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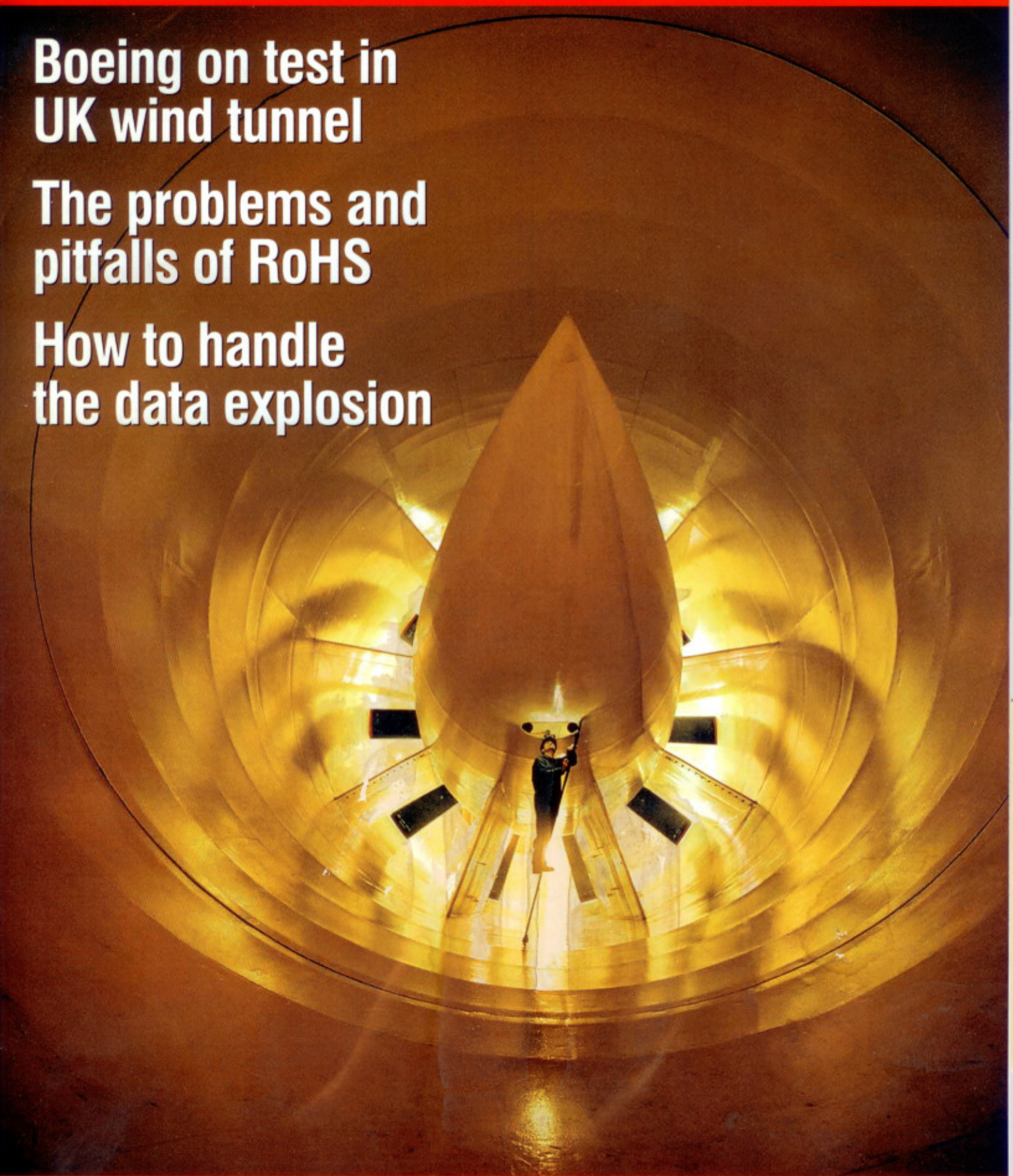
Boeing on test in UK wind tunnel

