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The future of driving.

Deliverable D33.2
Preliminary concept on optimum task repartition for HAVEit systems

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Authors

Frank Flemisch, DLR

Anna Schieben, DLR

Gerald Temme, DLR

Nadja Rauch, WIVW

Matthias Heesen, DLR

With contributions from:

Erika Jakobsson, VTEC

Johan Jarlengrip, VTEC

Arne Bartels, VW

Ina Petermann, VW

Holger Zeng, Conti

Martin Pellkofer, Conti

Waldemar Schrinner, Conti

Project Managers

Prof. Dr. Alfred Hoess
Continental Automotive GmbH
Siemensstrasse 12
93055 Regensburg, Germany
Phone +49 941 790 5786
Telefax +49 941 790 99 5786
E-mail: Alfred.Hoess-EXT@continental-corporation.com

Holger Zeng
Continental Automotive GmbH
Siemensstrasse 12
93055 Regensburg, Germany
Phone +49 941 790 92330
Fax. +49 941 790 99 92330
E-mail: holger.zeng@continental-corporation.com

Project Co-ordinator

Dr. Reiner Hoeger
Continental Automotive GmbH
Siemensstrasse 12
93055 Regensburg, Germany
Phone +49 941 790 3673
Fax +49 941 790 13 3673
E-mail reiner.hoeger@continental-corporation.com

Executive summary

HAVEit Deliverable D33.2 “Preliminary concept of optimum task repartition” gives an intermediate report on the automation behaviour and interaction design of highly automated vehicles within the EU project HAVEit. In contrast to fully automated driving, where the human is only a passenger, in highly automated driving a high percentage of the driving can be performed by an automation (called the co-system), but the human is still a driver who is in control of the highly automated vehicle. This distribution of the driving task between driver and co-system is not a static, but a dynamic repartition, where driver and co-system can find an optimum balance depending on the situation. Both the driver and the co-system can influence this balance: The driver e.g. by switching to a higher or lower level of automation, the co-system e.g. by recommendation or, in urgent occasions of overload or underload situations, by escalating towards a transition. This optimum task repartition is accomplished with a set of interaction schemes and with a concrete design of interaction between driver and co-system via a primary driving interface, switching and display devices.

The background of the optimum task repartition function allocation, adaptive and adaptable automation, and the extension these concepts towards a new research direction of shared and cooperative control. The concept of optimum task repartition based on an assessment of the driver’s state and/or the environmental situation is linked to the concept of transitions between automation levels.

The design space and the basic design decisions of the HAVEit task repartition start with the levels of automation. General design schemes for an optimum task repartition are:

- A scheme of discrete levels of automation on a assistance/automation scale/spectrum, with a compatibility demand between spectrum, switching device and display.
- An asymmetric function allocation scheme “Driver guides/co-system controls”.
- A layered scheme for transitions, with 4 layers that can be used on top of each other starting with a conservative layer expanding to more future oriented layers.
- An escalation/de-escalation scheme for automation/co-system initiated transitions.
- A scheme of interlocked transitions for safe de-/activation of automation levels.

As an example for the preliminary concept of task repartition, the automation level and transition design, and the implementation design for the Mode Selection and Arbitration Unit (MSU) of the HAVEit Joint System demonstrator are described in more detail.

The primary driving interface and other interface components are described, at first in general, then with concrete design decisions with a set of predefined display components. The design of interaction between co-system and driver is described for every use-case, based on the HAVEit use case catalogue defined in deliverable D33.1. The interaction is described in form of automation - interaction sequence diagrams (based on UML sequence diagrams), where the traffic situation is sketched together with the flow of information between the individual subsystems of the joint system “driver / co-system”. Finally, the next steps to bring this preliminary design to a final design and demonstrators are discussed.

HAVEit is a cutting edge research project: The development of the HAVEit optimum task repartition is not a linear, “waterfall”-like process as used in the serial development, but an iterative process of preliminary design, design variations, tests and variant selection, as sketched e.g. in the Prevent Code of Practice. We are quite confident about the concepts and design described here, but: Design is a hypothesis that has yet to be proofed. Parts of the preliminary concept described in this deliverable might and will have to be changed based on the findings of future tests and experiments.

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