Periodical Technical Report

Glossary
English Version

PEGASUS Family Glossary
as the result of joint collaboration of
SET Level, VVMethods, VIVALDI and GaiaX4PLC

Editors: Nils Müllner (DLR), Sebastian Frank (Stellantis), and Ken Mori (TU Darmstadt)
Former Editors: Christoph Thiem (Stellantis)
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Preface

The validation of automated driving has already been the subject of research in many projects of the Pegasus project family. In these projects, the need for a uniform use of terms in the communication of the project participants grew. The motivation behind the glossary is therefore to collect and contextualize those terms that are relevant to automated driving along with definitions that are meaningful in this context. The glossary is written in two languages in order to standardize not only the definitions themselves but also the direct translation into English. This glossary is a working document that is constantly changing, adapting and evolving in the dynamic project context.

Introduction

Origin

The glossary was initiated by two projects that followed the Pegasus project[1]: SETLevel[2] and VVM[3]. Although Pegasus produced a solid and rich glossary, its follow-up projects had different objectives and required different branches of that glossary. On the other hand, there was an overlap of scientists and engineers in both projects, accompanied by the TP-X transfer project. It became clear that communication is a key element and that the terminology must be consistent and standardized. Therefore, the unification of both branches and their continuation is the result of this glossary. However, some terms were already defined differently in the projects and required merging. During this process, Vivaldi joined the Pegasus family as the third project. The GaiaX4PLC project from the GaiaX family followed later. Table 1 provides an overview which partners are involved in which projects in order to illustrate the background of this glossary.

	3DMS[4]	ADC[5]	Audi	AVL	BASt	Blickfeld	BMW	Bosch	Continental	Daimler
Pegasus[6]										
SETLevel[7]										
VVM[8]										
Vivaldi[9]										
GaiaX4PLC[10]										

	DLR-SE[11]	DLR-TS[12]	dSpace	ETAS	FKA	FKFS[13]	Ford	FZI	IfR	ika
Pegasus										
SETLevel										
VVM										
Vivaldi										
GaiaX4PLC										

	IQZ	IPG	KIT	LBF	MAN	Opel	Prostep	Qtronic	SETLabs	THI[14]	TT[15]	TG[16]
Pegasus												
SETLevel												
VVM												
Vivaldi												
GaiaX4PLC												

	TUIl	TUDa	TÜV Süd	UAS Kepmten	Valeo	VCS[17]	Vires	Visteon	VW	ZF
Pegasus										
SETLevel										
VVM										
Vivaldi										
GaiaX4PLC										

Table 1: Participating Project Members

[1] https://www.pegasusprojekt.de/de/
[2] https://setlevel.de/
[3] https://www.vvm-projekt.de/

Contributing

The glossary is under a Creative Commons license, so anyone interested can create their own forks, or participate directly in the expansion as external contributors. The organization of the glossary and the addition of new articles are important for this.

Adding new articles To add a new item, create a new file *py_TERM.tex* in the *python_formatted* folder according to template *0py_template.tex* . The naming convention requires a leading *py_* and the English name, all lowercase and no spaces. If a definition of the term exists, add the alternate definition to the same file.

Order of Articles The articles in Part 3 are arranged alphabetically so that the section numbers differ between the English and German versions of this document. The translation tables show the translation from English into German, sorted alphabetically by the German terms, and also vice versa accordingly for the other direction. The references to the section or page depend on the language version, apart from the release.

Handling

It can happen that several definitions of a term are meaningful, for example the term artifact (cf. Definition 12 on page 18) is defined differently by sensor technicians than by software engineers. In these cases both definitions are offered with context.

When referencing, the version of the glossary, i.e. publication date and language, must be specified. It is published in English and German. The section numbers between both versions are different because the articles are sorted alphabetically and therefore differently. The glossary is published externally as a *vanilla* version. Within the project family, however, there is an extended version that contains additional information, such as the origin of the term or the authors involved. This extended version is confidential for privacy reasons.

The editors meet regularly to ensure the progress of the glossary. They work as a moderator as the interface between the participating projects and collect the findings from the projects. Among the tasks are the creation of an initial version, which all partners agree, as well as the maintenance, care and periodic publication thereafter.

Everyone can contribute to the glossary, also from outside the projects. The glossary is not intended to be exhaustive. In the event of a conflict, any of the editors (cf. Section 3 on page 13) may be contacted. The editor contacted will contact relevant individuals (other editors and individuals known to be interested in an article) to initiate clarification.

Reporting a problem

To report a problem, the editors can currently be contacted via email. A ticket system that will be established in the TPX platform is in preparation.

