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AdaptIVe
Automated Driving Applications and Technologies for Intelligent Vehicles

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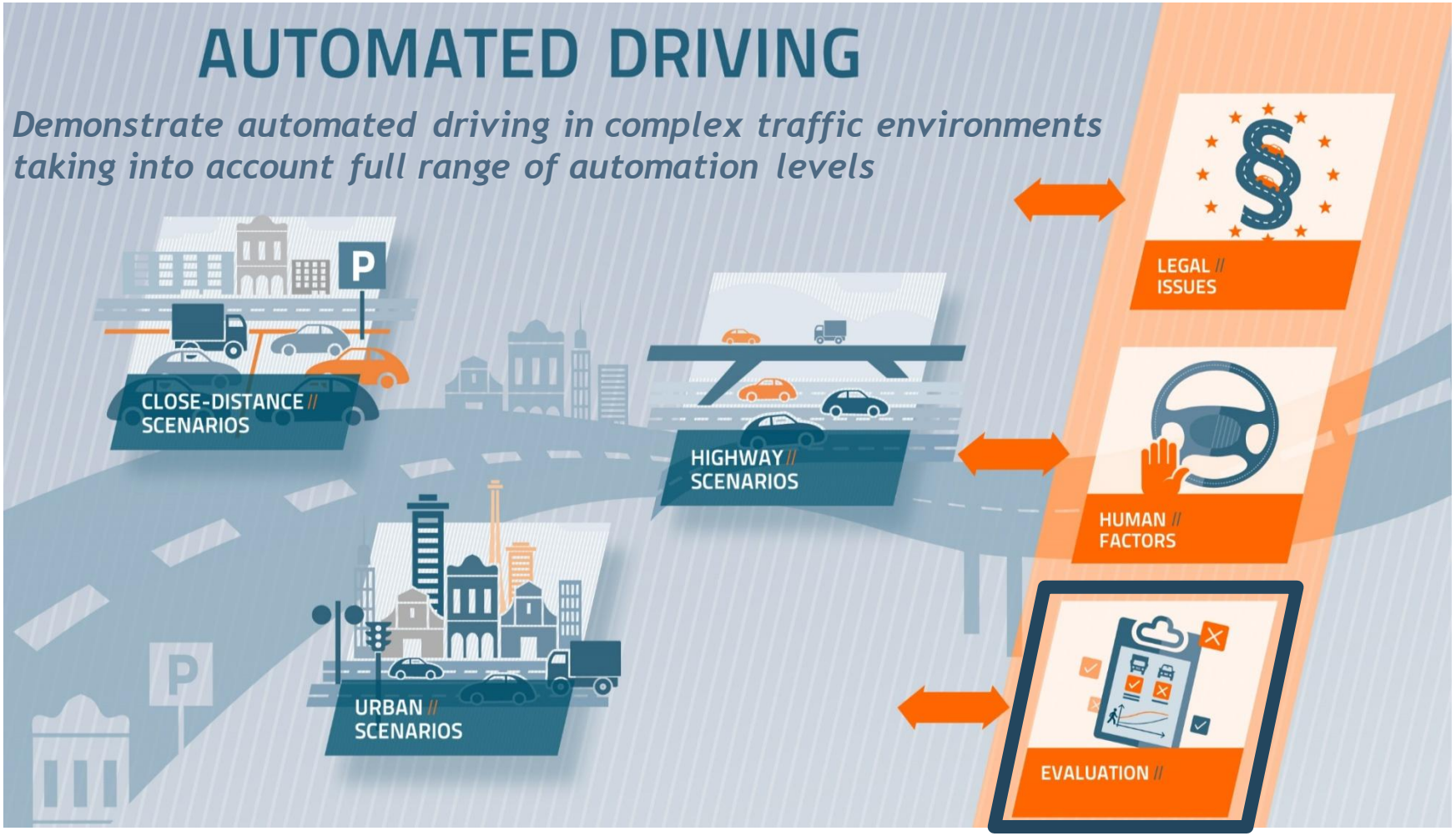
AdaptIVe - Evaluation

Automated Vehicle Symposium 2015


AUTOMATED DRIVING
Demonstrate automated driving in complex traffic environments taking into account full range of automation levels
CLOSE-DISTANCE // SCENARIOS
HIGHWAY // SCENARIOS
URBAN // SCENARIOS
LEGAL // ISSUES
HUMAN // FACTORS
EVALUATION //

// Validation & Verification

Definition according to "IEEE Guide--Adoption of the Project Management Institute Standard A Guide to the Project Management Body of Knowledge“

- Validation
  - The assurance that a product, service, or system meets the needs of the customer and other identified stakeholders. It often involves acceptance and suitability with external customers.
- Verification
  - The evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposed condition. It is often an internal process.

