DNA for Automated Driving

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A Driverless Car Developer’s World in 2017

Items to specify: 24

1999: Mercedes S-Class Distronic
2002: VW Phaeton ACC
2005: Mercedes S-Class Distronic plus
2006: Audi Q7 ACC plus / AEB
2010: Audi A8 GPS-guided ACC
2013: Mercedes S-Class Dist.+ / Steering Assistant
2015: Audi Q7 Traffic Jam Assistant

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DNA for Automated Driving

What helps? Sensor Data Fusion

**Interactions:** $n + m + k$

for $n$ sensors, $m$ functions, $k$ abstraction components
What helps? Architecture Is Key To Managing Complexity
Software Framework for ADAS and Automated Driving

**Interfaces for**
- Interoceptive sensors – wheel ticks, steering angle, accelerometers / gyros
- „Smart“ environment sensors – point clouds, object lists
- ADASISv2/3 for map, SENSORIS for cloud

**Integrated safety concept**
- System health monitoring and diagnosis
- Safe-state triggering
- Options for redundant environment model and functions (e.g. minimal risk)

**Interfaces for**
- Kinematic vehicle components
- Instrument cluster
- Infotainment display

[www.open-robinos.com](http://www.open-robinos.com)
Standardized Interfaces

Every software component has
• scalable, documented and standardized interfaces to other components
• exchangeable interfaces to the base system / OS
• a pre-industrialized algorithm core
A Modular Software Framework Enables You to...

Map onto concrete ECU architecture

Ensure differentiation, shorten time to market

EB modules | Your modules | 3rd-party modules

Upgrade across models / Upgrade over time

NCAP

HAD

DNA for Automated Driving

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Application example: Automated Valet Parking
Application example: Automated Valet Parking from one to another one
Software framework in action
What about maps?

Range of ego sensors are limited

- Reduce speed in advance before sign is reached
- Warn driver in time before autonomous driving road ends so that he can take back control

Recognition algorithms are limited

- E.g. truck hides speed sign
- E.g. weather conditions for recognition of a traffic sign
- Accuracy of a recognized sign can be improved by multiple observations

Not all information needed can be derived from sensor observations

- Which country / states specific traffic rules apply to the vehicle in its current position? E.g. left hand driving vs. right hand driving (safety critical!!)
Sensor-based Learning for Predictive Driving

1. Collect sensor data
   - Secure connection and transfer

2. Sensor learning
   - Data aggregation
   - Map matching
   - Sensor fusion

3. Incremental NDS Compilation
   - Enriched map updates on daily basis

4. Incremental Map Update Service
   - Delta maps

5. Consumer experience
   - Always up to date electronic horizon for ADAS functions
How sensor data is collected and sent

Image processing

• Objects form camera recognition modules

• Create 2.5D maps of the road

• Algorithms for feature extraction:
  – image processing
  – machine learning

• Objects that can be extracted:
  – lane markings
  – lane Geometry
  – road boundaries
  – lane arrows
  – traffic signs
How sensor data is collected and sent

Top View

Height Map
Example: Zebra crossing recognition on 2.5D maps
How to learn from sensor data and enrich maps

Data processing

• Data cleanup
  – Incoming data is validated regarding location and timestamp
  – Wrong movement profiles (e.g. ferries or trains) are discarded

• Data aggregation
  – Collected data is aggregated into clusters to ensure reliability
  – Clusters are matched on a recent map
  – User data is anonymized to ensure privacy
Example: Zebra crossing in the Cloud
Maps boost ADAS and Automated Driving
DNA for Automated Driving and NVIDIA

EB assist ADTF

EB robinos

DNA for automated driving

Rapid prototyping
C, C++, Model based
PC

Rapid embedding
C, C++
Evaluation hardware

Automotive grade software

EB tresos

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Join the community!

**EB robinos**

- implements the **open robinos** specification
- provides software modules
  - for prototyping in EB Assist ADTF
  - for rapid embedding on AUTOSAR / DRIVE PX
  - for production on vehicle ECU
- developed, tested, verified according to functional safety standards

**Open robinos**

- specifies a **reference platform** for automated driving up to Level 5 (SAE)
  - architecture
  - interfaces
  - data flow
  - control mechanisms
  - software modules
  - functional safety aspects
- **freely available** and licensed as Creative Commons
- **Available for download**

Download the open robinos specification

[www.try-eb-robinos.com](http://www.try-eb-robinos.com)

[www.open-robinos.com](http://www.open-robinos.com)
Conclusion

The problem is not difficulty but complexity.

Software frameworks and functional architectures help solve it.

EB robinos is a software framework for automated driving, applicable across car lines and models – it is DNA for automated driving.
Positioning (robinos, ground truth)

Automated Valet Parking

Automated Highway Driving

Electronic Horizon

Thank you!

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