Virtual reality for real driving: a tool to fill the gap between simulators and test tracks

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In order to conduct driving test, researchers and engineers have two possibilities, which are simulators, either static or dynamic, or test in a real car, on a test track or on open traffic roads. Each solution has its own advantages but they both have several drawbacks to deal with:

- Simulators: static simulators are too limited to represent haptic feedbacks and impact of acceleration. Dynamic simulators allow a larger range of feedbacks. Moving base simulators can even reproduce acceleration over a long period [Kem1]. However, they make the driver develops a self adaptation : his acceptable level of risk become higher than on real vehicle [Sah1]. They also can induce sickness [Joh1]. Moreover, the price of this kind of simulator may be a limiting factor.
- Real test: even on a test track, acceleration feedback is realistic. However, the safety of the vehicle and the driver, limits the range of test. The test on test track may also be limited because of the environment : less traffic and less interaction with the environment, it is difficult to represent specific situations and to reproduce them.

The solution that we present, allows tests on a real car but with a virtual environment [See Bock reference in Las1], as known as vehicle in the loop simulation. In a few words, the driver sees a simulated environment using a head mounted display (HMD) that masks the real environment, and acts on the steering wheel and pedals of a real car which is moving. In order to display the virtual environment in the helmet, the system must locate the vehicle on the track, must locate the position of the head in the car and must allow a control of the simulator using these data. All these functions have to be robust according to the specific environment of the car. The data frequency must be high enough to allow smooth and accurate movement display. And the transport delay must be minimized as much as possible to avoid simulator sickness.

In this paper, we focus on the architecture of the system. We have developed a data bus that allows fast transfer between the different part of the simulator and with the environment sensing process. Moreover, we specifically address the localization of the HMD with a reliable and low cost process that fits with the requirements of the environment. The application have been tested and demonstrated during the final of PARTAGE French project.

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