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Logische Szenarienklasse	Logical Scenario Class	111	39
Logisches Szenarienkonzept	Logical Scenario Concept	112	40
Logisches Szenario	Logical Scenario	110	39
Maneuver	Maneuver	114	40
Mathematisches Modell	Mathematical model	115	40
Meilenstein	Milestone	122	42
Messdatenszenario	Measurement Data Scenario	116	40

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German	English	Section	Page
Methoden-Standard	Method Standard	117	40
Metrik	Metric	118	41
Metrik-Observer	Metric Observer	119	41
Middleware	Middleware	121	41
Minderungsmechanismus	Mitigation Mechanism	124	42
Minimaldatensatz	Minimal Data Set	123	42
Mit ADS ausgestattetes Fahrzeu...	Automated Driving System Equip...	15	19
Mit ADS ausgestattetes Fahrzeu...	Automated Driving System equip...	16	19
Mit ADS dediziertes Fahrzeug	ADS dedicated vehicle	4	17
Mittlere Fusion	Middle Fusion	120	41
Modellqualifikation	Model Qualification	125	42
Nachverfolgbarkeitsmethode	Traceability Method	254	71
Nebenläufige Instanziierung	Concurrent Instantiation	35	24
Objekt	Object	126	42
Ontologie	Ontology	128	43
Open Simulation Model Packagin...	Open Simulation Model Packagin...	129	43
Operational Concept	Operational Concept	130	43
Operational Design Domain	Operational Design Domain	131	43
Operational Domain	Operational Domain	132	43
Over the Air	Over the Air	135	44
Parameter	Parameter	138	45
Parameterbereich	Parameter Range	139	45
Parameterraum eines Szenarios	Parameter Space	140	45
PEGASUS-Datenbank	PEGASUS data base system	142	45
PEGASUS-Eingangsdatenformat	PEGASUS Input data format	143	45
Physikalische Domäne	Physical Domain	145	46
Physische Architektur	Physical Architecture	144	46
Plattformlaufzeitsteuerung	Platform Runtime Control	146	46
Plausibilität	Plausibility	147	46
Post Encroachment Time	Post Encroachment Time	148	46
Produkt-Standard	Product Standard	153	48
Projekt	Project	154	48
Prozess	Process	150	47
Prozess-Standard	Process Standard	151	47
Reale Perzeptionstechnologie	Real Perception Technology	160	49
Reale Umgebung	Real Environment	159	49
Reale Welt	Real World	161	49
Redundanz	Redundancy	165	50
Reichweite	Range	158	49
Replay2Sim	Replay2Sim	166	50
Replay2Sim-Szenario	Replay2Sim Scenario	167	50
Reporting	Reporting	168	51
Risiko	Risk	173	51
Schaden	Harm	86	35
schnellerer Abdränger	Overtaking Side Swipe Challeng...	136	44
Sensor	Sensor	191	57
Sensorfusion	Sensor Fusion	192	57
Separation of Concerns	Separation of Concerns	195	58
Setup-Routine	Setup Routine	196	58
Sicherheitsargument	Safety Argument	175	52
Sicherheitsnachweis	Safety Case	176	52
Sicherheitsprinzip	Safety Principle	178	53
Sicherheitsrelevantes Verkehrs...	Safety Relevant Traffic	179	53
Sicherheitsziel	Safety Goal	177	52
Sichtbarkeit	Visibility	268	75
Sichtfeld	Field of View	69	32
Simulated Ground Truth	Simulated Ground Truth	199	58
Simulations-Gütekriterien	Simulation Quality Criteria	215	62
Simulations-Setup-Routine	Simulation Setup Routine	218	63
Simulationsablauf	Simulation Sequence	217	63
Simulationsdaten	Simulation Data	205	60
Simulationskern	Simulation Core	201	59
Simulationskerndaten	Simulation Core Data	202	59
Simulationskernerweiterung	Simulation Core Extension	203	59
Simulationskernlaufzeitsteueru...	Simulation Core Runtime Contro...	204	60
Simulationslauf	Simulation Run	216	63