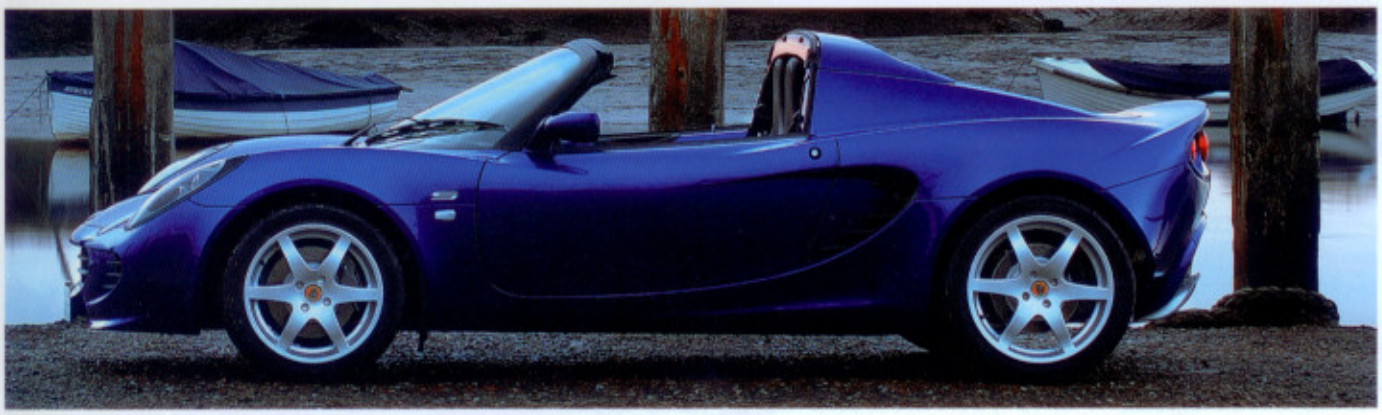
The problems and pitfalls of RoHS

How to handle the data explosion



VIBRATION CLIMATIC PACKAGING CONTAMINATION RELIABILITY

Controlling interest



Parametric Optimisation Solutions, or Paros, is a spinout company from the control systems work at Imperial College, London. **Simon Bickerstaffe** reports on its technology and its future plans

It is said that power is nothing without control. Yet control systems that lack the functionality needed to oversee complex systems waste power and are therefore responsible for higher emissions.

Patrick McHugh, executive chairman of Paros plc, says that the vast majority of applications are fine with simple controls but that 2 to 3 per cent would benefit directly from Paros' patented control technology.

Now listed on the Alternative Investment Market (AIM), which is targeted specifically at growing companies, Parametric Optimisation Solutions Ltd (Paros) started out as a spinout company of Imperial College London, providing advanced control solutions to industry.

Simple controllers work on the principle of proportional-integral-derivative (PID) function whereby a corrective output is applied, depending on the difference between the actual and desired states. Such systems are cheap and respond quickly but often result in an overshoot of the set point, and much energy is wasted as the system attempts to reach a steady state, especially when many actuators must be coordinated.

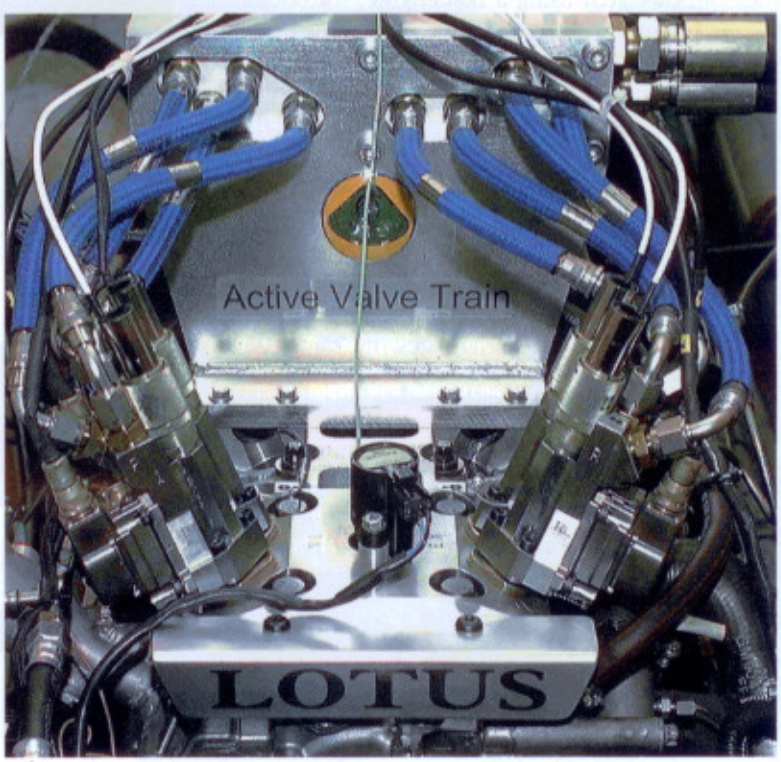
At the other end of the scale, model predictive control (MPC) systems can handle inputs from multiple sensors and handle constraints but require a complex model to determine the control action on-line, and the PC used to run the model presents obvious issues with packaging.

