FOUR WAYS DRIVING SIMULATORS HAVE INFORMED THE RESEARCH INDUSTRY

RESEARCH SIMULATION FOR AUTONOMOUS VEHICLE (AV) AND ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS)

HOW CAN WE MAKE HUMAN INTERACTION WITH AUTONOMOUS AND ASSISTIVE VEHICLES SAFER?

AV/ADAS systems clearly have the potential to both greatly increase public safety and vastly increase the independence for those with limited mobility options. This is especially the case with SAE L2+ through L4 autonomous vehicles. But as these systems hit the roads, high-profile accidents have highlighted our as yet incomplete understanding of how humans and autonomous/assistive vehicle systems interact.

In order to foster broad adoption (and safe use) of these advanced assistive and autonomous systems, more researchers need access to better tools for exploring human-machine interactions (HMI).

RDS-2000 FULL CAB DRIVING SIMULATOR

RDS-1000 WITH 205-DEGREE HORIZONTAL FIELD OF VIEW

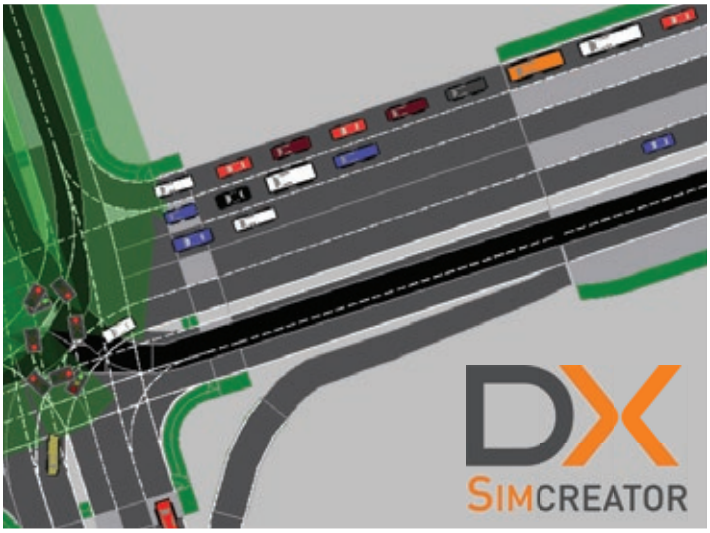
REALTIME TECHNOLOGIES COMBINE SOFTWARE AND HARDWARE INNOVATIONS FOR COMPLETE SIMULATION SYSTEMS

Developing new AV/ADAS strategies and exploring in-vehicle HMI require complete simulation systems. These must be able to provide a vivid immersive experience for human participants in addition to completely modeling the AV/ADAS system and directly interfacing with your platforms and peripherals. (i.e., they must handle “human-in-the-loop”, “hardware-in-the-loop”, and “full simulation” studies, where all aspects of both the driving environment and vehicle operations are modeled in software.)

Simulation platforms from Realtime Technologies (RTI) meet these demands through a combination of their hardware platforms (including full-cab simulators built with genuine OEM components), the SimCreator DX simulation authoring tool, and SimDriver plug-in.

