

**SIMULATION ENVIRONMENT
FOR THE DEVELOPMENT OF PREDICTIVE SAFETY SYSTEMS**

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The continuously growing vehicle density on European roads leads to a higher risk for traffic participants to be involved in accidents. In order to mitigate this risk both for vehicle occupants as well as unprotected traffic participants, the automotive industry seeks for solutions in the intelligent combination of active and passive safety systems towards an integral approach.

Safety applications like an active emergency brake that can reduce the consequences of an accident or even avoid a crash completely and predictive passive safety systems that feature optimized deployment characteristics of restraint systems (airbags, belt pretensioners) both depend on anticipatory sensor signals concerning the vehicle environment in the pre-collision-phase as a basis for their crash prediction algorithms. The development, test and validation of predictive safety systems require efficient simulation-based methods in order to be able to achieve a large test space coverage and to generate reproducible sensor signals for the respective test scenarios.

In this paper a highly configurable and flexible method for the simulation-based development and testing of predictive safety algorithms is presented. The method is based on a synchronized data connection between MATLAB/Simulink/Stateflow and “Virtual Test Drive” (VTD).

MATLAB/Simulink/Stateflow allows the intuitive model-based rapid prototyping of safety function algorithms using predictive sensor information as input data. These algorithms can easily be transformed into ANSI/ISO C-compliant code for diverse hardware targets e.g. by the Real-Time Workshop and tested in an identical form in the vehicle after the optimization and validation process in the simulation environment.

VTD consists of the components driving simulation, traffic simulation, visualization and sensor models, which supply the algorithms running in MATLAB/Simulink/Stateflow with the required sensor input data concerning the virtual vehicle environment.

This combination offers the possibility to easily implement a large variety of relevant traffic situations and environmental conditions in order to test, optimize and validate the predictive safety systems under repeatable conditions. Simulation data can be accessed via interfaces for an on-/offline data evaluation and visualisation by independent analysis applications. The complete simulation environment can be distributed over several computers connected via IP-network and executed in real-time or on the basis of a common simulation time.

The simulation environment was exemplarily used to test and optimize an anticipatory algorithm characterizing an imminent collision by the prediction of representative collision parameters. The testing was done on the basis of a huge pool of characteristic pre-crash-scenarios statistically representing the GIDAS database (German In-Depth Accident Study).