no man's land

Robots are taking the place of human drivers in an increasing number of vehicle test scenarios. The latest in oversized radio-controlled toys are quite remarkable

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Considerable new growth in the development of sophisticated new advanced driver-aid systems, coupled with an increase in extreme maneuvers, abuse, and durability testing, has brought demand for a new recruit to the world of dynamics testing – the robot driver.

For UK-based Anthony Best Dynamics (ABD), a producer of steering, braking and throttle robots, moves to driverless testing have opened a new market opportunity. Technical director Mat Hubbard is confident that successful integration of high-tech 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 more difficult was making it safe so that proving grounds would allow engineers to run tests using this equipment.

"The safety system is the most important aspect," says Hubbard. "Operators have to be able to stop the car remotely and be in no doubt that they're never going to have a runaway 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 simple computer gaming console steering wheel. It also facilitates configuring tests, including 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 such systems to German vehicle manufacturers, one of which is using the system to conduct extreme abuse tests, and another system to a French vehicle manufacturer. A Japanese manufacturer has also ordered such a system.

"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 traveling, but it's typically to within 5cm."

According to Hubbard, the four most compelling reasons to buy driverless robot test systems are risk, 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 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 area. One customer has justified buying robot systems rather than building a new proving ground. The fourth reason is the legislative test that requires a steering robot and is potentially risky, such as the FMVSS126 'spinout' or NHTSA 'fishhook' test. Our system removes the need to fit outriggers to test vehicles."

Hubbard sees demand for the systems as 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 an issue. However, if manufacturers already have steering and/or braking and throttle robot drivers, the extra investment required to put together a full

Mind over matter

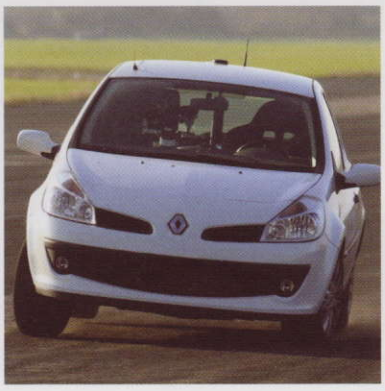
A key focus for driverless vehicles is the US Defense Advanced Research Projects Agency (DARPA) annual challenge. One entrant in the 2005 Grand Challenge event, GrayMatter Inc, was formed by the owners of a New Orleans-based insurance company simply to compete. But when its Ford Escape Hybrid came fourth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

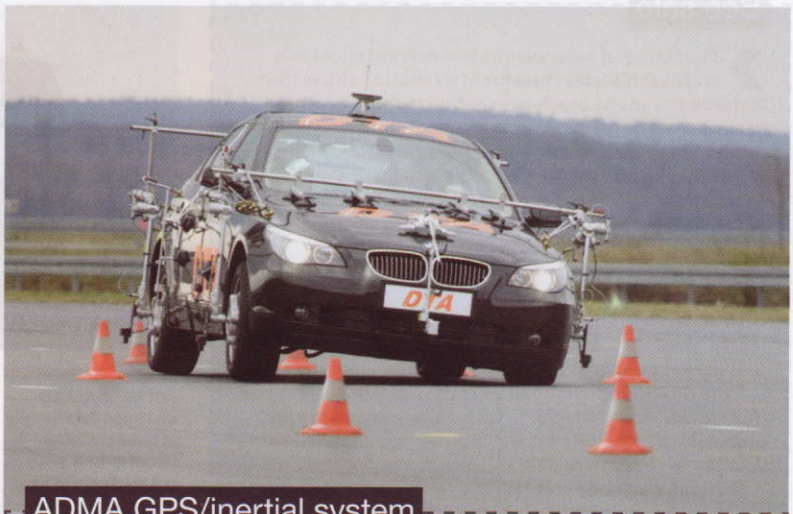
Today, GrayMatter is ramping up research on driverless and autonomous vehicles and is poised to launch projects that should bring in its first revenue, according to operations manager, Matt Hardey.

"We've done a series of tests with a major light-duty truck manufacturer,"

he reveals. "They have a track that stresses every part of the vehicle. They have identified that driver fatigue 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.

"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, any issues with respect to driver safety are mitigated."





ADMA GPS/inertial system

The ADMA GPS/inertial system is widely used for vehicle-dynamics testing applications to measure precisely acceleration, velocity, position, pitch/roll/yaw rate and pitch/roll/yaw angle, as well as the side-slip angle of a vehicle.