1229 Oak Valley Drive • Ann Arbor, MI 48108 • (248) 548-4876

Realtime technologies



DRIVING SCENARIO IN SIMCREATOR DX

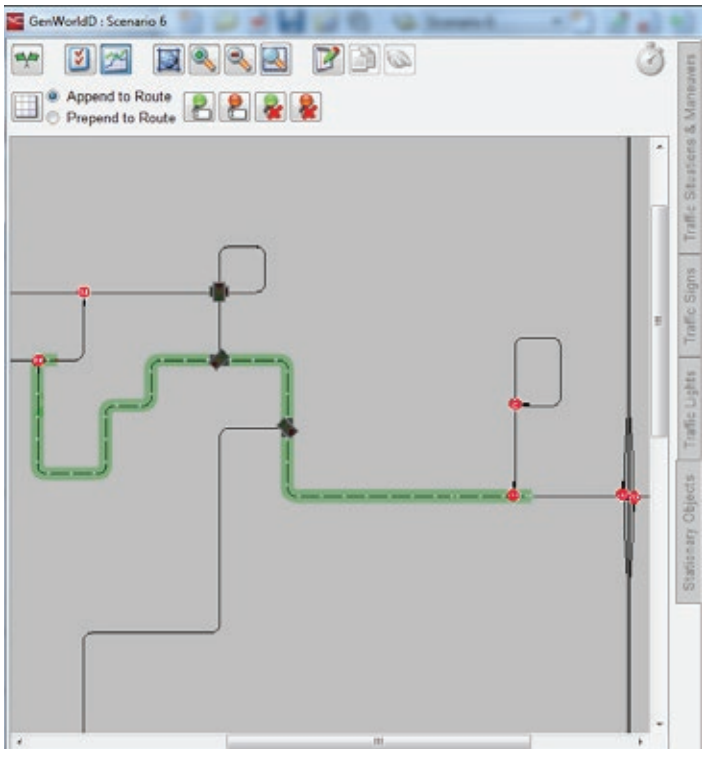
FEATURES

- Quickly design, develop, and debug complete experiments—without writing a line of code
- "Live modify" your scenarios as they run; quickly test or fine-tune new approaches
- See how your AV/ADAS solution performs on your streets with geo specific scenarios
- Test autonomous vehicle programming before creating costly prototypes
- The platform is trusted by Ohio State University, the University of Massachusetts, Georgia Tech University, and others.

SimCreator DX is the latest generation of graphical scenario authoring and development software for rapid research study development. It allows for the creation of completely custom driving environments—including geo specific models, so that you can test your AV systems on a digital twin of your town.

The **SimDriver** and **SimADAS** plug-ins add the technology required to accurately measure driver behavior with a focus on developing a highly accurate driver model for the purposes of improving self-driving cars and other ADAS or connected vehicle technology. It can also model complete algorithmic/machine control of the vehicle, as well as V2V (vehicle-to-vehicle) communications among vehicles within your simulation.

Premier research institutions and automakers worldwide rely on RTI simulation platforms for AV/ADAS research and development. Recent studies include SAE level 3 conditional automation systems, human-automation interaction, and the prototyping of Automatic Emergency Pullover (AEP) strategies for active safety systems in semi-autonomous vehicles.



SIMCREATOR DX SCENARIO CREATION

1229 Oak Valley Drive • Ann Arbor, MI 48108 • (248) 548-4876

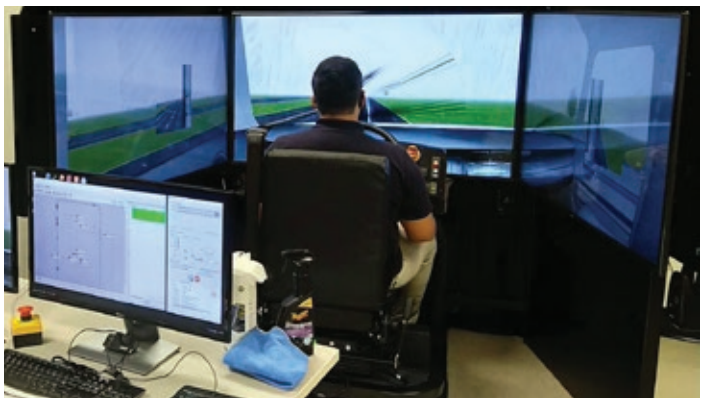
RESEARCH SIMULATION FOR IMPROVING ROAD SAFETY

VEHICLES ARE JUST ONE ELEMENT OF ROAD SAFETY

According to the World Health Organization (WHO), road traffic accidents are the main killers of children and young people aged 5 to 29. If this trend continues, road traffic injuries will rank fifth among the top ten causes of death in the world by 2030.

But improving road safety goes far beyond how vehicles interact with each other and the roadway. For example, WHO estimates that roughly 68,000 Chinese pedestrians are killed each year. That is more than a quarter of all Chinese road fatalities. (For comparison, although the United States and China have nearly the same number of cars on the road in a given year—around 280 million—the US has fewer than 1/10th as many pedestrian fatalities each year.)

