The race for remote diagnostics

While makers of medium and high-speed engines have offered remote analytics for several years now, the major two-stroke engine designers have only recently announced plans to launch their own diagnostics programmes. Gavin Lipsith reports.

The ship intelligence products we can deliver right now are already taking us beyond our traditional customer portfolio, and we hope to do the same with health management systems.
customer portfolio, and we hope to do the same with health management systems," says Christoforo. "We are already expanding health management to cover four-stroke engines from other makers and would like to go further. It is ambitious, but what gives us confidence is the technology we are using — not only data but the way we are processing it with machine learning and artificial intelligence so that we will be able to pick up failure modes not just in our equipment but in any company's equipment."

Rolls-Royce is not alone in that aim. ABB's integrated operation centres already have near real-time access to equipment on vessels it is monitoring, and is developing its already extensive condition monitoring expertise. So too is Wartsila through its Genius portfolio of digital services, recently boosted with the acquisition of performance monitoring specialist Triman.

Although MAN Diesel & Turbo does not yet offer remote diagnostics for its two-stroke customers, it is already monitoring around 200 four-stroke installations. Among the most recent ship owners to sign up for the service, under MAN's PrimeServ Online brand, is Stena Line. The company's Stena Hollandica and Stena Britannica ro-pax ferries are each powered by four MAN 48/60CR engines.

Constant monitoring of four-stroke engine and turbocharger data will enable Stena to optimise inefficient operation modes and maintain the availability and reliability of the MAN hardware. The information can also be made available to PrimeServ specialists, who can provide further recommendations for maintenance and repairs. Since 2000, all MAN Diesel & Turbo engines have been delivered with integrated data interfaces, which can be upgraded to complete local systems for engine monitoring. In the second phase of the digital strategy the company will introduce its online service for two-stroke engines.

Meanwhile, two-stroke engine users must rely on third-party providers to satisfy their needs for connected condition monitoring. One such company is Piraeus-based Propulsion Analytics, which used the CMAE World Congress in Helsinki last June to show its approach to condition monitoring.

The core of Propulsion Analytics' methodology involves the use of a thermodynamic simulation model for each specific shipboard engine. This model is tuned to be an exact replica of the actual engine in operation, reflecting the physical relationships of all primary parameters (temperatures, pressures, rpm) and resultant values including torque, fuel consumption and emissions. Once tuning is performed, the model predicts engine performance as influenced by ambient conditions, load, speed and fuel at any operating point.

Several simulations are then performed for combinations of all possible engine settings, ambient conditions and fuels, allowing an engine performance hyper-map - which the company calls an Engine Hyper Cube - to be generated. This map can provide the expected values of performance parameters at any engine operating condition.

These values are then compared to the measured values, offering diagnostics based on the residual differences between the two.

**Advanced Modelling**

Tanker operator Euronav installed Engine Hyper Cube models for seven Suezmax skimmer ships, each powered by a MAN B&W 6S70MC-C7 main engine. To ascertain the accuracy of the methodology and the predictive potential, a single blind validation was performed where the engine settings from service performance reports for some years in the past were input into the Engine Hyper Cube software. Any observed swings in residuals (the difference between measured and expected outputs) were then compared with the known engine maintenance events. The results indicated recognisable shifts in performance following maintenance events in the ship's records, confirming the accuracy of the methodology.

Euronav later used the system to investigate a fuel injection problem. An in-depth analysis using measured cylinder pressure diagrams compared with pressure trace predictions and the use of heat release analysis pinpointed the cylinder with fuel injection issues.

The methodology also allows the company to perform optimisation studies as well as execute a number of "what-if" scenarios for examining how the vessel engine performs in regimes it had not operated in the past. The shipping company is also using these methodologies and technologies for monitoring and evaluation, aiming at optimum vessel operation.

Propulsion Analytics' case study was clearly noticed — early this year Winfox announced that it would be partnering the company to develop an advanced diagnostics programme for its range of two-stroke engines. The system will be capable of connecting to shore-based stakeholders, with securely held data enabling fleet comparisons if required. It will also offer a virtual and interactive tutoring tool for shipping companies and crew. A prototype of the system is expected to be running in the field by mid-2017, with full release across the WinGo range forecasted for 2018.

The jointly developed system will acquire and analyse data on the performance and condition of engines and subcomponents in real time and provide live troubleshooting and diagnostic advice to the crew. The data will be used to improve performance based on load profiles acquired over complete voyages, as well as enabling ship owners to diagnose and troubleshoot abnormalities and integrate maintenance planning and spare parts purchasing.

Andrew Stump, vice president operations, Winfox, notes: "With real-time data collection and exchange across a shipping company's vessels, WinGo's new engine diagnostic system will be the first advanced product on a two-stroke engine that will not only optimise and monitor performance but will also track the condition of key engine components. It will be able to predict future malfunctions and provide troubleshooting support to shipping companies to prevent failures and fix technical problems faster and more economically."

Propulsion Analytics will develop software for processing and evaluating data gathered from on-engine sensors in a digital controlling, monitoring and diagnostic system. "The engine diagnostic system is something that the industry has been expecting for a long time," says Panos Theodoropoulos, CEO, Propulsion Analytics.

One way or another, it seems that two-stroke engine users will not have to wait much longer before engine developers address their need for remote diagnostics.