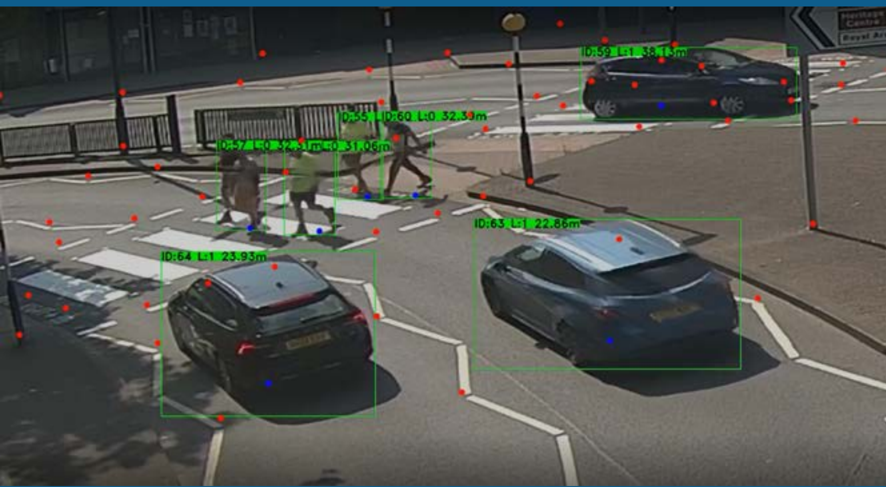
TRL THE FUTURE OF TRANSPORT

Building UK capability in CAM safety

The role of physical testing to support automated vehicle approval

By Oliver Howes



At the Smart Mobility Living Lab in London, the testbed monitoring infrastructure mirrors the situational awareness expected from the CAVs. Here, the testbed is demonstrating object detection, trajectory, speed, and a host of other parameters. This data can then be compared with that collected and used by the CAV, and used to create new edge-case training scenarios.

This data can also be shared with CAVs to provide additional awareness data and enrich the data sets gathered by onboard sensors.

The performance of both CAV systems and component parts needs to be evidenced for an array of different reasons from selling the solution to future clients, gaining necessary insurance, demonstrating the impact on existing transport systems and support vehicle approval. Evidencing methodologies will differ based on the requirements or obligations and will involve a mix of virtual testing and physical testing in a range of different environments.

The exact test requirements to gain approval for automated vehicles within the UK is currently unknown. There is a trend, in response to systems becoming more complex, for regulatory requirements to demand evidence gathering rather than conformity with specific controlled tests. One thing we can be certain about is that both physical and virtual testing will play a vital role in the approval process for CAM.

Virtual and physical testing both have their benefits and draw backs. Virtual testing (or simulation) can come in many different forms. Hardware or software components can be incorporated into the virtual tests as required; this is called X-in-the-loop testing. Virtual testing allows for a vast number of test iterations to be completed in a very short time period. It can also provide **quantitative** data sets describing the exact environment the vehicle or system is tested in. For example, classification of other road users, exact position and trajectories of test vehicle and other road users, exact geometry of the road network. This data provides a **ground truth** which can be used to assess the vehicle or system's ability to read the environment.

Within the physical environment, the ability to provide this ground truth data is much more complicated. An automated vehicle will make calculations to classify road users, calculate locations and trajectories, however, without a ground truth, it's difficult to validate this data. Without the ability to validate this data, the true safety of this technology will be unknown.

Although time consuming, truth data of the **static environment** is easier to capture. Road surveys could be conducted, or information could be extracted from a digital model, if already generated. Truth data of the **dynamic environment** is much harder to capture, without significant monitoring infrastructure and processing capabilities.

