Enhancements of Future Driver Assistance Systems

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A modern car is full of sensors (and actuators)

Intelligent Vehicles

Enhancements of Future Driver Assistance Systems > Strang, Röckl et al. > ESNC 2010
Advanced Driver Assistance Systems (ADAS) 
*increasing safety, efficiency and comfort*

- ADAS are systems that support the driver in her/his task of driving a vehicle in order to increase safety, efficiency and comfort
- Detection of situational parameters by sensors and, if necessary, performance of appropriate measures by actuators:
  - Sensors: Devices that measure a physical quantity and convert it to a readable signal (e.g. odometer, thermometer, yaw rate sensor)
  - Actuators: Devices that transform a signal into an action in order to perform a certain effect (e.g. brake, steering column, HMI)
- Examples:
  - Electronic Stability Control (ESC)
  - Adaptive Cruise Control (ACC)
  - Lane Departure Warning (LDW)
  - …

[ACC by Delphi]
[visual LDW]
Cooperative Systems

Cooperation mandates Communications

Intelligent Transportation Systems build upon robust and reliable communications
Interconnected Vehicles

Extending “sensor range” through communications:

- Beyond autonomous sensor range
- Beyond the driver’s visual range
- With enriched details and quality

Creation of an “Information Horizon”

- The right information in the right situation to the driver
- Extends safety time margin
- Extends beyond the physical horizon

[Based upon image from PreDrive_C2X consortium]
Vehicular Communications
Communication between …

- Vehicles
  - Cars
  - Trucks
  - Buses
  - Motorcycles
  - optional: trains, trams, pedestrians, etc.

- Infrastructure and vehicle:
  - Road-side Units (RSUs): variable message signs (VMS), traffic light signals (TLS), portable infrastructure (intelligent cones), …
  - Broadcast systems: Digital Video/Audio Broadcast (DVB/DAB), RDS-TMC, TPEG, …
  - Cellular network infrastructure: GSM/UMTS/LTE, WiMAX, …
Driver Assistance Systems
Preventive vs. Active vs. Passive safety

Preventive and Active Safety
- Information
  - Foresighted driving
- Support
  - Warning & assistance systems
- Intervention
  - Active vehicle control

Passive Safety
- Crash
  - Safety systems
  - Rescue systems & services

Applications
- Traffic information
- Hazard warning
- Stop sign violation
- Lane merging
- Emergency braking
- Adaptive cruise control
- Emergency vehicle clearing
- Materials (energy absorption)
- eCall

Capability
- Car to Car Communication
- Cellular Communication

(Adapted from: Car-to-Car Communication Consortium)
Car-to-Car Communications
Use cases

- **Safety:**
  - Traffic Jam Ahead Warning
  - Curve Speed Warning
  - Intersection Assistance
  - Black Spot Warning

- **Efficiency:**
  - Decentralized Floating Car Data
  - Optimal Speed Advisory

- **Infotainment:**
  - Access Control
  - Point-of-Interest Notification

More than 120 potential use cases have already been identified, about 5 of them do **not** require SatNav, many require **precise** positioning.
Next Generation Driver Assistance Systems

Example: Cooperative Adaptive Cruise Control (CACC)

- Automatic longitudinal gap keeping assistant based on V2V Communication
- Exchange of speed, heading, position, brake/acceleration action, vehicle type, etc.

+ Improved safety (timely & reliable reaction)
+ Improved traffic efficiency (closer safe gaps)
+ Improved comfort (less unnecessary deceleration)
+ Improved energy and material usage (e.g. use of engine brake or recuperator instead of service brake)
CACC: Ranging accuracy

Distance (between ego & target vehicle) error

No radar line-of-sight

Sensor fusion reduces distance inaccuracy by ~40% and ~80% respectively
Car-to-Car Communication Consortium
Dudenhofen Demo in October 2008

Objectives where to show…

- **functionality** of CAR 2 CAR Communication Consortium system with 4 selected use cases
  - Warning of road works
  - Emergency vehicle
  - Broken down vehicle
  - Motorcycle use case / intersection scenario

- **interoperability** between different comm. platforms
  - 9 vehicle manufacturers
    (Opel, BMW, Daimler, Volvo, Renault, Fiat, Volkswagen, Audi, Honda, …)
  - 4 communication supplies
    (NEC, Hitachi / Renesas, Delphi, Denso)
  - 1 after market supplier
    (Alpine)

- **impact** of vehicle-to-x communication to press, managers and VIPs, and researchers from the research field
Why position accuracy does matter...

- Data from the Dudenhofen Demo in Oktober 2008
- No „ground truth“ available, but...

Vehicle A

Vehicle B
Thank you
for your attention!

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The DLR

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Key areas
- Aeronautics
- Space
- Space Agency
- **Transport** today’s topic
- Energy