Positioning with accuracies down to the centimeter can be achieved. This allows for precise autonomous navigation in combination with steering robots. Interfacing to several steering robot suppliers like ABD has been successfully implemented.

Precise positioning is furthermore a key feature for the evaluation of advanced driver assistance systems such as ACC and LDW/LKS. Based on the ADMA GPS/inertial system, GeneSys Elektronik GmbH, in cooperation with Dewetron Ges mbH and Tüv Süd Automotive GmbH, has developed CAPS-ACC, a turnkey solution to validate driver assistance systems such as ACC and LDW/LKS. It allows recording of relative data, especially position, velocity, and angle of several vehicles dynamically and simultaneously. The position can be determined down to the last centimeter with the help of DGPS correction data from the base station.

Synchronism is ensured by using GPS synchronization. In each vehicle, data, such as ADMA position and velocity data, video data, data from the vehicle CANbus, and other data such as brake pedal trigger or steering angle, is recorded. As this data is generated at exactly the same time in each vehicle, it is possible to deduce the relative movement of all vehicles participating in the test. CAPS-ACC provides online data transfer via W-LAN from one vehicle to another, online calculation and visualization of the relative variables, online driver guidance, and in situ quality control of the data measured, as well as automatic generation of parameters and a test report.

GeneSys is a member of the Drivability Testing Alliance (DTA). Corrsys-Datron, Dewetron, GeneSys, Kistler and Tüv Süd Automotive have founded the DTA and offer the complete spectrum of acquisition and evaluation of vehicle drivability. Compatibility between all DTA products is guaranteed.

The ADMA system will be presented at Automotive Testing Expo Europe at booth 1360. A car showing the DTA's capabilities will be shown at booth 1366.

ABOVE LEFT: A driverless car equipped with ABD hardware awaits a test run

LEFT: Driverless technology from Stahle and GrayMatter hooked up in a Ford F-150 pickup truck

FAR LEFT: A robot-driven car undertaking hard cornering

driverless robot test system is reduced. Where tests provoke potential health and safety concerns for drivers, the investment in driverless systems is likely to be much less than compensation awards to injured drivers.

Not all suppliers are convinced that driverless testing yet has a role in their programs, however. "Having a driver in the car gives us the important subjective assessment," says Holger Simon, chief engineer of vehicle development and brake systems at TRW's technical center in Germany.

Simon believes simulation provides virtually all that is required without risking prototypes or drivers. For physical vehicle-to-vehicle tests, which can be dangerous or wreck vehicles, TRW uses one real and one soft rubber vehicle. The latter can be static or tethered to a second real vehicle.

Bee safe

The future of autonomous test driving could rely on Nissan's latest research: a robotic vehicle that features advanced crash-prevention technology that mimics some of the best proponents of collision avoidance in the natural world: bees.

Based on joint research with the Research Center for Advanced Science and Technology at the University of Tokyo, Nissan has built the biomimetic car robot drive, or BR23C, a robotic micro-car that recreates bee characteristics with the goal of producing a system that prevents collisions.

Nissan is working on BR23C as part of its 'Safety Shield' concept – an approach to safety based on the idea that cars should help protect people.

"The BR23C is positioned as the inner-most layer of this shield," says Mitsuhiko Yamashita, executive vice president of R&D. "We expect this car will support the development of future collision-avoidance technology."

In flight, each bee creates an oval-shaped personal space, which closely resembles the Safety Shield. The bee's compound eyes, capable of seeing more than 300°, allow the bee to fly uninterrupted inside its personal space. To recreate the function of a compound eye, engineers came up with the idea of a Laser Range Finder (LRF).

The LRF detects obstacles up to 2m away within a 180° radius in front of the BR23C, calculates the distance to them, and sends a signal to an onboard microprocessor, which is translated into collision avoidance.

ABOVE: Two ABD-equipped cars moving in close proximity. Robot driving systems are predicted to have a big future in such scenarios

Simon thinks that, for some supplier companies, the additional costs of a full driverless system could be difficult to justify. However, Dr George Gillespie, MIRA's new CEO, 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 traveling down the road and avoiding each other," says Gillespie. "A lot of development work on such systems is beginning, and taking the driver out of the vehicle during the development stages could be very useful.

"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," says Gillespie. "These are the occasions when we'd want to have robot drivers in the vehicle." ❮