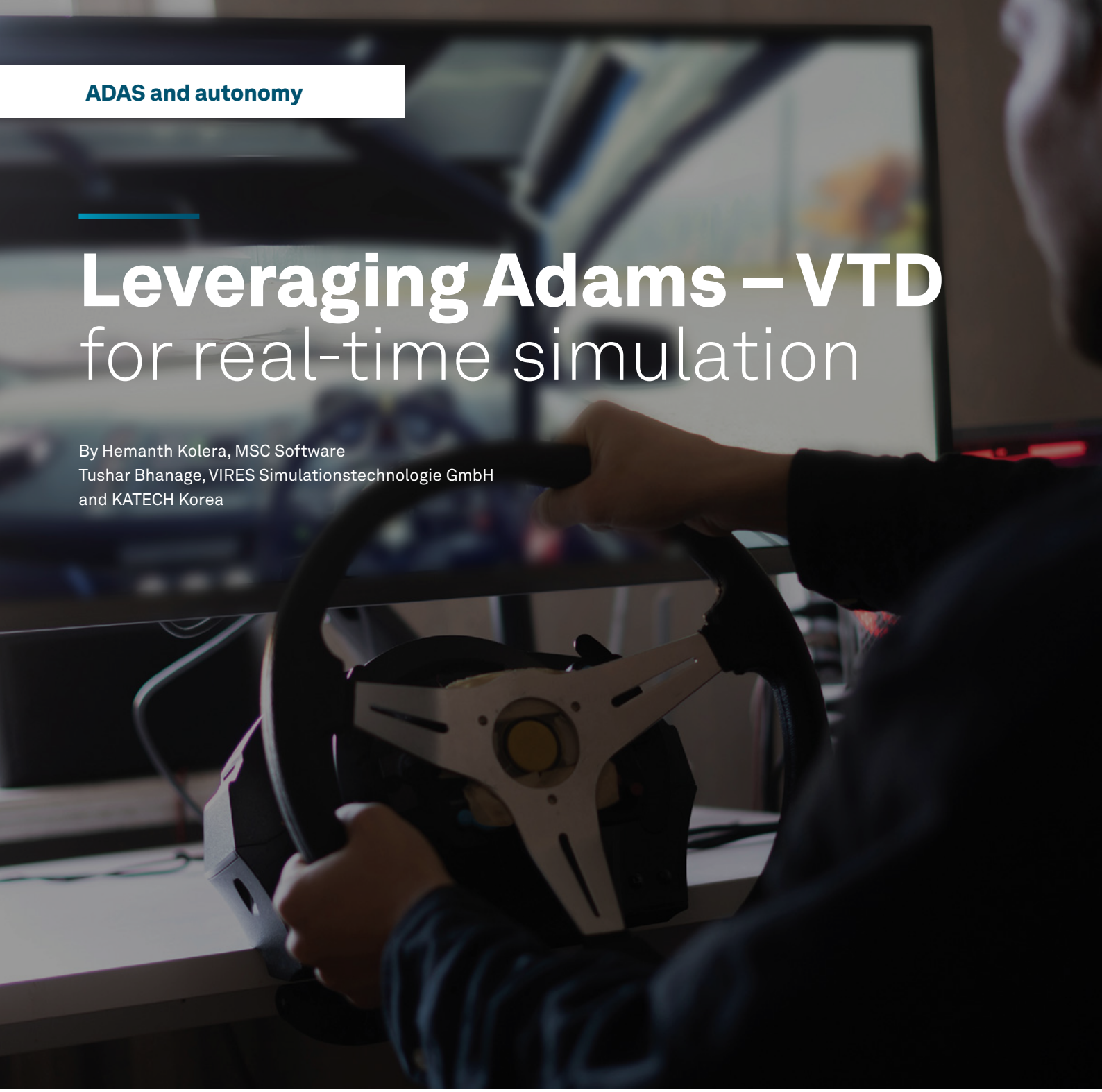

# Leveraging Adams – VTD for real-time simulation

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Autonomous vehicles and their associated technologies are becoming a vital part of today's society. Before envisioning fully functional and safe autonomous vehicles, companies are working on advanced driver-assistance systems (ADAS) functions that will not only keep vehicle occupants safe but also help the driver to navigate through complex road networks safely. It is estimated for the ADAS market to reach $659.9 million by 2025 (source: Frost and Sullivan). The automotive OEMs and other major players are gearing up to actively investing more in research and development for ADAS and autonomous vehicles. Prototype development and testing for autonomous vehicles is a significant industry challenge. Due to the number of critical scenarios, physical testing is complex and does not guarantee complete test coverage. There is a need for simulation-based test methodologies. Increasingly complex ADAS functionalities have to be analysed and validated with tools of proper fidelity in the context of the entire vehicle system. While the simulation environment is critical, the vehicle model's fidelity should also guarantee accurate and physically realistic results. This is especially true in the context of scenarios where several degrees of freedom have to be simulated to describe vehicle operation correctly.

