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Vehicle Environment simulation using realistic road networks for predictive driver assistance systems

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ABSTRACT

Since the 1990's computer aided engineering (CAE) and simulation (CAS) methods are used in the car development process. While the initial focus was set on crash simulation and car body design these techniques are applied in recent years also for the development and test process of Advanced Driver Assistance Systems (ADAS), like automatic cruise control (ACC).

The next step in this evolution is made by the development of predictive systems. These systems use external data sources to estimate the anticipated vehicle state. For testing predictive car functions it is necessary to provide the test bench with information about the car environment. Today this task could be solved by recording required sensor signals at a real test drive and playback the recorded data files during simulation. However, predictive vehicle systems which have a direct feedback at the longitudinal and/or lateral car behavior can not be tested with playback data. To validate these systems at a test bench, a closed-loop simulation is needed where all sensor signals (like GPS, radar, ultrasonic, camera, etc.) are generated in real-time based on the current vehicle position and state.

This technical paper demonstrates a test process for predictive driver assistance systems using Virtual Test Drive (VTD). VTD is a tool-set developed for provision a (virtual) test environment which is being utilized for active safety and driver assistance development respectively. The simulation is highly configurable and extendable. Its main components are a traffic simulation with appropriate vehicle dynamics, visualization and a sensor model which generates synthetic sensor data at object level. The road networks for the simulated scenarios are specified in the standardized OpenDRIVE Format. For visual models the wide-spread OpenFLIGHT standard is used. Thus, VTD and a realistic OpenDRIVE database provide all required information for the development and test of predictive assistance systems. Due to the real-time capabilities it is also possible to connect VTD to a Hardware-in-the-loop test bench and provide real electronic control units (ECU) with virtual plausible sensor information.

In our case a navigation system is connected to a Hardware-in-the-loop test bench, which provides other control units with predictive track data. The GPS-system thereby receives plausible positions, velocity, and acceleration information from the simulation, which are used by the control unit to determine the position on the digital road map. In that way the navigation system can display predictive track information for the current simulation position.