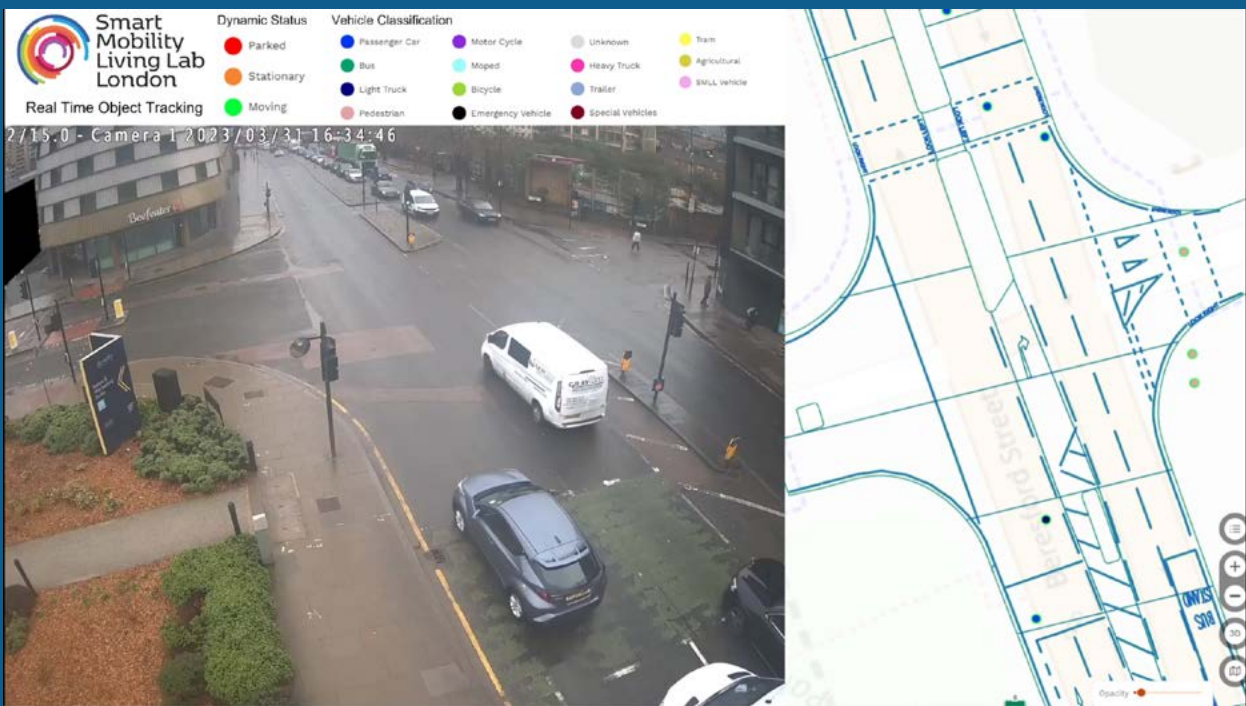
Test environments, such as the Smart Mobility Living Lab (SMLL), were built to provide the necessary truth data for both static and dynamic elements. Real world test environments such as SMLL will play a vital role in assessing the performance of complex automated systems as they allow organisations to gather the relevant truth data, but from an independent source.

Static environment:

- Road layouts
- Junction or pedestrian crossing type
- Presence of traffic lights (not status)
- Parking or loading bays
- Road rules
- Street furniture

Dynamic environment:

- Weather
- Pedestrians
- Cyclists
- Motorised vehicles
- Traffic light status
- Temporary road works



Mapping the classification, location, and pathways of road users onto a digital map provides truth data for dynamic objects using the road network.

The control room at SMLL continuously receving data feeds from across the testbed

Ensuring the continuous safe operation of automated vehicles on our roads

Without the continuous watchful eye of a human in the driver's seat, such complex vehicle systems will also require continuous monitoring and validating when operating on public roads.

Without continuous monitoring, how will the system designers continuously improve their technology? Without a standardised approach to continuous monitoring, how will authorities assess the ability of a system to continuously operate safely?

Will the data generated from the vehicle systems alone be enough to satisfy all stakeholders, or will there be a need for third party validation of these systems when operational?

There are many ways to achieve continuous monitoring. Early agreement by all stakeholders on the most beneficial approach will unlock options for initial safety approvals.

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Oliver's primary role is to support in preparing automated transport technologies for deployment. Oliver has over 7 years' experience in automotive consultancy designing, testing and validating new transport technologies. He played a key role in the design and build of TRL's Smart Mobility Living Lab, the UK's urban test bed for testing and validating emerging transport technologies. Oliver has authored technical guidance for automated vehicle safety case development and developed frameworks for automated vehicle systems safety cases.