Korea Automotive Technology Institute (KATECH) was established in 1990 to support the national auto industry and ensure its sustainable growth. It is actively involved in the fields of automotive, ADAS, and Autonomous vehicles (AV) research and development and is a pioneer in these fields. Solutions in these areas typically consist of a complex tool chain. Connecting solutions from multiple different providers is hard and time-consuming. While an ideal autonomous solution would have consisted of both physical and virtual/simulated technologies, KATECH was forced to bank on simulations and simulators to test autonomous solutions due to various time constraints.

To address the challenges of a complex tool chain with guaranteed deterministic results, KATECH choose Adams and VTD's integration. Adams is the leader in Multibody Dynamics simulations. It is the defacto standard for modelling of vehicle dynamics. Adams Car, the Adams vertical solution for the Automotive industry allows users to create complete virtual prototypes of vehicles using prebuilt templates. Users can run these prototypes through multiple open and closed-loop vehicle events and scenarios. Using this approach, engineers can perform the same tests they usually run in a test lab or on a test track virtually. All this in a fraction of the time and without the need for a physical prototype. Using standard tool independent interfaces, such as FMI, Adams can be connected with other tools such as VTD to enable solutions for autonomous applications. As the Adams model is inherently high fidelity, it allows the user to zoom into any aspect of the vehicle dynamics that they would like to investigate. Employing a high-fidelity model allows the user to capture a broader set of frequency responses as compared to lower fidelity methods with limited degrees of freedom.

The high-fidelity modelling approach in Adams provides an opportunity to utilise the same vehicle model through all the development stages from design to validation.

To solve real-time simulation problems, Virtual Test Drive (VTD) enables the creation of a virtual environment resembling the real world. KATECH was able to simulate complex urban situations that included pedestrians with deterministic behavior, to-the-scale vehicle models, variations in the weather, time-of-day, visibility, precipitation, and vehicle dynamics. A physics-based LiDAR sensor with ray tracing provides a scalable solution from high resolution to low-resolution images depending upon the number of rays you want to simulate for the system under test. A physics-based RADAR sensor with ray tracing helps to determine the false-positive artifacts in the simulation world. VTD supports open standards like OpenDRIVE, OpenCRG, and OpenSCENARIO to create road networks and manage dynamic behavior in these simulated road networks. These open standards provide full flexibility to integrate with 3rd party tools that were one of the necessities from KATECH.

Adams and VTD individually provides significant advantages to the automotive industry. Adams on one hand helps to solve the complicated challenges related to vehicle dynamics, while VTD on other hand helps to validate and verify the scenarios based on standardised file formats providing more autonomy. Virtual validation of system under test is increasing rapidly for which stable solutions are required. Co-simulation capabilities of Adams – VTD enables real-time simulation with stability and deterministic results even though the fidelity of simulations is varied either in terms of multiple vehicle dynamics model or different scenarios.

*Figure 1: Simulator setup with Adams – VTD Integration at KATECH*

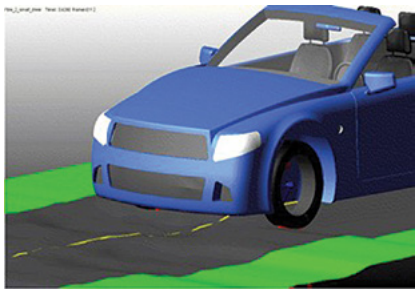

*Figure 2: Adams Car for vehicle dynamics analysis*

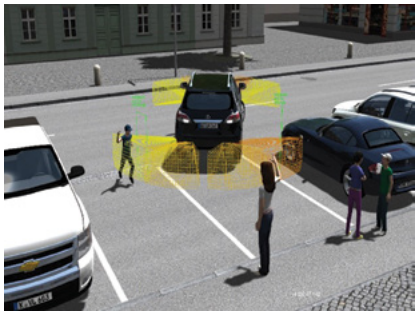

*Figure 3: Virtual Test Drive (VTD) for Simulation*

Adams – VTD integration is the starting phase for analysing the ADAS functionalities and Autonomous vehicles. Hexagon provides multiple solutions from early software development to validating prototype vehicles on the actual road. This includes road scanning with Leica Geosystems provided through their Content Programme, validation of GNSS sensors from NovAtel, and vehicle prototype validation from AutonomouStuff. The complete solution from Hexagon provides an opportunity to reduce the dependency on 3rd party tools enabling in-house testing of complete solutions and serving as a single sourcing technology provider.