity

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