The Paros controller claims to offer the best features of both of these: the low cost and speed of PID, and the accuracy, multiple input and constraint handling capacity of MPC. Paros refers to it as "advanced control technology on a chip."

Its patented mathematics, the result of 15 years of research, allow the model to be solved for all cases, resulting in a simple function look-up table. According to McHugh, this instantly yields the two things that are the problem with MPC: "First, the look-up table can be encoded in a simple silicon device: you only have one table to look up answers. Second, you don't need to be running the model all the time because you've solved it before you created the look-up table, so you can get rid of the high-end (desktop) computer. By the time you've reduced it down to a chip, you can put it into a common microcontroller with bare minimum computing power.

"Paros is a superior control strategy. It's not a product but simply the mathematics that allow you to develop a model into a look-up table that you can code onto a chip and use in an ECU or a thermostat, for example. You could even retrofit into an existing controller."

When asked what has created the demand for



Car and engine: Lotus' active valve train provides a test for Paros

improved control, McHugh said: "I think overall it's environmental impact; that people are looking to respond to the CO_2 issue. We are in conversations with the Carbon Trust about how our controllers can reduce CO_2 emissions. That's the biggest driver, in my view. We've routinely found improvements of 10 to 15 per cent in energy consumption just by using our controller."

Paros sees the industries which could benefit the most as those having the 2 to 3 per cent of applications where simple control doesn't work, and where MPC can't go, such as car engines. Then there are those where MPC is needed, such as air separation plants, but where the cost is an issue.

Others markets that offer significant potential are white goods. McHugh said: "This is where we think our business will take off in a big way: advanced cookers, freezers, washing machines. We will replace the current fuzzy logic controllers with advanced control: that's where we see the business going. But certainly, automotive applications we see as one of the big ones because of the cost implications: a need for advanced control without the bulk of a PC."

Production costs of Paros controllers should achieve parity with those of PID because the components used are very similar. However, the extra functionality means that they offer a better value than either PID or MPC solutions.

