New Engineering Application for Driving Simulators

Recently, Senior Research Engineers from a world-leading automotive manufacturer contacted the University of Michigan's Mechanical Engineering Department to develop a set of algorithms to model driver steering response to unpredictable external vehicle forces.

The team is in charge of the OEM's stability program and is developing adaptive controls that help drivers maintain control when exposed to random inputs such as wind gusts and pressure changes from passing trucks. Since driver steering behavior will interact with the vehicle's adaptive controls, the first phase of this research required the Michigan team to develop a model that accurately represents driver response to transient forces.

Creating this driver model is essential because the manufacture's adaptive controls will be programmed in Simulink and then validated against a CarSim vehicle running the exact same Simulink code. To make sure their algorithms compliment the natural behavior of the driver, the researchers will integrate their driver model into CarSim and measure the control's contribution to improved stability.

To start the process, University of Michigan researcher Dr. Huei Peng and Research Fellow Sean Yang needed to collect high-frequency steering response data from a wide variety of drivers under different driving conditions. Faced with limited time and budget, the team realized that equipping a vehicle with steering and yaw sensors and renting a cross wind facility for 24 amateur drivers would be expensive, time consuming, and could potentially produce unreliable data.

Since the project already has a strong simulation component, the team decided that the ideal approach would integrate their tests into a CarSim based driving simulator equipped with a high precision steering wheel. "After evaluating several options, the CarSim based driving simulator developed by Mechanical Simulation Corporation provided us with the best platform to collect precise steering data and the ability to quickly reconfigure the platform to simulate different vehicles and input profiles. "CarSim allowed me to place random forces at different points on the vehicle that represent the events I wanted to monitor," explains Sean Yang. "Also, the driving simulators let us test our subjects in a controlled environment where drivers were not distracted by external conditions and could focus exclusively on steering the vehicle in a straight line."

To prepare the test, the group developed a set of CarSim test runs with different vehicle configurations and force profiles. Each of the 24 test subjects drove the simulator for eight test runs while CarSim collected detailed data about each subject's attempt to keep the vehicle on course. With the data acquisition phase of the project complete, Sean is now analyzing the data and developing algorithms that model the driver's response.

The entire project, from conception to test driving, took less than three weeks. "The data collection project was a great success because we were able to quickly collect accurate data without having to worry about logistics, weather, and other uncontrollable factors. "We have discovered that a driving simulator is a valuable engineering tool that can be used for a wide range of research and design projects," summarizes Dr. Peng. The final seal of approval came from the 24 test subjects who unanimously praised CarSim's ability to generate a realistic driving experience.