Virtual modelling goes high performance

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The FLEXICON project addressed the need to reduce the timescales required for producing open and distributed fault-tolerant control and monitoring systems. It developed two integrated suites of tools to support the different development phases for high-performance distributed systems.

Photo courtesy of Rolls Royce

A key objective for the FLEXICON toolsets was to develop good facilities for 'co-simulation', or virtual prototyping of a model's performance, as such abilities allow experiments to be performed that would be impractical with a physical prototype, e.g. fault injection testing of an aircraft or large ship.

"Developing good co-simulation abilities was critical for us," says Haydn Thompson of the University of Sheffield. "When you are building ships of the size of the Queen Mary 2 it is not possible to build physical prototypes, the first time you build a system it has to be right, virtual prototyping is a very useful way to reduce the risks involved when dealing with highly complex systems. You can look at systems from the point of view of the hardware engineers, the software engineers or the control system engineers, link them all together and simulate the results in the lab."

The project produced two distinct FLEXICON toolsets, IPMCS for industrial process modelling, and MAA for the modelling of marine, automotive and aircraft applications. Both provide easy scaleability, so that the IPMCS toolset can for example be used to model anything from a small furnace control system through an integrated heat treatment line up to a factory with multiple production lines.

Likewise, the MAA toolset is capable of scaling up from development of a ship sub-system to an integrated model of a distributed control system for an entire ship. This toolset has proved particularly useful for modelling a new design of high-speed merchant vessel, says Thompson, one that is designed to cut through the waves rather than rise over them even in mid-ocean and bad weather. "For example we had a target to develop a ship prototype with five gas-turbine powered waterjet propulsion systems, capable of crossing the Atlantic in 90hrs rather than the current week. Such a ship would be capable of travelling at a speed of around 50-60 knots," he says.

The toolset has also proved its worth in developing systems for managing alarms and warnings, and monitoring the health of distributed systems. "Developing systems for fault detection, isolation and accommodation, and health monitoring has been very important for us," says Thompson. "We can model the mechanisms that identify and diagnose faults, as well

as simulate faults to confirm that the system deals with them correctly." In the marine demonstrator the health monitoring has exploited the latest in Web service technology and Bluetooth wireless monitoring.

The project results are already finding their way into production applications in industry. Partner Rolls Royce are extremely interested in utilising the tools for conceptual modelling for new applications. "Using the tools it is possible to virtually prototype a ship and try out different versions of propulsion systems," says Thompson. "Integrated through–life cost modelling, tools automatically extract information from the design tools on the proposed system's functionality, its level of safety-criticality and overall complexity. This is used to model and calculate the costs of developing the Platform Management System, the cost of maintaining the system over the vessel's lifetime, and its final disposal costs."

Such abilities are extremely important when bidding to build a new vessel, he says. For example, Rolls Royce now leases its engines to ship-owners rather than selling them outright and relying on spare parts supply for continuing business. So being able to calculate the 'through-life' costs of managing ship propulsion systems over 30 years, say, is fundamental. The company has used a modified version of the through-life cost tools in its development of engine control systems for the latest civil aircraft from Boeing, the 'Dreamliner'.

Source: IST Results