Lotus testbed

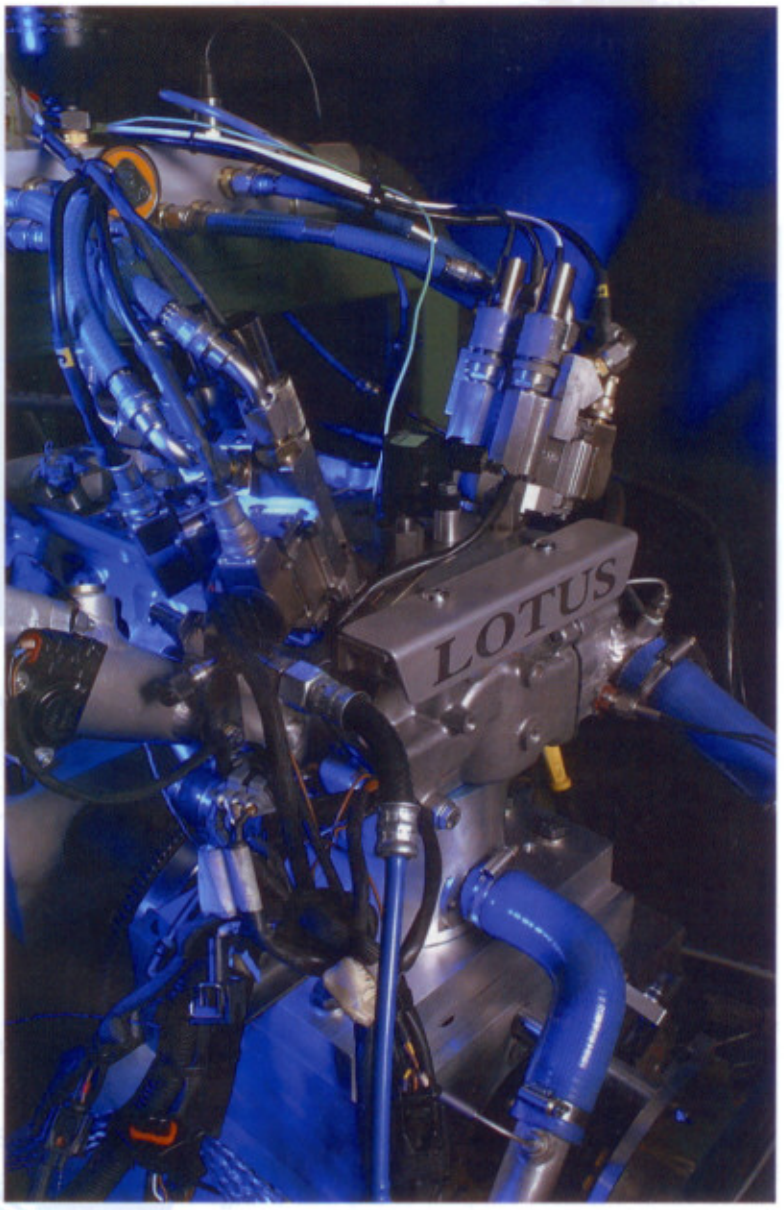
To date research into the effectiveness of the Paros controller has been conducted on Lotus' active valve train (AVT) system test bench. This "camless engine" replaces the camshaft with individual electrohydraulic actuation for each valve allowing fully independent control of valve timing and lift, matched to speed and load conditions, to the benefit of efficiency, emissions and performance.

The AVT engine is at present used to develop and test cam profiles before any metal is cut; virtual profiles can be tested using a real engine, with obvious reductions in development time and cost. Similar AVT systems are in use with a number of Lotus' OEM clients.

At present the parametric controller has been tested at a single engine speed but it is the intention to develop the controller such that the look-up table maps the entire range of speeds and loads.

Pending further development of the Lotus AVT, Paros intends to approach OEMs with the technology. In addition, McHugh sees the engine ECU as an ideal future application for Paros controllers. Explaining one of the advantages, he said: "Most current control strategies assume that there is a continuous range for every parameter, but in real life there are discontinuities. These are binary jumps: traditional PID can't cope with these at all, but we can set strategies. For example, under forthcoming legislation NOx has a finite limit, so you can set a discontinuity – you cannot pass it; there is no proportional rule across it. If you pass the limit, control action must be taken."

Catalytic converters too could benefit from more advanced control, reducing both emissions of NOx and fuel consumption. In conjunction with Ford, Jaguar and the University of Eindhoven, Paros ran a project to demonstrate that its controller and an air bypass could produce these benefits. McHugh said: "We showed that our advanced algorithms in place of a simple control loop could improve the performance of the catalyst even further."



Test bed: the Lotus AVT has been used for trials of the Paros controller

The decision was made by the academics to form the spin-out company and seek to commercialise the technology. McHugh said: "The desire of the academic staff to take their inventions out into the wider world is hugely important."

Expansion is underway already. Paros has just announced the formation of a Greek subsidiary, Paros EPE, based in Athens. Like Paros plc, the company will focus on efficient energy usage and reduced environmental emissions through control and product enhancement technologies in automotive, aerospace, appliance and medical industries, and will seek participation in funded EU, local and regional R&D programmes.

Dimitrios Alamaniotis, director of Paros EPE, said: "The creation of Paros EPE in Greece opens new paths filled with opportunities for our company. This will be a company offering unique technology and innovative products. Our strategy includes developing services in consulting and experts groups."