Tongji University Advanced Driving Behavior and Traffic Safety Research Simulator (TUDS simulator)

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Poser Session

In 2011, an 8 DoF driving simulator was delivered by Oktal (France) to the Tongji University (Shanghai, China) designed for research on driver behaviour and new road infrastructures. This simulator is one of the world's largests, and provides the driver with an highly immersive driving environment. To obtain the most realistic behaviour of the driver inside the simulator, human performance and subjective state (simulator sickness) were considered as main issues during the design and development of this simulator.

This driving simulator consists of a 6 meters wide dome housing a Megane Renault and a wide 250° display system for a complete immersion of the driver in an extremely realistic visual and sound environment. The dome stands on a 8 DoF (Degrees of Freedom) dynamic platform equipped with six electrical actuators and mounted on tracks of 20 meters by 5 to render perfect motion feedbacks (acceleration, braking, vibration, curves). The simulator is controlled and driven by the SCANeR™studio software that allows simulating vehicle and road environment, and creating vehicles and scenarios.

Most driving simulators are tools for Driver-in-the-loop experiments. Because the driver is part of the system when the driving simulator is used, the validation process was adapted to include the driver early in the development process.

Standard validation procedures were defined to ensure that all subsystems are operational (car cockpit, visual system, motion system …). After engineering validation tests, the interactions between the subsystems were tested like the effects of the motion system on the visual system stability, latency between the action on the commands of the car and the reaction of the motion and visual systems, reliability… These validation procedures are mostly standard for any integrated system.

For the first time, the validation process set by Oktal for Tongji University Simulator was also completed with advanced tests on the complete system taking into a count the driver in the loop. Accordingly, the test procedures included a complete experiment, with a protocol, casting, test and analysis phases. The protocol was conceived by the workgroup of the Tongji University, Oktal and IFFSTAR researchers. This test included forty drivers, to evaluate three main criteria for the future use of the simulator: simulator sickness, braking distance and realism of the displayed infrastructure elements.

This work opens the discussion on standard criteria and procedures that could be useful in the future to qualify a simulator based on driver-in-the-loop system instead of only technical specification of the sub-systems

Figure 1: Tongji University advanced driving simulator.