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German	English	Section	Page
Simulationsmodell	Simulation Model	208	61
Simulationsplattform	Simulation Platform	209	61
Simulationsplattformkonfigurat...	Simulation Platform Configurat...	210	61
Simulationsplattformsteuerung	Simulation Platform Control	211	61
Simulationsplattformverwaltung...	Simulation Platform Management...	212	62
Simulationsprinzip	Simulation Principle	213	62
Simulationsqualität	Simulation Quality	214	62
Simulationsschritt	Simulation Step	220	64
Simulationsschrittablauf	Simulation Step Sequence	221	64
Simulationsstatus	Simulation Status	219	64
Simulationssteuerung	Simulation Control	200	59
Simulationssystem	Simulation System	222	64
Simulationszeit	Simulation Time	223	64
Simulationszeitschritt	Simulation Time Step	224	65
Simulationsziel	Simulation Goal	207	60
Simulator	Simulator	225	65
Situation (Verkehrs-)	Situation	226	65
Software-in-the-Loop	Software in the Loop	230	66
Sollverhalten	Target Behavior	236	67
Späte Fusion	Late Fusion	96	37
Standard	Standard	231	66
Streuzentrum	Scattering Center	181	53
Suchbereich der Kritikalität...	Criticality Analysis Domain	42	26
Systemarchitektur	System Architecture	232	66
Szenario	Scenario	182	53
Szenario-definierender Faktor	Scenario-defining Factor	189	56
Szenario-Engine	Scenario Engine	184	54
Szenario-Generator	Scenario Generator	185	55
Szenariobeschreibungssprache (...	Scenario Description Language ...	183	54
Szenariomanager	Scenario Manager	186	56
Szenarioparameter	Scenario Parameter	187	56
Szenarioparametersatz	Scenario Parameter Set	188	56
Szene	Scene	190	57
Taxonomie	Taxonomy	238	68
Technische Testbeschreibung	Technical Test Specification	239	68
Testautomatisierung	Test Automation	240	68
Testdaten	Test Data	244	69
Testfall	Test Case	241	68
Testinstanz	Test Instance	245	69
Testklasse	Test Class	242	69
Testkonzept	Test Concept	243	69
Testmittel	Test Means	246	70
Testplan	Test Plan	247	70
Testspezifikation	Test Specification	248	70
Testwerkzeug	Test Tool	249	70
Time-To-Collision	Time-to-Collision (TTC)	251	70
Toolqualifizierung	Tool Qualification	252	71
Trace-Link	Trace Link	253	71
Traffic Simulation Vehicle (TS...	Traffic Simulation Vehicle (TS...	255	71
Überholender Einscherer (C)	Overtaking Turn Into Path Chal...	137	44
Umfeldmodell	Environment model	60	29
Umweltbedingung	Environmental Condition	61	30
Unfall (Beinahe-)	Accident (Near-)	3	17
Unfallschwere	Severity	197	58
Validierung	Validation	257	72
Validierungsmethode	Validation Method	258	72
Validierungstechnik	Validation Technique	259	73
Variations- und Explorationsmo...	Variation and Exploration Modu...	260	73
Vehicle-in-the-Loop	Vehicle in the Loop	261	73
Verarbeitung	Processing	152	47
Verdeckung	Occlusion	127	42
Virtuelle Umgebung	Virtual Environment	266	75
Virtuelle Validierung	Virtual Validation	267	75
Visualisierung	Visualization	269	75
Vorausfahrer (A)	Lead Vehicle Challenger (A)	103	38
Wahrscheinlichkeit des Eintret...	Probability of occurence	149	47

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German	English	Section	Page
Weltmodell	World Model	270	75
Wirkkette	Causal chain	21	20
Wirkzusammenhang	Causal Relation	22	20
World State	World State	271	76
X in the Loop	X in the loop	272	76
Zu testende Sensorik Rohdaten	Sensor under Test Raw Data	193	57
Zu testende Sensorik Rohdaten-...	Sensor under Test Raw Data Lab...	194	57
Zu testendes Fahrzeug	Vehicle under Test (VuT)	265	74
Zu testendes System	System under Test	234	67
Zugehörigkeitsmetrik	Affiliation Metrics	7	17
Zurückfallender Auffahrer (G...	Slower Rear End Challenger (G)...	227	65

Table 3: German to English

Release Notes and History of the Document

Release Notes

- version 1, current version
  - editors: Nils Müllner, Ken Mori, Sebastian Frank
  - release date: November 2023
  - licence: CC-BY
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In its cross-project and enduring character, the glossary is currently anchored in the TPX under the direction of Henning Hajo Moosebach.

Editors are the main contacts

- Henning Hajo Mosebach (henning.mosebach@dlr.de)
- Nils Müllner (nils.muellner@dlr.de)
- Christoph Thiem (christoph.thiem@stellantis.de)
- Ken Thaddäus Mori (ken.mori@tu-darmstadt.de)

History of the Document

A preliminary version was sent to the Vivaldi partners in 2021 and Ken Mori joined Nils Müllner and Christoph Thiem as editors. In 2022 Christoph Thiem was replaced by Sebastian Frank. In November 2023 the glossary was published for the first time under CC-BY. At the end of 2023, Sebastian Frank and Ken Mori left due to expiring projects.

