Ghosts in the machine

ROBOTS ARE TAKING THE PLACE OF HUMAN DRIVERS IN AN INCREASING NUMBER OF VEHICLE TEST SCENARIOS. **KEITH READ** INVESTIGATES SOME EXPENSIVE R/C TOYS

Considerable growth in the development of sophisticated new advanced driver-aid systems (ADAS), coupled with an increase in extreme maneuvers, abuse and durability testing, has brought demand for a new recruit to the world of vehicle dynamics testing – the robot driver. For UK-based Anthony Best Dynamics (ABD), a well-established producer of steering, braking and throttle robots with more than 160 sales worldwide, moves to driverless testing have opened a new market opportunity.

Technical director Mat Hubbard is confident that successful integration of GPS-corrected inertial motion packs from Oxford Technical Solutions, GeneSys and iMAR with ABD's existing robot driver equipment gives the company a healthy lead over the handful of rival companies.

Developing the ABD driverless robotic test system was not too complex. "What was difficult was making it safe so that proving grounds around the world would allow engineers to run tests with this equipment. The safety system is the most important aspect. Operators have to be able to stop the car remotely and have no doubt they're never going to have a run-away car."

The equipment's base-station system is operated through carefully selected high-quality radio links that allow operators to remotely drive the car (via a computer gaming console steering wheel) and configure tests. It also facilitates starting and stopping tests for one or more vehicles. If the test vehicle (or vehicles) goes outside radio range, it stops. It also stops if any onboard processors fail.

"Everything has redundancy and is self-checked," says Hubbard. "Safety has to be paramount because if there was ever an accident it would end the product or, at the very least, make people stop and think about how and when they used it. To date, we've had no problems."

ABD has sold three of its driverless robot testing systems to German vehicle manufacturers, and another to a French vehicle maker. One German manufacturer is using the system to conduct extreme abuse tests. Later this year ABD will deliver a system to a major Japanese manufacturer.

"We see it as a growing market," says Hubbard. "In terms of accuracy, we can control to 2-3cm laterally. Control longitudinally depends on what speed you are travelling, but it's typically to within 5cm."

According to Hubbard, the four most compelling reasons to buy

A DRIVERLESS CAR EQUIPPED WITH ABD HARDWARE AWAITS ANOTHER TEST RUN. THE FIRM'S EXISTING IN-VEHICLE ROBOT SYSTEMS HAVE RECENTLY BEEN DEVELOPED INTO AN AUTONOMOUS TEST SYSTEM

"I see a big role for robot driver systems where you have vehicles with automatic avoidance systems traveling down the road and avoiding each other"

Dr George Gillespie, CEO, MIRA

TWO ABD-EQUIPPED CARS MOVING IN CLOSE PROXIMITY. ROBOT DRIVING SYSTEMS ARE PREDICTED TO HAVE A BIG FUTURE IN SUCH SCENARIOS

driverless robot testing systems are risks, repeatability, reduced proving ground space requirements and legislative tests where steering robots are already used.

"Number one is removing the risks to the test driver," he says. "Not just the risk of a crash, but of long-term back injuries and similar health problems. Second is the repeatability. Our system can beat most human drivers on accuracy and it's more flexible than wire-following systems. Third is the fact that it allows testing in a smaller proving ground area. One customer has justified buying robot systems rather than building a new proving ground. The fourth compelling reason is the legislative test that requires a steering robot and is potentially risky, such as the FMVSS 126 'spinout' or NHTSA 'fishhook' test. Our system removes the need to fit outriggers."

Hubbard sees demand for the systems likely to come from countries where vehicle manufacturers are interested in making safer models, developing new technology quickly and saving time and money through efficiency. He cites Germany, France, Japan, and Korea.

Costs are likely to be a key issue. However, if manufacturers already have steering and/or braking and throttle robot drivers from ABD, the additional investment to put together a full driverless robot test system is reduced. And where tests provoke potential health and safety concerns, the investment in driverless systems is likely to be less than compensation awards to injured drivers.

Not all suppliers are convinced that driverless vehicle testing yet has a role in their development programs. Holger Simon, chief engineer of vehicle development and brake system application at TRW's Koblenz technical center in Germany, says simulation still provides virtually all that is required without risking expensive prototypes or drivers. For physical vehicle-to-vehicle tests, which could be dangerous for drivers

"Operators have to be able to stop the car remotely and have no doubt they're never going to have a run-away"

Mat Hubbard, technical director, ABD

LEFT: **ABD INSTALLATION IN A HONDA CIVIC.** BELOW LEFT: **DRIVERLESS SYSTEMS CAN REMOVE THE DANGER TO HUMANS FROM RISKY MANEUVERS**

or potentially wreck the vehicles, TRW uses one real and one soft rubber facsimile vehicle. The latter can be static or tethered to a second real vehicle. "Having a driver in the car gives us the important subjective assessment," he adds.

Simon believes that for some supplier companies, such as TRW, the additional costs of a full driverless system could be difficult to justify even though it already has ABD steering robots.

However, Dr George Gillespie, the new CEO at MIRA, is very keen on driverless testing: "I see an important role [for robot driver systems] when we're developing intelligent vehicles and telematics, where you have automated vehicles with automatic avoidance systems traveling down the road and avoiding each other. A lot of development work on such systems is beginning, and taking the driver out of the vehicle during the development could be very useful."

