Press Release

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TÜV SÜD: Using simulation to drive SAE level 5 and into the city

Munich. Applying the results of VVMethods (Verification and Validation Methods), a consortium comprising members from the fields of industry and science presented the world's first safety concept for automated driving in urban environments in Stuttgart on 22 November 2023. Among the 23 prominent partners participating in the research project is TÜV SÜD, represented by its experts in automated and connected driving. As a testing, inspection and certification (TIC) company, TÜV SÜD acts as the link connecting industry, science and the regulatory authorities that will ultimately approve the automated and connected vehicles for road use. Launched four years ago, the project was funded by the Federal Ministry for Economic Affairs and Climate Action. TÜV SÜD's role was to identify critical road-traffic scenarios by using simulation, thereby establishing this testing method in the homologation of automated vehicles. As the only third-party TIC company in VVMethods, TÜV SÜD underlines its global leadership in TIC services for automated and connected driving.

"We are very excited to be part of this important project. As part of VVMethods, we developed the first safety structures and the first safety concept that will serve as the future basis for the development of autonomous vehicles", emphasises Emmeram Klotz, Head of Testing and Validation of the Highly Automated Driving business line at TÜV SÜD Division Mobility. The challenge is that there is an infinite number of potentially critical situations in road traffic. However, it is impossible to assess all these scenarios in physical tests due to their sheer number, so that the experts rely on simulation. TÜV SÜD played a major role in assessing and describing hazardous factors in terms of their relevance. The objective was to use simulation in order to identify the critical situations in advance, thereby allowing the experts to focus on these critical situations in subsequent testing with the physical vehicle. Klotz points out, "The tests with real vehicles will always form an important part of the safety measures. However, in the future, simulation will likewise play an increasingly important role in testing, thus contributing to safety. And simulation is exactly what we have validated as a testing method here."

Establishing structures

A vehicle parked at the side of the road is obscuring a cyclist. This sounds like a critical situation in road traffic. But when does this situation turn from safety-critical to dangerous? What is the tipping point from which factors are considered critical? A look at this everyday situation in urban traffic alone reveals the level of complexity faced by the TÜV SÜD experts. A host of additional factors, including weather, road surfacing, glare and light signals, made their task even more challenging. Tuan Duong Quang, VVMethod Project Manager at TÜV SÜD, says, "We first had to overcome the challenge of filtering out the most critical phenomena from the open complex of road-traffic situations in the real world." To this end, the TÜV SÜD experts started with a criticality analysis in order to give structure to the open and unstructured context – in other words, the infinite number of possible road traffic scenarios. In criticality analysis, simulation proves the correlations between increased criticality and influencing factors. The experts can use it as a tool to identify a finite number of testable situations from the infinitely high number of situations in real-life road traffic.

Step by step

But back to that T-junction where a parked car is obscuring a cyclist, and back to the question of what factors influence the criticality in this situation and to what extent. Variable and critical factors include the position and speed of the approaching car, the position and size of the parked vehicle and the position and speed of the bicycle approaching from the right. An algorithm is used to change the factors influencing the obscured view of the cyclist in small increments based on stochastically determined values: for example, the approaching highly automated vehicle advances half a metre, and the cyclist correspondingly moves 20 centimetres. While the actual size of the parked vehicle remains the same, the line of sight between the automated car and the cyclist now changes.

The result shows that this traffic scenario may not be critical at that precise moment, because the automated vehicle will notice the cyclist and has sufficient time to respond to the situation. However, if the parked vehicle is "bigger" and blocks the line of sight between the road users, the situation gradually turns more critical.

Access for all

The TÜV SÜD experts opted for an open-source approach using the openPASS simulation tool. This open-source tool helps the experts to develop parameters such as specific road-traffic factors or conditions for simulation. Tuan Duong Quang says, "To ensure the simulation fulfils the requirements from the criticality analysis, the tool was adjusted step by step. This included the development of a cyclist model, an automated driving function, the interpretation of a zebra crossing, simulation of traffic lights and creation of weather conditions." Taken together, all these factors make up a picture of critical traffic situations, which forms the basis for using simulation in the approval of automated driving functions. Klotz points out, "VVMethods was developed on an open-source platform. In other words, all stakeholders involved in the design and development of autonomous cars can access the safety concept. By choosing this form, we are accelerating the rapid introduction of this new technology."

So what is VVMethods?

The idea that led to Pegasus, the predecessor of the VVM project, involved bringing together the worlds of research, industry and regulation to establish the basis for fast development of autonomous vehicles. Starting in 2016, the consortium partners in the Pegasus project worked to develop widely accepted methods and tools for assuring the safety of highly-automated driving functions, initially up to SAE Level 3. The Pegasus project has resulted in two successor projects since 2019, one of which is VVM. The partners in the VVM project have now succeeded in advancing to SAE Levels 4 and 5. The goal of this project is likewise to establish methods and tools for the homologation of highly automated vehicles – but now in urban environments.

Further information about TÜV SÜD at www.tuvsud.com.

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