List of Abbreviations

AD automated driving.

ADF automated driving (AD) function.

ADS AD system.

DGT dynamic ground truth.

DIN Deutsches Institut für Normung.

FAS Fahrer Assistenzsysteme.

FMI Functional Mockup Interface.

FOT field operational test.

hADF highly AD function (ADF).

HiL hardware in the loop.

HMI human machine interface.

ISO International Organization for Standardization.

ODD operational design domain.

OSI Open Simulation Interface.

PET post encroachment time.

SiL software in the loop.

SUT system under test.

TTC time to collision.

VUT vehicle under test.

Generic Articles

1 6-Layer Model

Definition. *The model, shown graphically in Fig. 1, describes the traffic area. It contains the levels*

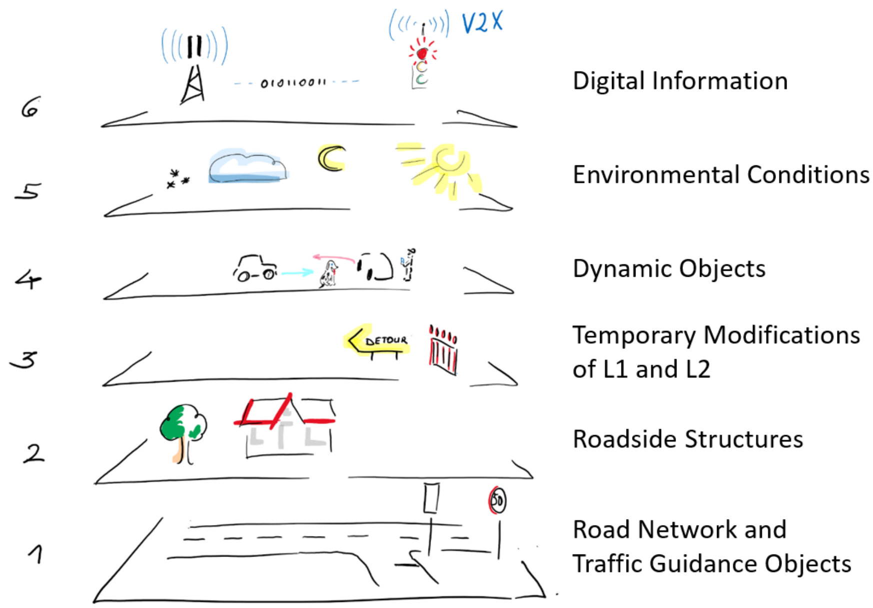

Figure 1: PEGASUS Layers

Ebene	Beschreibung	Abschnitt	Seite
1	Road geometry and topology	97	37
2	Road furniture and rules	98	37
3	Temporary physical limitations	99	37
4	Movable objects	100	37
5	Environment conditions (road weather)	101	38
6	Digital Information	102	38

The PEGASUS layers shown in Fig. 2 are taken from the overall method[18].

Literature

There is a citable publication from 2021 [SWT^{+}21] adding to the original sources (posters) from 2018 [PEG18b, PEG18a]. The six-layer model is an extension to the 5-layer model initially developed in the dissertation by Schuldt [Sch17].

- Fabian Schuldt. *Ein Beitrag für den methodischen Test von automatisierten Fahrfunktionen mit Hilfe von virtuellen Umgebungen.* 2017

[18] `https://www.pegasusprojekt.de/files/tmpl/Pegasus-Abschlussveranstaltung/PEGASUS-Gesamtmethode.pdf`, S0. 7