- Main objectives of SP7 in AdaptIVe:
  - Evaluation of automated driving research functions in four assessments (technical, user-related, in-traffic, impact assessment)
  - Development of an **evaluation framework** for automate driving functions
    - **Verification** is part of the **technical assessment** (→ checking requirements)
  - Methodology for **impact analysis** of automated driving applications
    - **Validation** is part of safety and environmental **impact assessment** as well as the user-related, in-traffic and **technical assessment**

// Classification automated driving functions

- Classification of automated driving functions for the evaluation
  - According to the SAE definition
  - According the operation time
    - **Event based operating**
      - Function that operates for a short period in time (typically vehicle stands still at the end or the automated driving ends)
    - **Continuously operating**
      - Function that operates for a longer period in time (typically vehicle is still moving at the end of an manoeuvre respectively automated driving is continued)

// Evaluation approach technical assessment

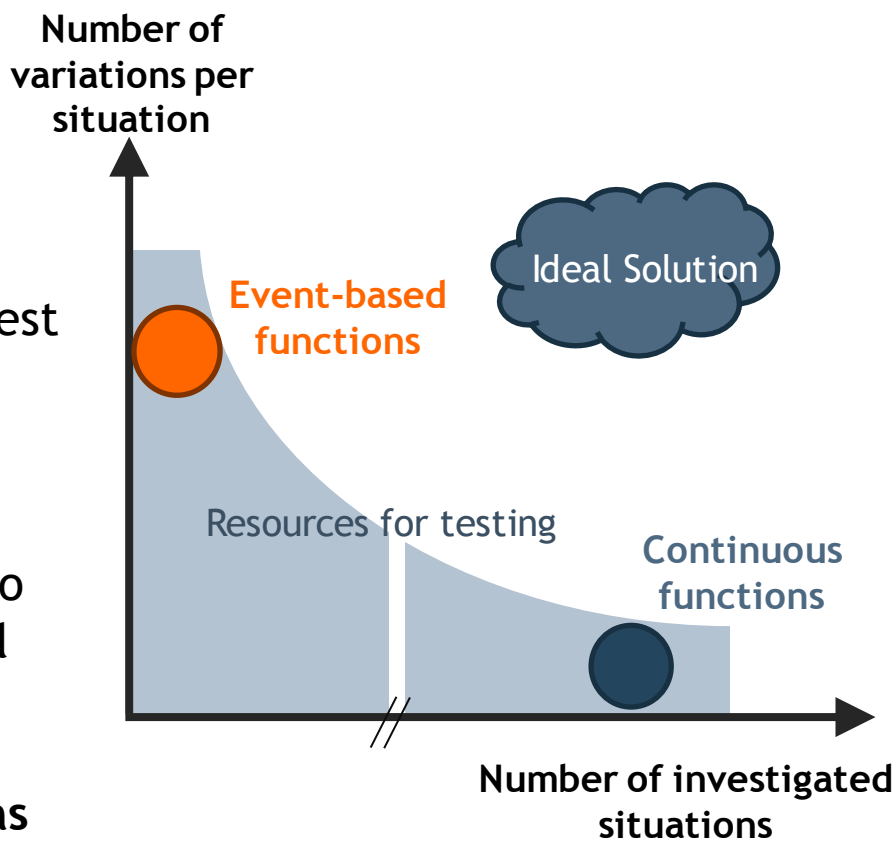
- How to limit the test amount to feasible amount?

Different approaches for event-based and continuously operation function

- Event-based functions: similar approaches as in previous research project e.g. interactIVe
- Continuously operating functions: test on public road

Evaluation criteria

- Automated driving functions need to operate within the **range of normal driving behaviour** (→ not disturb normal driving in mixed traffic conditions) and should **at least be as safe** as non-automated driving



// Evaluation approach technical assessment

1. **Defining evaluation scope**
   - Definition of research questions, hypotheses & indicators
2. **Planning of assessment**
   - Analyse system description and adaption of hypotheses
   - Planning of test cases
   - (Risk assessment)
3. **Tests in controlled field**
   - Number of test variations
   - Logging of test data
4. **Assessment of tests**
   - Analysis of hypotheses based on test data & indicators

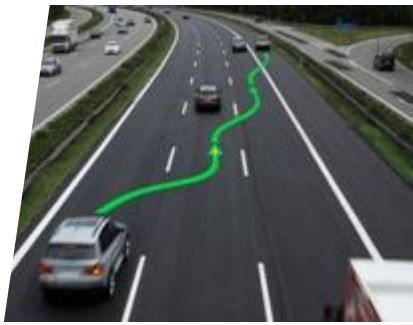
1. **Defining evaluation scope**
   - Definition of research questions, hypotheses & indicators
2. **Planning of assessment**
   - Analyse system description and adaption of hypotheses
   - Planning of test cases and test route
   - Definition evaluation criteria (distributions & boundaries)
   - Risk assessment
3. **Pre-/component tests in controlled field**
   - Basic tests of functionality
   - Sensor tests
4. **Tests in real traffic**
   - Test route and test amount to be determined
5. **Assessment of tests**
   - Analysis of hypotheses based on test data & indicators