WHO calls this "distracted walking"—analogous to "distracted driving" and a potent reminder that any given roadway is a complex environment where motor vehicles, cyclists, people, animals, civil engineering, architecture, and weather all interact to create a unique set of constantly changing conditions.



SIMCREATOR DX INCLEMENT WEATHER DRIVING SIMULATION

POTENTIALLY DISTRACTED PEDESTRIANS

USING RTI SYSTEMS TO BETTER UNDERSTAND DRIVER BEHAVIORS

Until recently, doing research on driver behavior was a slow process. Research teams needed to be proficient in C++, JavaScript, or other programming languages. Even with that expertise, months were lost to tedious development and debugging.

The latest simulators from Realtime Technologies (RTI) have removed this obstacle. These simulation platforms bring together high quality immersive simulation hardware (full cabs, force feedback steering, motion platforms, etc.) with a powerful, graphical scenario authoring and development tool (SimCreator DX) and integrated data collection (SimObserver). In just minutes, research teams with no programming specialists can begin constructing rich, immersive, complex driving scenarios that include ambient pedestrians and traffic, bicycle and construction zone interaction, distracted pedestrians, animals, audio cues, changing weather or visibility conditions, and more.

1229 Oak Valley Drive • Ann Arbor, MI 48108 • (248) 548-4876

Realtime technologies

COMPLEX DRIVING ENVIRONMENTS IN SIMCREATOR DX INCLUDES TRAFFIC, BICYCLE, AND CONSTRUCTION ZONE INTERACTIONS

RESEARCH BIKE SIMULATOR

Premier research institutions and automakers world-wide already rely on RTI simulation platforms for their roadway safety research. For example, both Oregon State University and the University of Texas have installed RTI motor vehicle and bicycle simulators. These are networked systems that allow researchers to explore how cyclists and motorists share the road. At Ohio State University and the University of Alabama at Birmingham, teams of psychologists, occupational therapists, and doctors have used their RTI simulator system to uncover the special driving challenges faced by individuals who have suffered a concussion or other brain injury.

FEATURES

- Research more than motor vehicles: integrate real and simulated bicycle, pedestrians, and more
- Coordinate experiment design, development, and data collection in a single system
- Deploy the same simulation platform as the University of Massachusetts, University of Texas, and Ohio State University (in cooperation with Honda Motor Company)

CUTTING EDGE SIMULATORS FOR DRIVING RESEARCH

SIMULATORS FOR RESEARCHING DISTRACTED DRIVING

RDS-2000 IMMERSIVE SIMULATOR FOR DRIVER DISTRACTION

DANGERS AND IDIOSYNCRASIES OF DISTRACTED DRIVING

Everyone agrees that distracted driving is a substantial problem—but how substantial? Many agencies estimate it accounts for 10% to 15% of all traffic accidents. But it could be much larger. According to a 2020 Chinese study, 74% of the survivors of traffic accidents cited distracted driving as the primary cause of their crash. This study interviewed 9,982 crash survivors between the ages of 18 and 34. The majority of these drivers (82%) cited phones specifically as a distraction. Other research has found that an average driver misses 40% of all traffic signs within one minute of taking a call (even when using hands-free technology).

But researchers are also beginning to discover how little we understand distracted driving. For example, at least one study has found a situation where distracted drivers perform better than expected. This was a 2019 study of 60 drivers, focused on emergency takeover while operating a "self-driving" car. Unexpectedly, researchers found that the participants they distracted with secondary in-vehicle task were able to respond to the "emergency" and take control of the vehicle more quickly than their undistracted peers.

USING RTI IMMERSIVE SIMULATORS TO CONFRONT DISTRACTED DRIVING

Today's researchers and engineers are looking to delve deeper into the inner workings of the distracted mind. For example, for a study recently published in Nature, researchers at Stanford tracked the brain activity of distracted drivers while they were behind the wheel. This team was able to "highlight a significant increase" in specific brain activity "in response to increasingly greater levels of smartphone distraction." These, in turn, reliably mapped to notable deviations in vehicle control. The hope is to eventually craft safety features that alert a motorist to the fact that they are losing focus—before they are even aware this is the case.

