

Virtual verification

Siemens' Simcenter Prescan360 software enables the cluster-based simulation of many thousands of scenarios in an orchestrated fashion

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The ADAS/AD V&V framework enables automated preparation, execution and post-processing of complex traffic scenarios, which are simulated by Simcenter Prescan360 on a local machine or on the cloud

Over the next several decades, the autonomous vehicle market will generate many trillions of dollars of economic activity from new and existing auto makers, shared mobility services, and an increasingly varied auto supply chain. This new autonomous vehicle revolution will also bring big changes to the way the vehicles are designed, manufactured and sold.

With the rise of autonomy comes a new premium on agile development cycles, shorter production runs of a wider array of vehicle types, and new partnerships and collaboration across the supply chain. The new autonomous vehicle ecosystem includes new chip, software, sensor and systems-oriented technology companies, in addition to the traditional manufacturers and their upstream partners.

Meanwhile, auto makers must still maximize revenue from existing product lines and appropriately balance R&D spending to refresh these lines today while investing for a likely radically different future.

Supporting full traceability and verification throughout the entire autonomous vehicle development process, the Siemens Digital Industries Software portfolio helps to execute this balancing act. With an emphasis on an integrated, digital development environment, and advanced chip to full-vehicle simulations, Siemens is helping auto makers and their suppliers create safe, commercially viable autonomous vehicles, on time and on budget.

The most critical requirement of the vehicle development process is occupant safety. Shifting decision-making responsibility from driver to auto maker to prevent accidents has a major impact on the development process. Car makers will have to prove the thoroughness of their development processes and robustness of the vehicle's automated driving systems to



Simcenter Prescan360 uses realistic lighting simulation to test computer vision systems. The ADAS/AD verification and validation (V&V) framework can be used to scale-up and automate this kind of assessment against numerous environmental conditions

prevent people getting injured or killed by wrong maneuvers from autonomously driven vehicles.

This implies automated driving systems will have to react in a safe manner to all possible traffic scenarios under any possible weather and road conditions. The technology enabling this is complex. It requires a validation and verification process that allows performance testing in a large number of circumstances. The process should be able to be repeated for different car evolutions over time, allowing performance comparisons for design exploration purposes.

Scaling-up virtual verification

To cope with the previously mentioned challenges, Siemens Digital Industries Software has developed a simulation-based validation and verification framework called Simcenter Prescan360.

SIMCENTER PRESCAN360 HAS ALL THE COMMON SCENARIO INTERFACES TO SUPPORT MASSIVE SIMULATION IN CLUSTER ENVIRONMENTS, AND ALSO REAL DATA VIRTUALIZATION INTERFACES

Starting from requirements and vehicle-level system architecture, this solution makes it possible to generate endless numbers of virtual scenarios, combining world models with vehicle models connected through sensors models.

Computer-aided engineering teams can use Simcenter Prescan360 and Simcenter Amesim to model the autonomous system or even assess the complete vehicle. Simcenter Prescan360 is the core simulation engine for environments, scenarios, sensors, AI and controllers, and its representations contain the reflective properties for radar, camera, lidar and ultrasonic sensors. The sensor models can therefore be scaled from basic ground truth information up to full-wave propagation modeling for detailed sensor evaluations.

There are multiple possible sources for scenarios. There are scenario databases such as GIDAS and CIDAS (German and Chinese accident databases, respectively), which many OEMs and Tier 1s use to record traffic data and generate OpenScenario format descriptions, and there are software solutions to generate scenarios synthetically. Simcenter Prescan360 has all the common scenario interfaces to support massive simulation in cluster environments, and also real data virtualization interfaces.

Recent in-depth reworks now allow a combination of ego model components with increasing flexibility, to submit execution on cloud or cluster, and also to sweep more and more scenario concepts, all in an externally pilotable way.

These three major enhancements are naturally leveraged by HEEDS, Siemens' simulation orchestrator, which aims to check requirements through model-in-the-loop or software-in-the-loop simulation. HEEDS has

evolved from its previous design toward massive simulation orchestration, specialized for ADAS and autonomous driving virtual assessments. It offers mature technologies for process automation, execution distribution on any targets, and high-level results dashboards, useful for extensive analysis of thousands of results. HEEDS is also able to efficiently explore a scenario's parametric space to capture valuable simulation results, giving precious insight about failure modes of ADAS/AD systems under development. Simcenter Prescan360 is open to third-party tools and scripts to customize the processes for all companies and simulation teams.

If more physical properties are needed for the vehicles, Simcenter Amesim is the tool of choice for vehicle dynamics and powertrain modeling. It offers the possibility of modeling mechatronic systems or subsystems, using various fidelity levels that best match any simulation requirements and connecting them in a modular way.

Conclusion

The introduction of Simcenter Prescan360 for ADAS/AD is a breakthrough on the challenging road toward mass-produced autonomous vehicles. The combined strengths of Simcenter Prescan360 and HEEDS have been the foundation for the launch of a new platform to confirm complete system and vehicle performance. Continued investments will further drive efficiency and coverage metrics, supporting Siemens' customers to introduce safe, reliable and comfortable self-driving cars. With an emphasis on an integrated, digital development environment, and advanced chip to full-vehicle simulations, Siemens is helping auto makers and their suppliers create safe, commercially viable autonomous vehicles, on time and on budget. <

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