Driving safety innovation through real-world DMS testing

Being able to identify a raft of human behaviours – including drunk driving – is one of the challenges facing developers of the latest Driver Monitoring Systems. Ashley Patton, Chief Engineer at HORIBA MIRA, explains why.

As vehicle technology progresses and we investigate new ways to make our roads safer, a new breed of Advanced Driver Assistance Systems (ADAS) is emerging: Driver Monitoring Systems (DMS). The automotive industry has made great strides in developing technology that detects, categorises and potentially responds to threats outside of the vehicle. But making sure human behaviour and actions inside the driver compartment are safe is a different challenge altogether.

Ensuring driver alertness and attentiveness is no longer just a recommendation; it's a necessity through regulation. But achieving accurate and reliable assessments of a driver's state presents numerous technological, ethical, and legal challenges. At HORIBA MIRA, we're helping OEMs to develop robust DMS technology and operational parameters that can accurately determine the condition of the driver behind the wheel.

The most common solution in today's automotive market is the Driver Facing Camera (DFC) which can track eye movements, blinking patterns, and head orientation to assess driver attentiveness and fatigue levels. But while DFCs are effective, they are not the only solution.

We believe a technology-neutral approach is essential to foster innovation. Alternative technology – including wearables and other sensors that can detect early signs of fatigue or stress – are options in the mix. However, they come with their own challenges around user adoption, data accuracy, and integration with existing vehicle systems.

Minimum capability mandated into GSR2

Driver Monitoring Systems represent an important step towards autonomy, and with a keen eye on the socio-economic benefits that self-driving technology is expected to bring, minimum DMS capability around fatigue and distraction has been written into regulation via the General Safety Regulation 2 (GSR2) which links to Whole Vehicle Type Approval. For more intricate technology, such as Automated Lane Keeping Systems (ALKS), Driver Availability Monitoring Systems (DAMS) are required.

According to data, **fatigue is a factor in 10-25% of all road crashes** in the EU (EEC-20211341).

That is partly why new vehicles can now feature inferred Driver Drowsiness and Attention Warning (DDAW) technology that monitors steering inputs and road position via a front-facing camera. These systems combine to detect drowsiness and warn the driver.

A build on this capability, and written into the latest GSR2 regulation, is the mandated requirement for Advanced Driver Distraction Warning (ADDW) technology. These systems can use a camera to monitor the driver and detect long periods of distraction. The system sounds an alarm if the driver is distracted and different timing thresholds are used to determine when a warning needs to be given: 6.5 seconds for low speed and 3.5 seconds for higher speeds.

Going above the minimums to drive innovation

While the minimal requirements contained within GSR2 provide a solid regulatory baseline, Euro NCAP's voluntary new car assessment programme – which HORIBA MIRA contributes to as an accredited active safety testing laboratory – is going a step further by setting an even higher benchmark for DMS capability in its pursuit of Vision Zero.

The extra scrutiny that Euro NCAP applies to Driver Monitoring Systems is good news for safety because its work is driving technological innovation and confirming what is feasible in regulation. This will ultimately contribute to setting the next level of regulatory requirements for DMS to drive system performance and safety standards even further forward.

To score full points during the assessment of their DMS technology, OEMs are being encouraged to increase system capability by embracing a broader set of requirements.
While GSR2 regulations focus on vehicles issuing warnings to distracted or fatigued drivers, Euro NCAP's goes further by incorporating intervention requirements. For example, systems that issue Forward Collision Warnings (FCW) earlier when distraction or fatigue is detected, will earn higher scores in Euro NCAP assessments.
This aligns with Euro NCAP's broader aim of addressing not only distraction and fatigue, but also impairment related to the consumption of substances like alcohol and drugs which will come into its assessments from 2026.

An important marker on the journey towards autonomy

Over and above the socio-economic benefits of improved vehicle safety, using DMS technology to monitor the human inside a car is also a crucial marker on the journey towards autonomous driving.

