Steer-by-Wire Test Bench

ETAS supports Stuttgart University

At the Chair of Automotive Mechatronics of the Institute for Combustion Engines and Automotive Technology (IVK), engineering students gained detailed insights into modern vehicle mechatronics by taking part in lab internships. One of the internship exercises consists of comparing the CAN (Controller Area Network) fieldbus with the better-performing FlexRay vehicle bus.

ETAS made it possible to put the steer-by-wire test bench into practice for FlexRay testing (shown schematically in the figure) by providing the ES520 and ES910/ES920 hardware modules, along with the ASCET and INTECRIO software tools.

Working principle

The series of experiments centered on the “steering”, “blinking”, and “honking” functions. Due to system constraints, exclusive communication of the sensor and control signals via FlexRay is not possible. That is why trigger signals from the steering wheel lever are first packaged in CAN messages through the C-Control II (CC2) microcontroller from Conrad Electronic. A “send” option for CAN messages is then integrated into the Takata Petri steering angle sensor (LWS). CAN messages from both sensors can be accessed via the signal lines of both communication buses. For example, this allows voltage differences to be detected with an oscilloscope, thus allowing for easy influencing as desired via software. Negative transmission ratios can be likewise selected, clearly illustrating how rear axle steering can be accomplished with steer-by-wire.

Lab internship

At the outset of the internship experiment, the hardware modules must be connected and the correct terminating resistors selected. Although communication via FlexRay can also function without terminating resistors, this disrupts communication via CAN due to line reflections – which can lead to steering failure. An ETAS ES520 FlexRay and CAN Module is additionally integrated into the network to analyze the bus signals with Multibus-Analyser. In addition to reading out individual message details – including identifiers, data length, payload data, transmission intervals, etc. – this makes it possible to specifically influence the CAN bus. The ES520 module is configured as sending node for this purpose. The continuous sending of high-priority “ID0” and “ID1” messages can drastically increase bus load and cause major delays in signal transmission.

Outlook

Susceptibility to errors and fail-safe operation are key issues in the automotive industry. Consequently, at this time the implementation of a “babbling idiot” – i.e., a node which continually sends erroneous messages – is being pursued in order to visually represent the error response of bus systems. The further increase in bus load resulting from the addition of nodes in the residual bus simulation represents another application scenario that is to be examined in the future within the scope of the lab internship.

Summary

The IVK’s steer-by-wire test bench provides students at Stuttgart University with a “hands-on” opportunity to explore the CAN and FlexRay bus systems. There they can gather initial experience with the hardware and software that is prevalent in the engineering departments of the automotive industry. Some 50 students per semester take part in the FlexRay lab internship. The “FlexRay” experiment series is offered in conjunction with the lecture “Embedded Controllers and Data Networks in Vehicles.” The lecture is an element of the “Automotive Mechatronics” major of the Chair of (Engineering) Professor Dr. H.C. Reuss, offered within Stuttgart University’s “Automotive and Engine Technology.” Master of Science academic program.