Under construction at MIRA is Europe's new InnovITS – Advance R&D center, where customers from the telecommunications, automotive and electronics industries as well as highways authorities and operators will develop, test and validate future transport technologies. "This is exactly where I would see us using robot driver systems," says Gillespie. "There are many things to be learned about autonomous vehicle systems, and there will be occasions when some of the things we have to do will be relatively dangerous. These are the occasions when we'd want to have robot drivers in the vehicle."

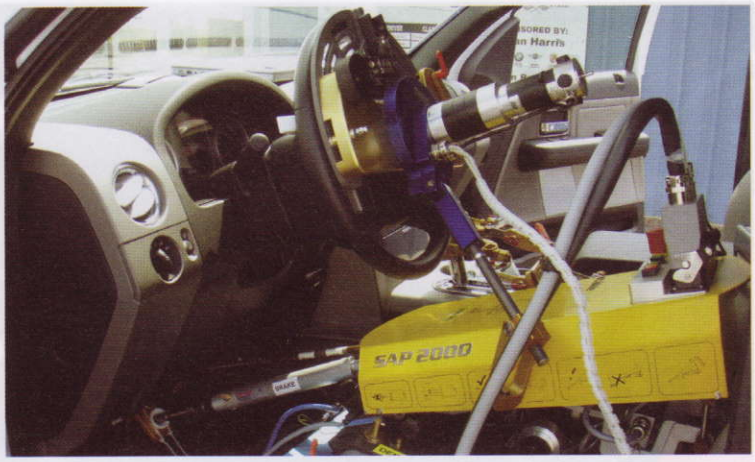
He also acknowledges their value in avoiding driver injuries. "There could possibly be applications for robot drivers in vehicle-to-vehicle impact tests because they're certainly not tests where we are going to use human drivers!

"Health and safety is of paramount importance, and we need to look after our employees and those of customers using our facilities," he adds. "So, as we get into highly aggressive testing, I can see opportunities where a robot driver could be an alternative."

Gillespie's views are shared by Brian Bucallo of Michigan-based Test

ON THE WEB

Watch video footage of ABD's driverless systems in action at vehicledynamicsinternational.com



DRIVERLESS TECHNOLOGY FROM STAHLE AND GRAYMATTER HOOKED UP IN A FORD F-150 PICKUP TRUCK

Cells Service, a company servicing and installing Stahle equipment including robot drivers. "A lot of manufacturers are looking to do more aggressive testing that they can't do with a human being as unions are getting a bit upset about these test guys getting beaten up as badly as they are. It is an issue.

"Our latest technology is all completely enclosed," continues Bucallo. "Behind the robot is the complete operating system with battery and battery backup. We're also demonstrating vehicle avoidance – a radar system that can avoid obstacles in the road."

"They have identified that driver fatigue is a factor that seriously limits their ability to conduct the test"

Matt Hardey, operations manager, GrayMatter

Mind over matter

A key focus for driverless vehicles is the US Defense Advanced Research Projects Agency (DARPA) annual challenge. One entrant in the 2005 Grand Challenge event, GrayMatter Inc, was formed by the owners of a New Orleans-based insurance company simply to compete. But when its Ford Escape Hybrid (below) came fourth – and was one of only five vehicles to complete the 132-mile course – things got serious.

Today, GrayMatter is ramping up research on driverless and autonomous vehicles and is poised to launch projects that should bring in its first revenue, according to operations manager, Matt Hardey.

"We've done a series of tests with one of the major US light-duty truck manufacturers," he reveals. "They have a track that stresses every conceivable part of the vehicle. They have identified that driver fatigue is a factor that seriously limits their ability to conduct that test, and that they were experiencing a higher-than-acceptable level of medical issues relating to the pounding that the driver took in the cab of the vehicle.

"We put one of our vehicles out there, equipped with our complete system, and ran repeatedly over the course with complete precision and a high degree of accuracy. With no driver in the vehicle, any issues with respect to driver safety are mitigated."

Despite the high cost of driverless systems, Hardey sees potential market opportunities in the tire industry. "A lot of the work that goes into tire testing is mileage accumulation in a real-world environment. A small staff of technicians could supervise a large number of vehicles without having to have a driver on board, thus reducing the primary issue they face of driver boredom and inattention, and resulting safety problems."

GrayMatter is currently prototyping a low-cost driving robot without the 'intelligence' of an autonomous vehicle. Hardey says it should fall in the US$25,000-US$40,000 range. However, if GrayMatter's autonomous vehicle system (AVS) is added, the total cost will rise to US$150,000-US$175,000. "That, of course, is before you add the GPS and whatever sensors you want to use," he continues.

Vehicles for military missile and aircraft gunnery targets are the sort of application Hardey has in mind for the low-cost system. "You wouldn't want to put US$500,000 worth of equipment into a vehicle just to have it blown up by a missile," he says. Testing of the system is imminent and a decision on production will be taken immediately afterward.

Crash-testing is also on Hardey's radar. "Much of the side-impact testing takes place with the target vehicle static and a sled running into the side of it. Using our system you could, in fact, conduct a completely dynamic test with the target vehicle in motion – just as it would be in the real world.

"There are a lot of opportunities out there for driverless systems, and we'll be attacking them as we see them – not only in automotive testing, but also in the military, agricultural and mining markets."