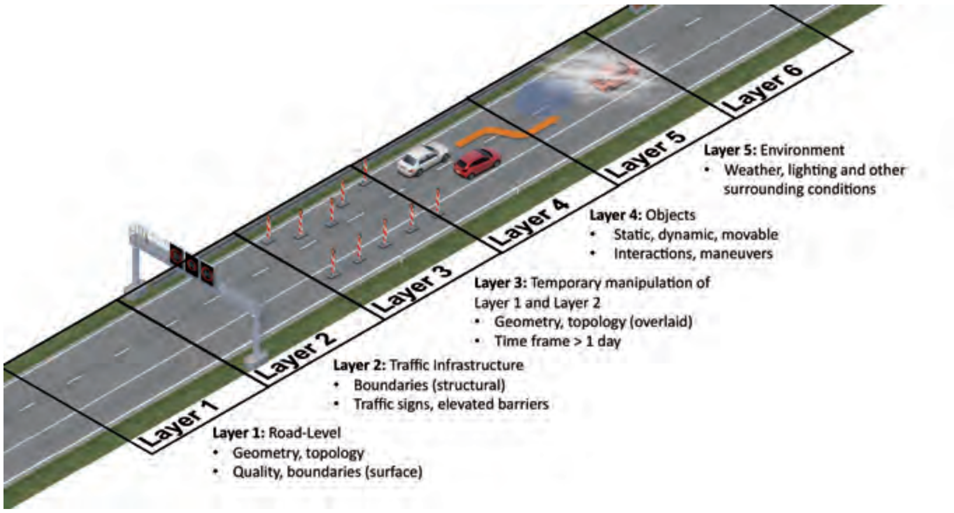

Figure 2: PEGASUS Layers

- Scenario description and knowledge-based scenario generation, 2018. last accessed 2022.11.23
- Scenario description, 2018
- Scenario formats. last accessed 2022.11.23
-
- Maike Scholtes, Lukas Westhofen, Lara Ruth Turner, Katrin Lotto, Michael Schuldes, Hendrik Weber, Nicolas Wagener, Christian Neurohr, Martin Herbert Bollmann, Franziska Körtke, Johannes Hiller, Michael Hoss, Julian Bock, and Lutz Eckstein. 6-layer model for a structured description and categorization of urban traffic and environment. *IEEE Access*, 9:59131–59147, 2021

2 Abstract Scenario

Definition. *An abstract scenario is a formalized, declarative description of a traffic scenario with the focus on presenting complex relationships, in particular interdependencies. The semantics of the description are based on an ontology. [Ami20]*
See also

- *ontology, 128 on page 43,*
- *Scenario, Section 182 on page 53, and*
- *scenario description language, 183 on page 54.*

Literature

- Gil Amid. VMAD/SG1A - Scenario Abstraction Levels, 2020. last accessed 2022.11.23

3 Accident (Near-)

Definition. *A traffic situation in which either damage occurred (accident) or in which damage could only just barely (temporally or spatially) be avoided.*

Literature

4 ADS dedicated vehicle

Definition. *A vehicle equipped with AD system (ADS), which was developed specifically for driverless operation and is used consistently in driverless operation.*

Literature

5 ADS dual-mode vehicle

Definition. *An ADS dual-mode vehicle is a vehicle equipped with an glsads, which can be used both with a driver and in driverless operation.*

Literature

- [oAE18]

6 Aerial Ground Truth

Definition. *Data of the type "Ground Truth Data" from the source of an aircraft or a drone recorded sensor system (Birdseye View). The data must meet defined qualities.*

Literature

7 Affiliation Metrics

Definition. *The affiliation metric divides continuous input data into sections of logical basic scenarios. Due to temporal overlaps of logical basic scenarios, a vehicle can also be in several logical scenarios at a time.*

Literature

8 Agent

Definition. *An agent is an entity that is not controlled by a central controller (e.g., the simulation core of a simulation system), but controls itself within an environment. An example is the autonomous functionality for controlling a simulated car in one concrete scenario during a simulation run.*

Literature

9 Allocation

Definition. *Process and result of distributing requirements, resources, or other entities among the components of a system or program.*

Literature

ISO/IEC/IEEE 24765:2017 Systems and software engineering-Vocabulary

10 Analysis Task

Definition. *The term analysis task is to be understood as a specific, differentiated analysis task for a special purpose of development or virtual validation (simulation goal).*

Examples:
Exploration with observers for the purpose of logical (parameter studies) / concrete scenarios

Question: Is model configuration already necessary? between goal (what?) and run independent of the simulation system (the sim system must meet specifications that are specified in the task.)

Literature

11 Argumentation Structure

Definition. *An argumentation structure does not describe a concrete proof of safety, but a pattern/template that describes a content-related ranking aid for arguments and types of evidence for the support of a claim in a concrete context, so that the fulfillment of required Characteristics such as completeness can be understood in the chosen context.*

For example, the VVM argumentation structure describes this pattern for the components (required from the VVM point of view) of a release certificate that should be accepted by the relevant stakeholders (approval authorities, society, ...).