In order to accomplish this, Stanford deployed a standard Realtime Technologies (RTI) immersive simulator which they then networked with an off-the-shelf

SIMDRIVER CAN OFFER DATA THAT SHOWS WHY DRIVERS BECOME DISTRACTED

Realtime technologies

DISTRACTIONS FROM DRIVING COME IN MANY FORMS, INCLUDING ADDITIONAL PASSENGERS IN THE VEHICLE

smartphone and third-party neural monitoring peripherals—including eye-tracking and functional near-infrared spectroscopy (fNIRS) hardware. Stanford chose an RTI system specifically because the open architecture allowed them to create a custom system that would "automatically synchronize EEG, EKG, respiration, and skin conductance with driving behavior, allowing new answers to questions about distraction and the ability of cars to take over based on the driver's mental and physical state."

FEATURES

- Integrate third party devices and peripherals or create your own custom plug-ins to transfer data via TCP, UDP, local wireless, Bluetooth, etc.
- Natively track and synchronize driver behavior data via the optional SimObserver add-on
- Design, develop, and debug complete driving scenarios—without writing a line of code or sacrificing open access to the underlying program
- The driver distraction research platform favored by Stanford, MIT, University of Texas, and Ohio State University (in cooperation with Honda)

1229 Oak Valley Drive • Ann Arbor, MI 48108 • (248) 548-4876

COMPLETE VEHICLE DYNAMICS SIMULATION AND MODELING SOLUTIONS

STATISTICS ALONE GIVE FEW INSIGHTS

Model-based design has transformed the automotive industry and automotive research. Today, a few engineers in a lab can rapidly evaluate hundreds of different engine control or powertrain designs without ever touching an actual vehicle. This has led to vast improvements in vehicle efficiency, safety, and huge leaps in the driving experience.

But vehicle dynamics research calls for more than just accurate and precise real-time multi-body dynamics modeling. In order to do meaningful work, vehicle simulation solutions need to translate those numbers into an authentic, coordinated, multi-sensory driving experience for test drivers. That platform also needs to make it easy to track what that experience means to those drivers. With these tools, you can greatly expand the role vehicle dynamics simulation plays in your design and development process.

RDS-2000 FULL CAB SIMULATOR

INSIDE RDS-2000 FULL CAB SIMULATOR USING SIMVEHICLE

RTI SIMULATION TURNS DATA INTO DRIVER EXPERIENCE

SimVehicle is a complete, high-fidelity, multi-body, real-time vehicle dynamics simulation solution. It can model a wide range of vehicle types (four-, six-, or eight-wheeled, tracked, etc.) with any style of tire or tread. These vehicles can be unencumbered, loaded down, or pulling two- or four-axle trailers with varying load types and sizes. They can demonstrate any combination of vehicle dynamics, malfunctions, and be driven on accurate models of a wide range of road surfaces and conditions—with real-time external monitoring of all vehicle dynamics output.

This is all handled through user- selectable/configurable/customizable input data files. You can directly access and modify these via the included graphical **Vehicle Dynamics Editor**. Modify any vehicle with your engine map, breaking profile, gear ratios, or other dynamics. The SimVehicle system models all four corners

