Outline

• From assistance systems to automated driving systems
  • Research activities
  • Challenges
  • Deployment issues

• The interactIVe outcomes
  • Objectives and automation areas
  • Lessons learned

• Automated driving in AdaptIVe
Automated driving | research activities

Input sources

- Sensors: radar (short/long range), camera (mono-, stereo-), laser scanner, ultrasonic, INU
- Digital maps
- Wireless communication (V2I, V2V)
Automated driving | European projects

- active interventions
- continuous support
- transitions among automation levels (user in the loop)
- cooperative support of neighbouring vehicles
- cooperative support of the infrastructure

...level of automation is set dynamically
...resilient to different types of system and human failure
Automated driving | challenges

**Real-time environment perception**
- **reliability** of sensing has to be quantified;
- reliability has to be **improved** for real life conditions (e.g. adverse weather conditions + complex traffic scenarios);

**Automation control strategies**
- Up to now focus on longitudinal control; **Lateral control** systems are predominantly advisory
- Complex use cases like **overtaking**, **lane merging** and **crossroad entering/exiting** need more investigation

**Human factors**
- Driver becomes a **supervisor** of a system instead of a **manual controller** of the vehicle
- In partial and high automation, a capable driver is still required to **resume manual control**
- Profound insight is needed into the **determinants** of the quality of the **interaction of the driver with the automated vehicle**
- Most knowledge in relation to driver behavior is based on **driving simulator studies** and not **real traffic conditions**;
Automated driving | deployment issues

- Legal and regulatory framework that implies that the driver must always be in full control of the vehicle.
- High cost of the sensors required for the full environmental perception.
- Immature testing and evaluation in unconstrained real conditions.

*Geneva Convention on Road Traffic requires every vehicle to “have a driver” who is “at all times...able to control it”---A recent amendment has been made this year by the U.N. Working Party on Road Traffic Safety which would allow a vehicle to indeed drive itself, as long as the system "can be overridden or switched off by the driver".*
Active intervention poses “hard” real-time requirements for application data processing & sensor fusion modules

- Design of a unified perception framework for multiple safety applications
  - Different sensor types and products attached based on the plug-in concept
- Advance research on path control algorithms for active collision avoidance and mitigation
- Advance research on IWI strategies: intervention transition modes
• integration of longitudinal and lateral support functions
• in a continuous and coherent way: warning, advice, support, temporary automatic vehicle control for collision avoidance
- Oncoming vehicle collision avoidance / mitigation
- Side impact avoidance (depicted above):
  - Lane Change Collision avoidance
  - Rear end collision avoidance
  - Run off road prevention (curve)
- Automated emergency braking
- Emergency Steer Assist

**Partial + conditional automation (SAE)**

- Assisted mode: adapts its speed automatically to the curve radius ahead.
- Achieve: optimized point of impact--
  Any braking and/or steering intervention of the function can be overridden by the driver.

- Soft feedback on the steering wheel is provided supported by corrective steering.

- Auto-braking+
  Evasive maneuer
• **IWI strategies provide**
  • sequence of interaction
  • automation scale
  ...which allow the integration of a high number of ADAS

• **Tests on System – User shared control**
  concept in highway, rural and urban environments with emphasis on haptic feedback

• **Legal aspects study**
  • vehicle type-approval for interactive functions according to relevant UN ECE
  • legal framework on EU-level
Often drivers start a reflexive reaction by counteracting the intervention to some extent:

- Active interventions, especially when steering and braking are combined, requires further investigations with a larger set of subjects and situations.
- The drivers should be allowed to overrule the functions. Which strategy is best depends on the function.
- IWI strategies should ensure a smooth transition with regard to the different levels of human and system control. It appears convenient to group automation functions into modes of increasing degree of automation, as well as to the type of support and direction.
lessons learned (2/2)

- Obtain near real time performance
  - **Real time OS + object-level fusion** (need for new sensors)
- Extensive evaluation of RunOfRoadPrevention
  - **Need for** common groundtruth data such as **road edge annotations**
- Longitudinal and lateral **optimal control models** for understanding driver’s intentions can proliferate from **cognitive science based driver models**
- A very high reliability is needed for the **lane change manoeuvre** to ensure that the adjacent lane is free. Also, more efforts are needed to improve the **estimate of the vehicle position**, e.g. by implementing all the available signals and fully exploiting the **GNSS techniques**
Supervised automated driving deployed into assistance, partial, conditional and high automation

- advanced parking applications;
- stop&go functionality in high traffic/slow speeds

Full automation will be studied for special situations:

- return to a minimal risk condition;

Controlled and graceful degradation from high to partial automation and from partial automation to driver assistance will be exploited as a strategy to manage complex scenarios in a robust and safe way.
New features

• suited for **mixed traffic**
• **real world** complex environments
• provide **adaptive support** based on the driving task demand (bidirectional V2V also included)
• **design “take over requests”** based on system and driver state

→ ...design and develop solutions for the automation of vehicles that will become **deployable in a short to medium time frame** in new vehicle models
Thank you!