Literature

12 Artifact

12.1 Artifact (Sensors)

Definition. *An entity as it is defined in the field of environmental sensors.*

12.2 System Engineering

Definition. *An entity intentionally created by humans or machines. Examples of artifacts (in the context of system development) are*

- *models*
- *descriptions (documents)*
- *templates*
- *simulation results*

Literature

13 Assessment Scale

Definition. *Assessment scales limit the subjective part of evaluations to enable a comparability of evaluation results and evaluated elements within certain limits.*

Literature

14 Automated Driving System

Definition. *Automated Driving System (ADS) is the hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT) on a sustained basis, regardless of whether it is limited to a specific operational design domain (ODD); this term is used specifically to describe a Level 3, 4, or 5 driving automation system.*

Literature

SAE J3016

15 Automated Driving System Equipped Vehicle as Product

Definition. *An ADS-equipped vehicle as a product is the validated result of a product design process that takes into account the challenges of the open context. A major difference between a vehicle equipped with ADS in traffic (one example of the vehicle) and as a product (the (partial) fleet of all examples, the traced data of which allow conclusions to be drawn about the properties of the product) is the viewing scope with a focus on the individual vehicle or on the traffic situation.*

Literature

16 Automated Driving System equipped vehicle in traffic

Definition. *A vehicle equipped with ADS in traffic is a safety-validated example of a product in the specific traffic situation in which it is intended to act (target behavior). An ADS-equipped vehicle in traffic can optionally enable the collection of field information to respond to open-context challenges.*

Literature

17 Automation risk

Definition. *Automation risk is the risk that is induced or caused by an automated driving function. The automated vehicle is therefore the primary cause of the accident. Deficits in effectiveness such as an insufficient reaction in scenarios that are induced by third parties are not included.*

Literature

- Eckard Böde, Matthias Büker, Werner Damm, Martin Fränzle, Birte Neurohr, Christian Neurohr, and Sebastian Vander Maelen. Identifikation und quantifizierung von automationsrisiken für hochautomatisierte fahrfunktionen, 07 2019

18 Backend

Definition. *The backend is a series of algorithms which, in the background and invisible to the user, represent the interface between the database and the frontend.*

Literature

Pegasus Glossar

19 Baseline

Definition. *A baseline contains a collection of entities whose changes are to be tracked in the course of a process. A baseline always contains the frozen status of the entities at the point in time at which the baseline was created. The changes to the individual objects can be compared with one another by comparing the individual baselines.*

Literature

- Systems and software engineering — System life cycle processes. Standard, International Organization for Standardization, Geneva, CH, May 2015

20 Capability Architecture (Organization)

Definition. *Architecture definition of a set of organizational capabilities, with leaf-level capabilities aligned to needs and their measures.*

Literature

21 Causal chain

Definition. *A chain of effects is an interrelationship in which each subsequent event has only one occurrence. Events that run parallel in time cannot be mapped.*

Literature

22 Causal Relation

Definition. *Effect-relations describe plausible causalities (e.g., how criticality arises in a traffic scenario). Contexts of action are a series of events in a traffic scenario, partially arranged with regard to their occurrence and continuation in time, so that the simultaneous occurrence of previous events is plausible and causal for the subsequent event. Events running in parallel are possible.*

Literature

23 Causality

Definition. *Causality is the relationship between cause and effect. Causality is thus the relation between events and states, whereby the application of the cause brings about the effect. One cause can lead to several effects, and several causes to one effect.*

Literature

24 Challenger

Definition. *A challenger is a vehicle/object (Layer 4) that, through its behavior/presence, triggers a response from the vehicle under test (VUT) (cf. 265).*

The behavior of the VUT can also be influenced by more than one challenger. The challenger on the test site is identical to the TSV, which requires the vehicle under test to take direct action.

Literature

25 Challenger Paths

Definition. *The general term challenger is defined for highway scenarios in Section 24 on page 21. The positions derived from that are:*

English	*German*	*Position*	*Definition*	*Page*
Lead Vehicle Challenger	*Vorausfahrer*	*(A)*	*103*	*38*
Slower Turn into Path Challenger	*langsamerer Einscherer*	*(B)*	*229*	*65*
Overtaking Turn Into Path Challenger	*überholender Einscherer*	*(C)*	*137*	*44*
Slower Side Sweep Challenger	*langsamerer Abdränger*	*(D)*	*228*	*65*
Side Swipe Challenger	*Abdränger*	*(E)*	*198*	*58*
Overtaking Side Swipe Challenger	*schnellerer Abdränger*	*(F)*	*136*	*44*
Slower Rear End Challenger	*zurückfallender Auffahrer*	*(G)*	*227*	*65*
Rear End Turning Into Path Challenger	*einscherender Auffahrer*	*(H)*	*164*	*50*
Rear End Challenger	*Auffahrer*	*(I)*	*163*	*50*