Simulation (SiL)

- In case test effort for other test tools is too high or tests are not feasible (optional)
- Higher relevance for the (serial) development

// Safety Impact Assessment

- Research Question:
  - What is the safety benefit of automated driving functions?
- State of the art approaches for ADAS:
  - Field of application
  - Accident re-simulation
  - Field test
- Open issues for the impact assessment of automated driving applications
  - Today's accident data do not consider collisions of automated vehicles
  - Automated driving function operate already before a critical situation occurs → Re-simulation of accidents gets more difficult
  - Interaction with other road users (automated / non-automated) → mixed traffic

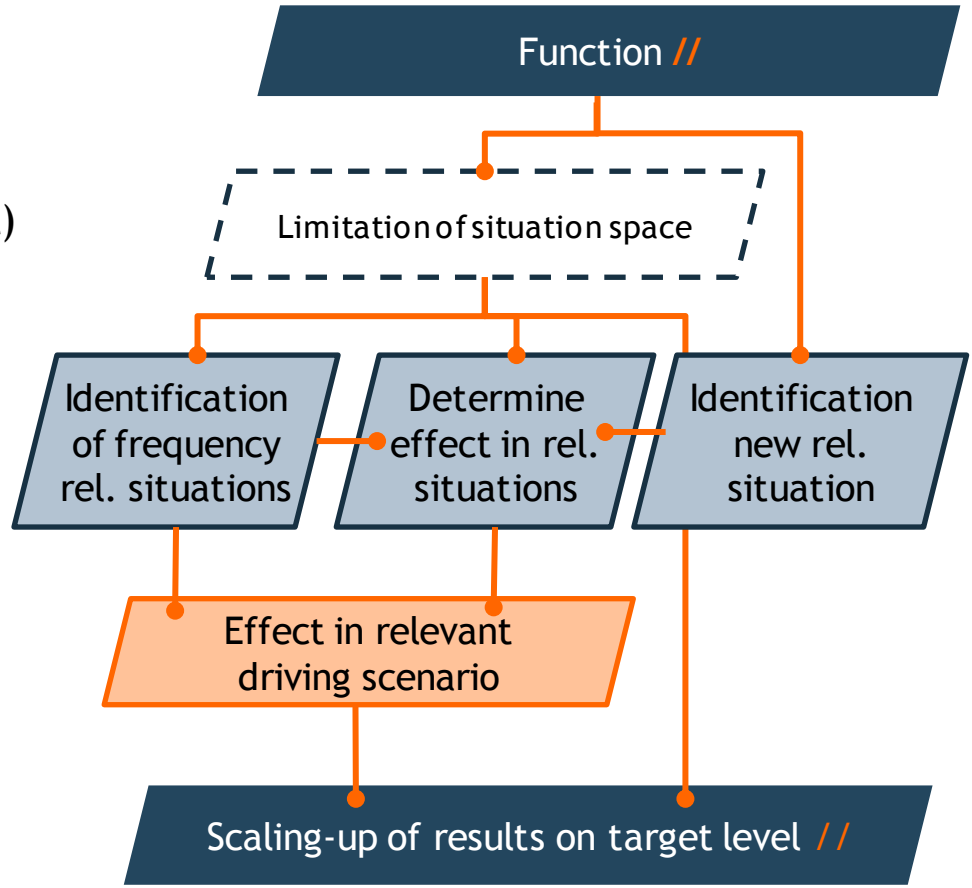


Soruce: http://files.coloribus.com, www.7-forum.com, ika

// Safety Impact Assessment

Safety impact assessment in AdaptIVe bases on three main steps

1. **Identify relevant situations**
   - Focus on accident and other (relevant) driving situations
   - Use of microscope traffic simulation
2. **Investigate the relevant situation in detail**
   - Approach is similar to the re-simulation approach
   - Input data from other assessment (technical, user-related, in-traffic assessment) are considered
3. **Identification of new situations**
   - e.g. transition of control or minimum risk maneuver



// Outlook: ika's approach for the safety validation

- How to validate / verify that the a automated driving functions safe enough for the market introduction?
  - Circle of relevant situation approach [ECK13] [ZLO15]

[ECK13]: Eckstein, Zlocki; Safety Potential of ADAS – Combined Methods for an Effective Evaluation; 23rd ESV; 2013
[ZLO15]: Zlocki, Eckstein, Fahrenkrog; Evaluation and sign-off methodology for automated vehicle systems based on relevant driving situations; 94th Annual TRB Meeting; Washington D.C.; 2015

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Thank you.

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