1229 Oak Valley Drive • Ann Arbor, MI 48108 • (248) 548-4876

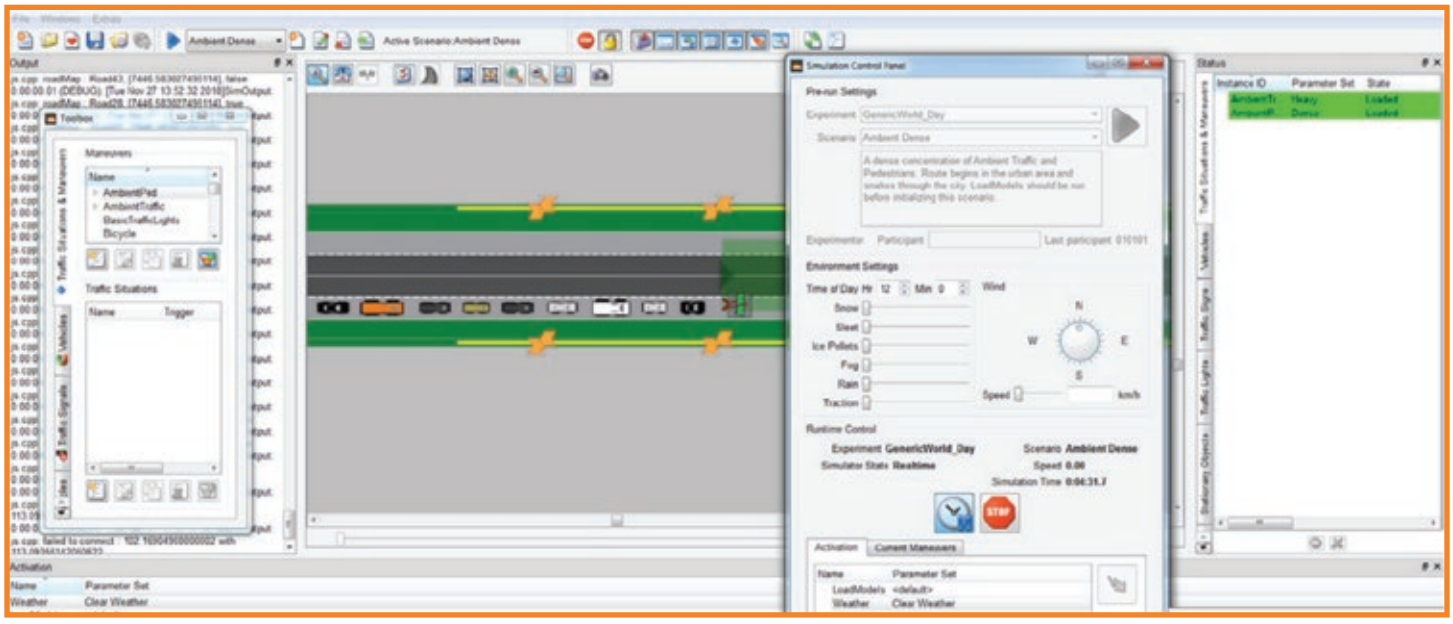
of the vehicle, incorporating spring and damping rates, bump stops, anti-sway bars, anti-squat, and anti-dive geometry coupled with a 6 degree of freedom body component. Advanced powertrain modeling calculates the torques at each wheel, taking into account both modeled inputs (engine, transmission, etc.) and any available user inputs (brake pedal, gear selector, accelerator pedal, steering angles, etc.), as well as roadway conditions and any equipment malfunctions you specify.

Built on Realtime Technologies' custom Multi-body Dynamics Component Library, these models will seamlessly mesh with **SimCreator DX**, RTI's premier simulation scenario authoring software. This allows for the highest degree of model fidelity while giving you full access to RTI's complete range of simulation and experiment design and development tools. Explore how drivers will experience your design in any scenario and under the widest range of terrain and operating conditions (day, night, poor visibility, inclement weather, variable traffic patterns, etc.)—before you spend a single cent on prototyping.

FEATURES

- Develop control strategies in a flexible software environment
- Evaluate engine control unit hardware design using hardware-in-the-loop simulation
- Perform human-in-the-loop testing using a robust vehicle model
- Use the simulation platform deployed at Stanford's Center for Design Research, the University of Michigan, MIT, the University of Florida, and elsewhere

DX SIMCREATOR



ADVANCED SCENARIO GENERATION WITH SIMCREATOR DX

RESEARCH SIMULATION SIMPLIFIED

Realtime technologies

Phone: (248) 548-4876
Email: sales@simcreator.com
Website: SIMCREATOR.COM