Literature

26 Clustering

Definition. *Clustering refers to the process of grouping data, in the case of radar to the grouping of detection points. For extended objects it is possible to obtain multiple detection points for a single object. Clustering aims at grouping points belonging to the same object. [SLF+18, p.1]*

Literature

- [SLF+18]

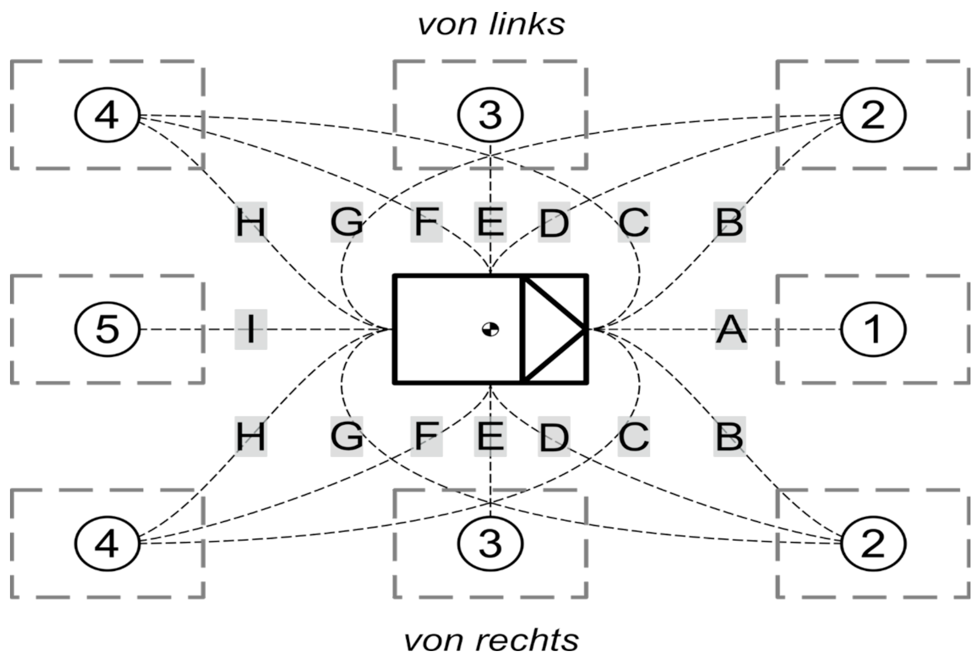

Figure 3: Challenger Paths

27 Co-Simulation

Definition. *Co-simulation is defined as the coordinated execution of two or more models that differ in their modelling paradigm as well as in their runtime environment. A runtime environment is a software system that solves model equations or generally allows the model execution. The models in a co-simulation system, therefore, have been developed as well as implemented independently. In general, all components of a co-simulation setup may be either hardware or software, i.e. hardware/software co-simulation for hardware testing is called hardware-in-the-loop. [SLR+17, p.4-5]*

Literature

28 Component

Definition. *A component provides a function and an interface to access that function. Components are commonly implemented in software, hardware, models or simulators. Components can carry a version number, a description, and can be inventoried in catalogues or libraries.*

Relevant to components are their

- *instantiation and*
- *their ability to interface each other directly, bypassing the simulation system.*

Literature

29 Concept of Operations

Definition. *The Concept of Operations (ConOps), at the organization level, addresses the leadership's intended way of operating the organization.*

Literature

30 Conceptual Model

Definition. *The conceptual model comprises the collection of abstractions, assumptions, and descriptions of physical components and processes representing the reality of interest for the respective simulation task. It includes the real world system, its environment, and their relevant behaviors.*

The conceptual model results from an analysis of the reality of interest within the modelling process. It can be composed of, e.g., flow charts, schematics, descriptions, and mathematical models, representing the real world system and potential interactions with its environment.

For the use case of a vehicle dynamics simulation, the model shall be able to approximate the vehicle behavior with respect to the intended use in a sufficiently valid manner.

Taking the example of a Radar sensor model: The reality of interest comprises the real world system (the real Radar Sensor), its environment (e.g., how and in which vehicle it is mounted) as wells as its relevant behavior (impact of other vehicles, weather, ...).

Literature

31 Conceptual Validation

Definition. *The conceptual validation describes the process of determining the degree to which a conceptual model or model design represents the reality of interest in a sufficiently valid manner with respect to the intended use of the model or the simulation.*

The aim is to guarantee that all underlying assumptions and modeled cause-effect relationships are sufficient and reasonable with respect to the intended use of the simulation model.

