

Making cars more intelligent



FlexRay Demonstrator Steer-By-Wire

Recognized experts agree that *x-by-wire* systems will become increasingly important in future, specifically via FlexRay. In order to show the basic technologies and principles, ICT Software Engineering (ICT-SE) has built a FlexRay steer-by-wire demonstrator.



Customer

ICT-SE investment project

Brief

Build a *FlexRay* demonstrator for demonstration and reinforcement purposes and to support in-house training

Solution

For the steering wheel unit, a force feedback steering wheel was used that had been electrically adjusted. To realize the steering unit, an interactive servo motor with integrated position sensor was deployed.

To control the two subsystems and communications, two standard FlexRay base boards were used. Each of these boards is fitted with a Freescale PowerPC (MPC5567) with integrated FlexRay controller. This integrated FlexRay controller was used to control the two FlexRay channels (A and B). The actuators (motors) for the steering wheel unit and steering unit are controlled directly via the analogue outputs on the base board. The sensor signals were read directly via 12-bit A/D converters.

The system was realized without an operating system although it features simple but effective time slicing. Software modules for the steering wheel unit and the steering unit have an identical structure; they configure themselves independently from the hardware on start up. To control the motors, a PID controller algorithm was implemented.

Communication between the two subsystems takes place via two FlexRay channels. The cluster is configured as a dual ECU system with a slot in the static segment for communication from the steering wheel unit to the steering unit and a slot for communication between the steering unit and steering wheel unit for each channel. There are a total of 12 slots in the FlexRay cluster which provides potential for further add-ons in future.

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Principal configuration

Steering wheel unit

- Force feedback steering wheel
- PID controller (software realized)
- Position sensor: 12-bit A/D converter

FlexRay

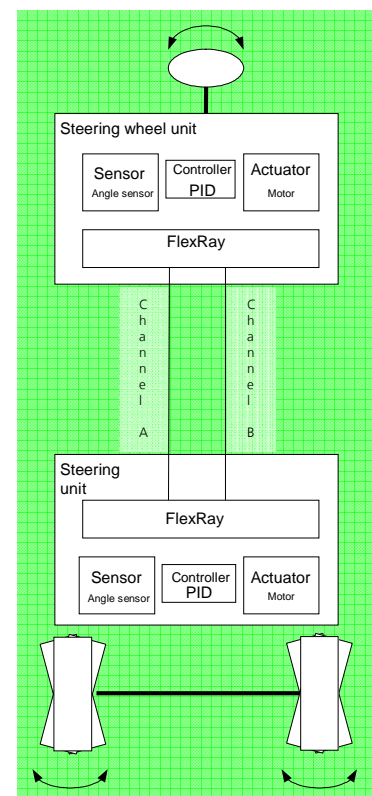
- Redundant 2-channel FlexRay communication
- Bus topology
- 2 channels
- 12 slots, of which 2 are in use
 - o Steering wheel unit -> steering unit
 - o Steering unit -> steering wheel unit
- 3 ms cycle

Steering unit

- Interactive servo motor from Lego Mindstorms
- PID controller (software realized)
- Position sensor: 12-bit A/D converter

General

- Use of a developer board from TZM/Eberspächer
 - o Freescale MPC5567 controller
 - o 120 MHz PLL frequency



Technologies

- ▶ Microcontroller programming in C
- ▶ FlexRay, DENoe.FlexRay

Customer benefits

- ▶ Know-how associated with the FlexRay demonstrator
- ▶ Evaluation of hardware and tool landscape

ICT-SE's contribution

- ▶ Commissioning of FlexDevel boards
- ▶ Implementation of steer-by-wire functions
- ▶ Implementation of gateway functions
- ▶ Integration of FlexRay, CAN, MOST bus systems
- ▶ Testing and analysis
- ▶ Microcontroller programming in C