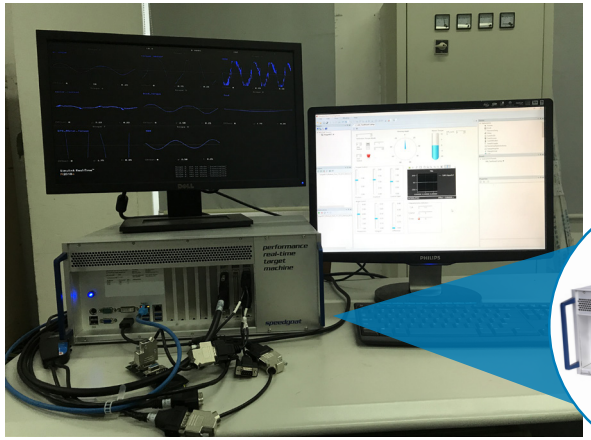
Tongji University

Accelerating the development of a driver-adaptive ADAS control strategy using hardware-in-the-loop simulation

speedgoat
real-time simulation and testing



Top left: the left view of the ADAS driving simulator
Middle left: the right view of the ADAS driving simulator
Bottom left: the testing setup with a closeup of the Performance real-time target machine in action
Top right: a diagram of the driving simulator

Tongji University in China is using Speedgoat products to safely and rapidly test driver-adaptive ADAS according to subjective feedback and varying driver characteristics

Tongji University in Shanghai, China, is a state university under the direct administration of the Ministry of Education. The University has gone through a balanced growth in all aspects of education, research, outreach, cultural inheritance and innovation since its founding over a century ago. Researchers at the Chassis Electronic Control Systems Lab at the School of Automotive Studies are focusing on the emerging trend of intelligent and connected electric vehicles. They are committed to their research in advanced driver-assisted systems (ADAS) and aim to improve human-machine interactions for ADAS through the application of artificial intelligence to automated driving. As a result, they developed an ADAS function that assists drivers with lane keeping using a Speedgoat-MathWorks real-time simulation system. The data of the driver characteristics indices extracted from naturalistic driving is used to design the driver-adaptive ADAS.

The Challenge

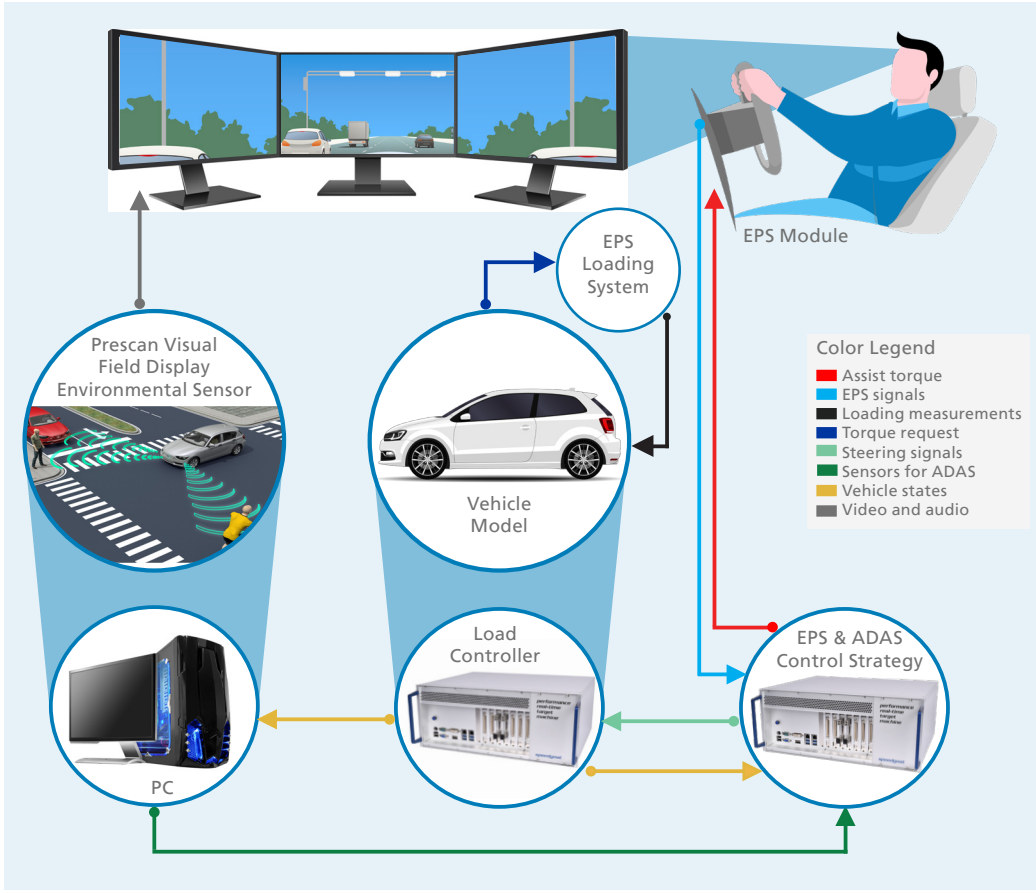
It was crucial to find a testing environment that could produce abundant and realistic driving scenarios to validate their driver-adaptive lane-keeping assistance system. Additional requirements included being able to create dynamic and precise vehicle models for real-time simulation, having a high level of performance to compute complex models and strategies, and multiple hardware peripherals for actuators, sensors and communication interfaces to other platforms. Lastly, the overall solution had to be cost effective and safe.

The Solution

The chosen platform which met all the requirements comprised of an integrated Speedgoat-MathWorks solution. Compared to testing on a real vehicle, running virtual tests were quicker, low cost, repeatable and completely safe.

The Results

In order to calibrate the driver-adaptive feature, several drivers tested a wide range of parameter sets. The driver-adaptive algorithm was tuned based on the feedback by building the driver preference model, which was the correlation model between the driver characteristic indices and the preferred parameters of each driver determined through answering a questionnaire.



Today, most vehicles use an electric power steering (EPS) system as the actuator for ADAS functions such as lane-keeping assistance or an automatic parking system. The electric power steering system bears the aligning torque from the tire and the ground. A motor loading system was designed to simulate the vehicle working condition.

The lab team at Tongji University plans to use a machine-learning method to realize the adaptive functions. They will soon be conducting HIL tests for the automated driving system.

The Key Benefits

- Reduced efforts on hardware
- Accelerated research
- Reduced testing time and costs
- Safe environment to test driver-specific feedback

> "The Speedgoat system works well with many of the tools in MATLAB. It is a very efficient way to construct the test platform so that we can concentrate on the development of the ADAS algorithm."
>
> - Professor Hui Chen

Utilized Speedgoat products:
» Performance real-time target machine
» IO133 Analog and digital I/O module
» IO306 Configurable FPGA I/O module
» IO612 CAN I/O module

Utilized MathWorks products:
» MATLAB®
» Simulink®
» MATLAB Coder™
» Simulink Coder™
» Simulink Real-Time™
» Vehicle Dynamics Blockset™

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