HIGHLY-AUTOMATED DRIVING – STATE OF THE ART AND FUTURE CHALLENGES

HIGHLY-AUTOMATED DRIVING – STATE OF THE ART AND FUTURE CHALLENGES.

- Highly-Automated Driving.
- Classification of Automated Driving Functions.
- Legal and Socio-Economic Issues.
- Future Challenges.
- Conclusion.
THE BMW TRACKTRAINER – BACKGROUND.

Idea: intuitive learning of the ideal line on race tracks. BMW driver training tool.

Used on the following racetracks: Nürburgring, Zandvoort, Valencia, Hockenheimring, Lausitzring

First highly automated lap on the Nordschleife on 21.10.2009:
- Extreme conditions for the vehicle dynamics controller and localization technology
- Character of a rural road
THE BMW TRACKTRAINER – TECHNOLOGY.

- High-precision GPS-system
- Camera based „lane“ detection
- High-precision digital map
- Vehicle dynamics sensors

cm-precise, redundant and highly available localization

Highly-automated driveable area of Nordschleife
FROM RACE TRACKS TO PUBLIC HIGHWAYS.
THE EMERGENCY STOP ASSISTANT.

Incapacitated driver detected

Take over control of the vehicle

Safely move the vehicle to a secure location

Immediate notification of emergency services
THE „AUTOBAHN“-PILOT – A RESEARCH STUDY.
TRAFFIC JAM ASSISTANT – BMW I3 CONCEPT.

Traffic Jam Assistant

Combination of Active Cruise Control and steering assistance
Das Auto der Zukunft braucht keinen Fahrer mehr. Sind Sie dafür?

1504 Stimmen wurden abgegeben.

| Nein, nicht mit mir. Ich lasse mir den Spaß nicht nehmen und fahre weiter selbst. | 33% | No |
| Ja, find ich gut. Endlich kann ich die Zeit im Auto sinnvoll nutzen. | 67% | Yes |

Quelle: http://www.faz.net/ (Dec. 2011)

IHRE MEINUNG ZÄHLT!

| 54% Ich wäre begeistert, sollte sich diese Technik durchsetzen. |
| 21% Ich bin zumindest sicher, dass es das bald gibt. |
| 19% Ich glaube nicht, dass so etwas einmal flächendeckend eingesetzt wird. |
| 6% Auf keinen Fall sollte es das geben! |

127 abgegebene Stimmen

Quelle: http://www.sueddeutsche.de/digital (Juli 2011)
CLASSIFICATION OF AUTOMATED DRIVING FUNCTIONS (COMP. BAST-WORKING GROUP).

- **Driver conducts longitudinal and lateral vehicle control**
- **Driver conducts longitudinal or lateral control**
- **Driver has to supervise the system constantly**
- **Driver does not have to supervise the system; he takes over control if necessary**
- **Vehicle takes over longitudinal and lateral control in defined use cases without any supervision by the driver.**

<table>
<thead>
<tr>
<th>Degree of automated driving function</th>
<th>Full automation</th>
<th>No automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver only</td>
<td>No intervening vehicle system is active</td>
<td>Driver conducts longitudinal and lateral vehicle control</td>
</tr>
<tr>
<td>Assisted</td>
<td>Vehicle takes over the complementary control tasks</td>
<td>Driver conducts longitudinal or lateral control</td>
</tr>
<tr>
<td>Partially-automated</td>
<td>Vehicle takes over longitudinal and lateral control (for specific times and/or in specific situations)</td>
<td>Driver has to supervise the system constantly</td>
</tr>
<tr>
<td>Highley-automated</td>
<td>Vehicle takes over longitudinal and lateral control (for specific time or in specific situations); sufficient time for takeover by the driver. All system limitations are detected by the system.</td>
<td>Driver does not have to supervise the system; he takes over control if necessary</td>
</tr>
<tr>
<td>Fully-automated</td>
<td>Vehicle takes over longitudinal and lateral control in defined use cases without any supervision by the driver.</td>
<td></td>
</tr>
</tbody>
</table>
RESPONSIBILITY ISSUES – TODAY’S VIEW.

Specific Infrastructure?

- yes
  - Ok.
  - Specific Lanes, driver is not in control.

- no
  - Driver is active (in the loop)?
    - yes
      - Driver has the „main“ responsibility
    - no
      - Who has the „main“ responsibility?

- Assisted

- Partially-automated Driver in the control loop

- Highly-automated
  - Limited to technically-controllable use cases
  - „100%“ free of failures

- Fully-automated
The car delivers the same "overall performance" as a "perfect" driver.

The car delivers "statistically" better performance than the "average" driver.
CHALLENGES OF HIGHLY-AUTOMATED DRIVING.

- Discussion of legal issues (regulation, registration, liability)
- Evaluation of socio-economic benefits
- Driver: Understanding and acceptance of new ways to interact with the car
- Discussion of scenarios to introduce highly-automated driving („mixed mode“)
- Technological improvements (sensors, data fusion, reliability of components,....)
- New methods for testing (e.g. controllability)

ITFVHA, Helmer, October 2012
CONCLUSION – HIGHLY-AUTOMATED DRIVING.

• Significant technical prerequisites achieved by numerous research projects.
• Dialogue between authorities and OEMs has already been initiated.
• Increasing awareness and acceptance by the customers.
THANK YOU FOR YOUR ATTENTION.