Overcoming Testing and Validation Challenges for Automated Driving

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August 23, 2018
Overcoming Testing and Validation Challenges for Automated Driving

Agenda

1. Introduction

2. Automated Driving Development Challenges

3. Mammoth Task Testing and Validation

4. One-Stop Solution for Testing and Validation

5. Joining Forces for a Comprehensive Solution
EB software offering for Automotive

Automated Driving (AD)
- Environment model incl. positioning
- Safety monitor
- Electronic horizon
- Tools for test and validation

User Experience
- Cockpit software platform
- Multimodal UI toolkit
- Augmented reality framework

Connected Car
- Remote analytics
- Software update OTA
- Security ARGUS

Platform services

Scalable software for in-vehicle infrastructure
AUTOSAR Classic & Adaptive, Virtualization, Android & Linux
Trends in Automated Driving

Tackle the challenges and pave the way towards future mobility.

Safety & security

Accurate environment models

Tremendous test and validation efforts
EB’s Solutions for Automated Driving

EB robinos
Building blocks for automated driving systems (hardware- and sensor- agnostic )
• Comprehensive environment model
• Accurate vehicle positioning
• Code-generation based tooling to monitor system parameters
• Electronic horizon

EB Assist
Test and validation for automated driving
• Proven-in-use hardware and software products
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Increasing Functional Complexity

- Functional complexity
- Components
  - Interactions
- AD functionality
Overcoming Testing and Validation Challenges for Automated Driving

Verification and Validation Requires Vast Test Coverage

Complexity

Unusual situations

Hazards

Difficult conditions
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240 Million Kilometers without Accidents

5% done with real driving equals 12 million test kilometers

- An average of 200 test cars with each recording 275 km/day
- For one year (220 working days)
- Producing 10 TB per day per car
- The whole fleet generating 2 petabytes of data per day

95% done in simulation equals 228 million virtual test kilometers

- 114,000 scenarios with 1 km length each
- 2,000 variants per scenario at an average of 60 km/h
  -> 158,000 days of simulation on one high performance computer
- 10,000 high performance computers running software and simulation takes 15.8 days

At the same time, development and update cycles must get shorter. Virtualization enables parallel replay and simulation for accelerated testing.
In Order to Manage Upcoming Tasks We Need...

Reliable measurement technology
Suitable test environments
Well-matched, fully integrated solutions
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One-Stop Solution for Testing and Validation

Cloud-computing platform (public/on premise)

HAD test data platform

Database

- Raw data
- Label ground truth
- Scenarios
- Test cases
- Test results
- Archive

Test drive recording (replaying OLT)

Scenario generation (simulation OLT / CLT)

Data enhancement

Test case management

Test execution

Test post processing
Test Drive Recording

Smart solutions for efficient test drive recording and handling of large amounts of data are essential.

- Efficient logging software
- Hardware which supports all common bus types and high bandwidths
- Various possibilities for direct annotation, triggering, and recording feedback
Scenario Generation

Efficient solutions for generation and simulation of test drives are crucial.

- Efficient creation of new scenarios
- Efficient simulation of scenarios
- Physically correct modeling of:
  - Ego car behavior
  - Behavior of other objects
  - Sensor simulation
Enabling a high level of automation to handle the rising amounts of required test drive data at reasonable expenses.

- Data ingestion into cloud has to be supported, e.g. with disc logistics and upload facilities
- Basic meta data has to be generated automatically for newly uploaded recordings
- Services (AI-based) for meta data generation like driving context
- Efficient label tool supporting (semi-) automatic labeling of recordings
- Adaptable and customizable to customer and use-case specific needs
Test Case Management

Allowing efficient generation and administration of test cases and test sets

- Define preconditions
  - Software version
  - Algorithm state
- List of input data
  - Recordings
  - Simulation scenarios including variations
- Expected results
  - Ground truth
  - KPIs
- Automatic generation of test cases
- History and coverage of test cases
Executing abstracted test cases to cover any kind of test scenarios in a transparent, efficient way

- Supporting infinite scalability by using cloud-based solution
- Improving efficiency of existing hardware by providing smart load balancing
- Decreasing down time by automatically detecting and handling execution errors
- Enabling efficient post processing of tests and test runs
- Automatic creation of meaningful test reports
- Administration and archiving of test results
- Comparison between test results
The EB Assist Product Line at a Glance

Hardware products

EB Assist CAR Box
- High-performant and reliable automotive-grade PC systems for testing and validation
- Data-logging, replaying, and simulation of real and virtual driving scenes

EB Assist bus tools
- Modular I/O slot cards, I/O interface modules, and simulation tools
- Built for highly precise data-logging, replaying, and simulation

Software products

EB Assist Busmirror
- Tool for testing ECU software during implementation stage, both on hardware and on PC
- Supports all established bus systems, including Ethernet/BroadR-Reach, FlexRay, CAN, and LIN

EB Assist ADTF
- Tool for the development, testing, validation, and visualization of ADAS and AD systems
- Wide range of toolboxes available to extend its functionality

Test Lab by EB
- Comprehensive driving scene database and management
EB Assist Covers all Automated Driving Development Phases

- **EB Assist CAR Box**: Automotive grade PC-platforms for testing and validation
- **EB Assist bus tools**: Modular I/O slot cards, I/O interface modules, and simulation tools
- **EB Assist ADTF and toolboxes**: Tool for the development, testing, validation, and visualization of ADAS and AD systems
- **EB Assist Busmirror**: Tool for testing ECU software during the implementation stage, both on HW and on PC
- **Test lab by EB**: Comprehensive database and management

Creating driving scenes for testing purposes

Function development

Simulation, testing, and validation

Hardware

Software
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Further Enhancement with Partners

Simulation experts

Data plugin specialists

Test tracks

Computer center providers

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Test and Validation Tools for Automated Driving

EB Assist

- Data-logging, replaying, and simulation of driving scenes

- **Test and visualization** for continuous development

- **Leverage development** with products based on industry standards

- Test and validation to prove mass production

- Fast and flexible tool customization through **comprehensive in-house** hardware/firmware development
Summary

Comprehensive testing and validation solution to bring automated cars to serial production.

- Flexible platform covers data from real driving scenes and from simulation
- Automated labeling and data enhancement
- Management, execution, and post-processing of parallel tests
- Leverages cloud-computing platform for maximum flexibility and scalability
- Open interfaces to create a comprehensive solution with partners, answering the needs of car makers and suppliers
Thank you.

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