Minimising downtime by decentralising control

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(PhysOrg.com) -- When complex, computerised control systems encounter a malfunction in any part of the process they control, the whole operation often grinds to a halt while the problem is diagnosed and fixed. Software developed by European researchers overcomes that problem by decentralisation.

Power stations, oil refineries, factories and other types of industrial plant will, when some more development work has been done, be much better able to work around localised faults, thanks to European research.

Road vehicles, ships and aircraft could also benefit from the results and prototypes developed by the EU-funded NeCST project which came to an end in late 2007.

With a partner mix comprising four universities, two software developers and an oil company, the project set out to develop and test a set of algorithms – simple software programmes – for use in networked control systems (NeCS).

These systems may operate at a number of different levels in complex industrial facilities. The project made them fault tolerant by making individual components of the overall system as autonomous as possible. This means, once a fault is diagnosed or predicted, and the problem is being pre-empted or fixed, the rest of the network can carry on operating as normal.

Autonomous but unified

Says project coordinator Eric Rondeau: “The systems can be seen as a distributed network of nodes operating under highly decentralised control, but unified in accomplishing complex system-wide goals.”

In human terms, this is somewhat analogous to a team sport, such as rugby where there are specialist players performing different functions, but all also working together as a team to fulfil the same objective – winning. If one team member is injured or sent off, the team still continues and compensates for the loss.

For example, in a petroleum-oil refinery (which was the actual practical testing ground for a prototype NeCST algorithm) the overall objective is to produce high-quality products. To do this, there are a large number of different processes, all of them falling under a networked control system. If a fault develops in one of the processes, then rather than the whole system shutting down for it to be fixed, NeCST isolates the fault and allows the rest of the system to continue functioning.

Tolerance is a virtue

To carry the rugby analogy further, if the captain is the one injured that still does not mean the team stops playing as other players step in and fill the leadership gap. In a NeCST system there are individual processors, each controlling a specific function. If the network goes down, and system control is cut off, they are still able to operate autonomously and make sure their part of the system continues working towards the common goal.

The partners set out to develop both a software platform and a toolkit of software modules or algorithms. These run on the platform and provide

the monitoring, diagnostic and remedial-action functions for a fault-tolerant network – that is a network which can work around a fault rather than being forced to close down.

A key part of the project was to ensure the software developed could be integrated with, and embedded in, users' current and future control systems. Once in place, the project objectives required it to be able to generate information on network behaviour and to communicate with, and advise, human operators.

Wider implications

These objectives were achieved during benchmark tests in a laboratory environment and a real-time test was successfully conducted in the oil refinery operated by the end-user partner.

Now the two software companies, which were partners in the test, are working on developing commercial applications, and the research work has been found to have wider implications.

French company PREDICT has integrated the NeCST software into its KASEM (Knowledge Advanced Services for E-Maintenance) platform. This is designed for nuclear and conventional power plants, oil refineries and shipping.

By creating a fault-tolerant control network, KASEM allows operations to continue when part of the system is down for whatever reason. This guaranteed continuity of service means regular maintenance work can be undertaken without the need for plant closure, which is of particular value to power plants.

Slovakian partner SAE-Automation has produced its own proprietary OpcDbGateway software based on the NeCST research. The first

commercial installation of this will be in a HVAC (Heating, Ventilating, Air Conditioning) system in Malaysia.

“Although we were looking at the implications for industrial facilities, the software can be used in any situation where there is a networked control system, a modern car for example,” says Rondeau.

While there is still a lot of development to be done before the NeCST system is in widespread commercial use, its viability has been proven and there are important implications for enhanced performance in a range of fields.

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