Ko-HAF – Safety by Cooperation

Dr. Andree Hohm, Project Coordinator Ko-HAF, Continental Teves AG & Co. oHG
Individual Mobility?  
An Enormous Success Model!

Carl Benz  
Motorwagen  
1886

1900  
9,500  
Vehicles

2018  
1,270,878,000  
Vehicles
Individual Mobility?
Successful Model in Danger?

PRO
Driving pleasure
Privacy
Freedom

CONS
Environment
Boredom
Loss of time
Stress
Accidents

Driving pleasure can lead to privacy and freedom, but it also poses risks such as accidents and stress. The balance between the benefits and drawbacks needs to be considered.
Individual Mobility?
Successful Model in Danger?
Automated Driving
A Solution for many Challenges

More Safety
More Efficiency
More Comfort
More Mobility for everyone
Automated Driving
Two Ways to Success!
# Automated Driving Classification

<table>
<thead>
<tr>
<th>Driver</th>
<th>Vehicle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only the driver</td>
<td>No interfering vehicle system</td>
<td>The system can manage any situation automatically / No driver necessary</td>
</tr>
<tr>
<td>Assisted</td>
<td>The system takes over the other function</td>
<td>The system can manage any situation automatically in specific application</td>
</tr>
<tr>
<td>Partly automated</td>
<td>Longitudinal and lateral guide in special application</td>
<td>The system can manage any situation automatically in specific application</td>
</tr>
<tr>
<td>Highly automated</td>
<td>Longitudinal and lateral guide in specific application, Detects system limits (\rightarrow) Take-over command with safety time</td>
<td></td>
</tr>
<tr>
<td>Fully automated</td>
<td>No permanent monitoring / driver prepared to take over</td>
<td>The system can manage any situation automatically in specific application</td>
</tr>
<tr>
<td>Driver-less</td>
<td>No driver necessary in specific application</td>
<td>Only the driver</td>
</tr>
</tbody>
</table>

Source: Verband der Automobilindustrie e. V. (VDA)
## Ko-HAF

### Underlying data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Project duration</strong></td>
<td>06/2015 – 11/2018</td>
</tr>
<tr>
<td>Specification and concept phase</td>
<td>– 05/2016</td>
</tr>
<tr>
<td>Development / implementation of the interaction between the safety server (back-end) and the vehicle (front-end)</td>
<td>– 05/2017</td>
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<tr>
<td>Implementation of the Ko-HAF function for normal and emergency operation</td>
<td>– 02/2018</td>
</tr>
<tr>
<td>Trial phase</td>
<td>– 11/2018</td>
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<tr>
<td><strong>Overall volume</strong></td>
<td>36.3 M€</td>
</tr>
<tr>
<td><strong>Funds from the German Ministry for Economic Affairs and Energy (BMWi)</strong></td>
<td>16.9 M€</td>
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</table>
### Ko-HAF

#### Most efficient partners

<table>
<thead>
<tr>
<th>OEM</th>
<th>Suppliers</th>
<th>Small and medium-sized companies</th>
<th>Public institutions</th>
<th>Research organisations</th>
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<tbody>
<tr>
<td>Opel</td>
<td><strong>Bosch</strong> Technik fürs Leben</td>
<td>3D Mapping Solutions</td>
<td>bast</td>
<td>IZVW</td>
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<tr>
<td>Audi</td>
<td><strong>Continental</strong></td>
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<td>Hessen</td>
<td>Technische Universität Braunschweig</td>
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<td>BMW Group</td>
<td><strong>Visteon</strong></td>
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<td>TUM</td>
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<tr>
<td>Daimler</td>
<td></td>
<td></td>
<td></td>
<td>FORWISS</td>
</tr>
</tbody>
</table>

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Ko-HAF

What have we set ourselves?

Ko-HAF aims at the **highly automated driving of the second generation**, this means

- **Turn away** from the task of driving  
  Ko-HAF contribution: *You can use your time in the car at will!*

- **At speeds of up to 130 km/h**  
  Ko-HAF contribution: *You drive relaxed and safe on highways!*

- **Availability in extraordinary situations** and in complex highway scenarios  
  Ko-HAF contribution: *You do not have to take over yourself all the time!*
Highly Automation in Ko-HAF
Big Challenges

Sensor technology and environment modelling

- It suddenly becomes **necessary that the driver takes over** (e.g. road marking ends, very complex course of the road at construction sites, ...)
- At 130 km/h and a 10 seconds advance warning, a situation at a distance of **over 350 m must be perceived** in order to warn the driver **in time** that he will have to take over.
- On-board environment sensors that will be available in the foreseeable future **do not provide this capacity**!

**How can the car detect critical situations safely and in time?**
Validating and securing

- How do we test highly automated driving?
- Securing expenses increase with increasing system complexity. Automated vehicles are very complex!
- How do we get a representative overview of possible hazardous situations (field tests, extended accident analyses)?
- How do we test technologies at their limits?

How do we ensure that the automated vehicle operates safely in all situations and "passes the driving test"?
Highly Automation in Ko-HAF
Big Challenges

Human

- What is the driver’s role?
- Integration and Validation of non driving related activities
- Concept and design of transitions

How can man and machine share driving harmoniously and clearly?
High Automation in Ko-HAF
Benefits of Swarm Knowledge
Ko-HAF
Our Project Structure

AP1
Detection & representation of the environment in the Safety Server

AP2
Localisation and static environment model

AP3
Cooperative driving and controllable automation

AP4
Function development for normal and emergency operation

AP5
Validation and Test
Ko-HAF Workpackage 1
The Safety Server

- Increase of the anticipation exceeding the range of sensors existing today by collective perception
- The prototypical back-end service Safety Server combines the heterogenous landscape of the test cars.
- Cars and external data sources provide more up-to-date data than ever before
- Precise maps thus become up-to-date maps
Ko-HAF Workpackage 2

Interface to the Car

- Transmission of environment data to a central back-end
- High-precision localisation with a robust availability
- Fusion of the sensor-based environment model with back-end data

AP2
Localisation and static environment model
Ko-HAF Workpackage 3

Man uses Function in the Car

- Specifications of the test scenarios and aspects of the man-machine interaction
- Modelling the driver availability and vigilance
- Investigation of automation effects
- Transition concepts optimised for HAD
- Recommendations for methods and interaction concepts
Ko-HAF Workpackage 4

The computer that controls the car

AP4
Function development for normal and emergency operation

- Environment modelling and situation analysis
- Development of highly automated driving functions
- Anticipatory reaction to danger points
- Transition into a minimal risk state
Ko-HAF Workpackage 5

The Functions are tested

- Test methods for testing automated driving functions
- Setup of virtual trial test environment (HW/SW)
- Setup of test tools for reality trials
- Trial testing new highly automated driving functions

AP5 Validation and Test
Conclusion / Expected innovations

- **Collective perception** by means of a communication among the vehicles and the safety server (back-end) → extended perception of the environment
- **Collection of data** in the vehicle including auto-localisation and interaction with the safety server
- **Gapless transition** between normal operation and active safety functions and between different automation levels
- **Transfer into the safe state** (emergency operation), e.g. in case of a driver blackout (no reaction to the take-over command)
- **Experimental joint trial testing** of the HAD functions on highways in mixed public traffic
- **Development of test and evaluation methods** for highly automated systems
Ko-HAF Experience the Results
In Cars and in Discussions
Stay in Contact

Project coordination

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- Continental Teves AG & Co. oHG Frankfurt
- koordinator@ko-haf.de
Thank you for your attention!

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