FUNCTIONAL DECOMPOSITION

Functional Decomposition.

An Approach to Reduce the Approval Effort for Highly Automated Driving.

A statistically approval of the “Autobahchauffeur” would require several billion kilometer test distance. This is not feasible.

A scenario based approach can reduce testing effort, BUT the different scenarios are still proving simultaneously the skills in all functional layers. Additionally the number of possible combinations of constraints and initial states lead to a high number of test cases.

The functional decomposition of the highly automated driving function and the following segmentation of relevant scenarios in particular tests, that test one ore more functional layers, promises

• The reduction of testing effort
• The targeted usage of test tools (XiL, proving ground, etc.) depending on their validity.
• A reduction of testing risk by skipping the action layer (open-loop testing).

Challenges for a implementation of the approach:

• Definition of independent decomposition layers and accessible interfaces.
• Definition of pass / fail criteria for the particular tests.
• Approval of the completeness of the approach.

The different scenarios contain redundant requirements for the functional layers.

Methodology for the development of the decomposition approach.
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From relevant scenarios to particular test cases:

Relevant Scenarios (functional)

- Relevant functional scenarios are identified in SP 1 and saved in the database.
- Relevant scenarios can be identified analytical with suitable metrics, based on FOT data or accident databases or be created synthetically based on ontologies.
- Scenarios can be described functional (linguistic description without values), logical (allocation of value ranges) or concrete (allocation of fixed values).
- The example shows a functional scenario that was derived from a real accident in which a Tesla Model S crashed into a van at the road verge in May 2016 in Switzerland.
- See also stands 4-6 as well as 11 and 12.
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**From relevant scenarios to particular test cases:**

- A overview matrix to allocate fail criteria / requirements to functional layers and relevant scenarios is created.
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From relevant scenarios to particular test cases:

- For all relevant scenarios functional fail criteria are identified, using a fault tree analysis (FTA). The fail criteria are allocated in the overview matrix.
- Possible accidents that can develop from relevant scenarios are used as top event. The base events are the fail criteria.
- The description in this step is done on the level of functional scenarios (see stand 4 and 11).
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From relevant scenarios to particular test cases:

- Redundant fail criteria / requirements are eliminated.
- Fail criteria / requirements that are subsets or intersecting sets of each other are subsumed.
- This is firstly done on functional level, followed by logical and concrete level.
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From relevant scenarios to particular test cases:

- For the remaining fail criteria suitable test environments / methods (e.g. XiL, proving ground tests, etc.) are chosen depending on their validity.
- Particular test cases are defined to prove that the fail criteria are not fulfilled.
- If the fail criteria have been defined complete, this can be used for an approval safety assessment.
- See also stands 10-21.