Development of a Vehicle Simulator for the Evaluation of a Novel Organic Control Unit Concept

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New challenges in the field of automotive systems (e.g. autonomous driving) require innovative and highly robust vehicle architectures. These are intended to increase the reliability and fault tolerance of the system and therefore realize the transition from *Fail-Save* to *Fail-Operational* behavior. Organic computing is a possible approach to achieve these goals. Based on an artificial hormone system and an artificial DNA, a novel organic concept for control units can be developed.

In this paper we introduce an evaluation tool for this novel organic control unit concept. Therefore, a simulator physically models the longitudinal and lateral dynamics of a vehicle. The parameters of the vehicle (weight and measures, engine and gear parameters, brake parameters, air and roll resistance, …) can be individually chosen. For an easy handling, visualization and reproducibility of experiments, an extensive user interface and a scripting language is designed. Also, batch processing is enabled by the introduction of command line parameters.

This simulator allows the evaluation of various automotive control components (ECUs) like antilock braking systems, traction control systems, power steering and cruise control. All input data like brake, throttle and steering positions can be given by the user interface or the scripting language. In addition, both input options can be used simultaneously in combination. The output values like brake force, wheel speed, vehicle speed, steering angles, etc. are visualized in the user interface, timestamped and written to a log file for detailed examination. Thereby, the user can chose which physical value is logged as well as the time resolution of the logging process. By fault injection, ECU failures at run-time can be induced at arbitrary times during a simulation run.

In the extensive evaluation runs of the usability of the vehicle simulator has been tested. Hereby, the data of a real vehicle have been used. It turned out that all demanded requirements are fulfilled and therefore the simulator can be used as an evaluation tool for the organic control unit concept.