As the industry advances from ADAS to higher levels of automation capability, DMS is going to play a vital role in supporting this transition. Governments are actively supporting this shift. For example, the UK Government's CAM Pathfinder 1 initiative (enabled with funding from the Centre for Connected and Autonomous Vehicles), which closed to entries on 15 January this year, will use feasibility studies to explore the removal of safety drivers by focusing on identifying and overcoming barriers to safe and secure deployment.

Contributors will run the rule over various DMS technologies, before assessing how they can be used in research to classify the status and the value of the human safety driver when monitoring autonomous systems.

Once this objective is achieved, the industry will be able to determine when there's an equilibrium of the driver's value, and that can then be used to support the justification for removing the on board 'user-in-charge', allowing fully-automated systems to operate without the need for a physical driver monitoring the system.

But, testing the multiple, real-world scenarios that could present themselves when a human is behind the wheel presents a set of challenges that have never been encountered before.

Testing to the real-world extremities

When we're operating within HORIBA MIRA's private testing environment in Nuneaton, we work with vehicles in a professional manner. But when we're testing to ensure the reliability and effectiveness of DMS technology, we must simulate real-world driving behaviours that are extreme.

That can mean getting humans to drive when they may be drowsy, asleep, distracted for long periods and, at the top end of the scale, when they've consumed alcohol or are under the influence of drugs. These scenarios present ethical and legal considerations that have to be dealt with to ensure system validation can safely take place.

Examples include making sure we always provide the correct and legal duty of care for employees, we ensure total operational safety during simulations with impaired drivers, we give participants the right to opt out and not do anything they don't want to, and even make provision to accommodate a participant in a hotel if they've been driving while tired.

These are important challenges that must be addressed and are heavily influencing the way we design today's DMS tests. Our priority is to ensure nobody involved with a test comes to any harm.

Simulation and real-world correlation

One of the best ways to remove safety challenges during DMS validation is by moving the simulation to a synthetic environment. As a laboratory that's accredited to provide regulation testing services for GSR2 and Euro NCAP to OEMs, we use our world-class Driving Simulation Centre (DSC) to successfully support our ADAS and autonomous vehicle development work.

This facility recreates real-world driving scenarios safely, but achieving high fidelity in the virtual environment is no small feat. There are challenges in this environment as well.

For instance, when we're using a Driver Facing Camera in the simulator, we need to ask ourselves if the topography of the interior cabin is relevant and affecting the performance of the DMS? And is the behaviour of the human driver in the simulator the same as it would be in the real world? After all, the psychological 'red dress effect' – coined from the Matrix film – isn't present in a synthetic environment.

That means the efficacy of simulations must be validated against real-world driving behaviour and data to ensure systems perform as intended in practical scenarios.

By getting this correlation right and being able to develop DMS technology that not only meets regulatory requirements at the basic level, but excels under voluntary standard scrutiny as well, the automotive industry can make significant progress towards Vision Zero.

Driver Monitoring Systems are not just a compliance tool. They are a critical component of safer, smarter mobility.

GSR2: Navigating the post-Brexit pathway

Although Brexit has been a long time in the rear-view mirror, the UK is still defining its approach to the General Safety Regulation 2 (GSR2). As an interim step, it has adopted the EU scheme while the Department for Transport (DfT) considers future details. The DfT has outlined three key principles to guide its decision-making process: standardisation through UNECE regulations, and having the flexibility to recognise global standards and testing – but permitting deregulation where UK-specific updates are not needed. Additionally, the UK is also empowered to explore bespoke domestic requirements that will benefit Great Britain.

A clear challenge is the UK's lack of representation when the EU makes regulatory decisions. This could mean supplementary regulations will be needed. For example, Intelligent Speed Assistance (ISA) regulations in the EU don't list UK-specific road signs in the annex. To bridge this gap, the UK may follow the Vienna Convention approach and align with international norms.

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