EB Assist Robos
A Standard Architecture for Driving Automation

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Agenda

• Complexity for ADAS development
• EB Assist Robos:
  A Standard Architecture for Driving Automation
  – Architecture
  – Example Robos modules
  – Application
• Applying and extending EB’s Software Factory for Robos
• Conclusion
An ADAS Developer’s World in 2002.

Items to specify: 4.
A Driverless Car Developer’s World in 2015.

Items to Specify

- Radar
- Steering Wheel Sensors
- Motor Speed Control
- Head Unit
- Camera
- LIDAR
- Sonar
- Wheel Speeds
- IMU / Gyro
- Global Position Maps
- Brake Pressure
- Steering Angle
- Regenerative Braking
- Moving objects
- Static obstacles
- Lanes
- Vehicle ego motion
- Signs
- Side Tasks
- Trajectory planning & control
- Functional safety
- Fail-safe / -degraded mechanisms
- Redundancies
- Power and Data Grids

Items to specify: 25.
Strategies Against The Complexity Explosion

Sensors

Functions

Actuators

Standard Abstractions

World View

Behaviors

Motion Manager

Sensor Data Fusion
Vehicle Motion Management
Multi-Function Arbitration
A Standard Architecture For Driver Assistance

- Sensors
  - World View
  - Behaviors
  - Motion Manager

- Actors
  - HMI
  - Motors
  - Braking System
  - Steering System

- Functional Safety, Safety In Use

- Tools

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A Standard Architecture For Driver Assistance

EB Assist Robos: A Standard Architecture for Driving Automation

Situation and Decision Framework

Functions

- SIT = Situation Interpretation
- TPL = Trajectory Planning

Motion Manager

- Traject. Control
- Longitudinal Control
- Lateral Control

Motion SW Services

Functional Error Management

Safety Supervisor

Sensors
- Sensor Data Fusion
  - Ego Fus.
  - Obj. Fus.
  - Grid Fus.
  - Lane Fus.
  - Sign Fus.

Function Specific Views

EB sensor cloud

Electronic Horizon

Perception SW Services

EB sensor cloud

HMI

Motors

Braking System

Steering System

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Component Example: Ego Fusion

- **Positioning**
  - **Single Source of truth**
  - **Map Matching**
    - **Map Pos**
      - **Global COS**
        - **Localisation**
          - **Calib**
            - **Delta Local COS**
              - **EgoMotion-Estimation**
                - **exterceptive**
                  - **Delta Local COS**
                    - **EgoMotion-Estimation**
                      - **interoceptive**

- **Map**
  - **Positioning Single Source of truth**
    - **Map Matching**
      - **Map Pos**
        - **Global COS**
          - **Localisation**
            - **Calib**
              - **Delta Local COS**
                - **EgoMotion-Estimation**
                  - **exterceptive**
                    - **Delta Local COS**
                      - **EgoMotion-Estimation**
                        - **interoceptive**

- **GPS**
  - **Calib**
    - **LandMarks**
      - **Camera, ...**
        - **Laser**
          - **Gyro**
            - **Odometry**
              - **Steering Sens**
                - **...**

- **(d, \dot{d}, \ddot{d}, \alpha, \dot{\alpha})**
  - **+** position matched to semantic map information
  - **+** error accumulation over time capped to GPS accuracy
  - **-** low functional safety
  - **+** high functional safety
  - **+** high frequency
  - **-** error accumulation over time still uncapped
  - **+** very high functional safety
  - **+** very high frequency
  - **-** high error accumulation over time
Component Example: Grid Fusion

- Independent of object shapes
- Models free space and occupied space
- Ideal for path planning
- Can be used as redundancy component together with object fusion to increase functional safety level
Component Example: Grid Fusion
Component Example: Trajectory Planner

- Find the optimal, collision-free trajectory between car pose and target pose
- Rapid re-planning to deal with dynamic obstacles
- If configured, handle direction changes and manoeuvring
EB Assist robos can be mapped to your system.

- Although integration into a central ECU is easier, it is not strictly necessary.
- **EB Assist robos** can run on a distributed system of ECUs. All components have scalable interfaces mapped to CAN, FlexRay, Automotive Ethernet or high-speed on-board buses.
- EB Consulting and Engineering services will help you choose the right solution for your existing systems architecture and work on migration strategies.
EB Assist robos scales with your Application.

- **EB Assist robos** is built on the concept of modularity.
- Components can be added or removed depending on your need.
- Component re-use minimizes development, application and testing effort.
- Mechanisms for OTA Upgrade are currently in development.
**EB Assist robos** is ready for Embedded.

- **EB Assist robos** is 100% ready for embedded and safety-relevant applications.
- New components can be rapid-prototyped on PC and run in an environment of AutoSAR-tested partner components.
**EB Assist robos** talks to the cloud.

- **EB Assist robos** is ready to connect to a rich cloud service: **EB sensor cloud**.
- The cloud provides up-to-date information for traffic, road hazards, signs, or other data (it’s extendable!)
- The cloud runs on a highly redundant, scalable backend cluster.
- Adherence to Functional Safety principles is certified, of course.
- Likewise, data protection and privacy are guaranteed.
EB Platform for Autonomous Driving

EB p@d

Elektrobit
Bringing R&D software to production

Research & Development in the lab → **EB Automotive Software Factory** → Production – on the road

- Rapid prototyping C, C++, Model Based
- Rapid embedding C, C++
- Automotive Grade Software

PB Assist Robos

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Platform for autonomous driving combines powerful computing with safety-critical software to enable the advanced driver assistance systems necessary for self-driving vehicles.

- **EB Assist Robos**
  - Application-Layer Architecture and software components for automated driving development
  - Rich abstraction for ADAS tasks like fusion, planning, control, multi-function coordination, and functional safety

- **EB tresos**
  - Full Autosar basic software and safety products on safety µC
  - RTE on Linux on high-performance µC
  - OS-to-OS communication via Ethernet + SPI (planned)

- **Hardware** (NVIDIA Drive PX)
  - 2 NVIDIA Tegra X1 (RT Linux)
  - 1 Infineon Aurix (EB ACG 7.3)

- **Scope**
  - Generic platform for ADAS Applications
  - Hybrid approach for performance and mixed criticality
  - Linux & Autosar
Conclusion and Summary

• The complexity to build ADAS systems, from an integrator’s perspective, rises exponentially into unmanageable dimensions

• Standard abstraction components are a way out of this dilemma

• EB develops a standard software architecture for scalable ADAS functions, **EB Assist Robos**, that
  – is powerful, scaleable and can be mapped to arbitrary hardware configurations
  – is sold on a component-by-component basis
  – can be integrated with existing hardware/software ADAS systems to extend their functionality

• EB develops a three-tiered hardware/software stack together with NVidia and Infineon that allows smooth migration of software components into the Robos architecture, and others

• EB integrates this new system with our existing services, tools and technologies for specification, development, testing and verification.
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