Therefore, one important step of the conceptual validation is the structured comparison of the intended use with the decisions made within the conceptual model (e.g., assumptions, modeled cause-effect relationships, intentionally neglected cause-effect relationships).

For enabling a conceptual validation in a simple way it is recommended to use structured formats for the documentation, e.g., a Phenomena Identification and Ranking Table *(PIRT) for the review of modeled cause-effect relationships.*

Literature

32 Concern

Definition. *Interest in a system relevant to one or more of its stakeholders.*

Literature

- Systems and software engineering — System life cycle processes. Standard, International Organization for Standardization, Geneva, CH, May 2015
- https://pubs.opengroup.org/architecture/archimate31-doc/chap06.html
- ISO/IEC/IEEE 42020:2019 Software, systems and enterprise–Architecture

33 Concrete Scenario

Definition. *A concrete scenario assigns concrete values to open parameters of a logic scenario. It models one discrete allocation/selection of parameters over possibly continuous spectrums of a logical scenario. In case a probabilism persists within a concrete scenario (e.g., drift parameters of aqua planing), that probabilism is to be resolved during runtime (i.e., while executing the simulation run) by the simulation system. The randomization seeds must be stored in the logfiles/report to maintain traceability of results and replayability.*

For instance, a concrete scenario would be that a non-ego car changes its lane (with given initial positions and velocities of both cars) from right to middle at simulation time 5s with a velocity of 130km/h, while the ego-car is at 20m distance on the middle lane with a velocity of 150km/h. Or in the case of the crossing pedestrian, consider fixes positions for car and pedestrian, the pedestrian walking towards a fixed location at a constant velocity of 5km/h while the car takes the turn at a constant speed of 20km/h.

Literature

34 Concrete Scenario Generator

Definition. *The generator for concrete scenarios is an optional part of the simulation platform manager, which is mandatory if logical scenarios are to be analyzed.*

The tasks of the generator for concrete scenarios are the implementation of the variation/exploration strategy and the generation of the concrete scenarios.

Various approaches can be taken into account. The generator for concrete scenarios can receive a logical scenario with a configuration from the simulation platform control, which contains, among other things, the creation strategy. Based on this creation strategy, the generator for concrete scenarios can generate one or more concrete scenarios and transfer them to the simulation platform control.

Furthermore, the generator can react to evaluation results for concrete scenarios. After executing one or more generated, concrete scenarios, the generator for concrete scenarios can generate new concrete scenarios in response and transfer them to the simulation platform control.

Literature

35 Concurrent Instantiation

Definition. *When a component is a limited resource, it might become necessary to utilize it multiple times, i.e., instantiate it.*

Consider a hardware prototype of an embedded system being the system under test (SUT) and the test case demanding it being tested against itself (i.e., multiple agents within one simulation being equipped with the SUT). Since it is not a FMU, it cannot be instantiated in parallel (i.e., copied, with the copies being executed on *parallel machines). The SUT has to be accessed by multiple cars concurrently. Each car accesses the same SUT at each (simulation-)time step with its own parameter set (thus possibly forfeiting real-time properties of the simulation). For ensuring realtime properties, each agent would require its own SUT.*

Literature

36 Confidence Evaluation Method

Definition. *The confidence evaluation method describes, how confidence for a certain measure is to be evaluated.*

Literature

37 Configuration Item (CI)

Definition. *The configuration item (CI) describes any entity of a system that serves the purpose of configuration management. It can therefore be used at any point in the system as a placeholder for a real system element (e.g., hardware, software, combinations) and keeps configuration-relevant data. It has a unique identifier that can be referenced elsewhere (e.g., in baselines).*

Literature

ISO 15288

38 Consistency Checker

Definition. *The consistency checker is part of the simulation control and ensures, for example, that all simulation models and simulation core extensions have the inputs and outputs defined in a configuration. The consistency checker also checks the feasibility of a concrete scenario.*

Literature

39 Controllability

Definition. *The controllability of a scenario/a scene indicates how demanding it is to manage this/these accident-free. It implicitly indicates the necessary driving skills of the vehicle-driving system or the driver.*

Literature

Pegasus Glossar

40 Criticality

Definition. *The criticality (of a traffic situation) is the combined risk of the actors involved in the continued traffic situation.*

- *Remark-1: In order to determine criticality, probabilities and types of damage, dynamic and behavioral models as well as action restrictions of the actors involved are taken into account.*

- *Remark-2: The time horizon of the criticality of a traffic situation is limited by the fulfillment of the intentions of the actors involved.*
- *Remark-3: Criticality is inversely correlated with the set of (sequences of) actions to avoid damage that are available to the actors involved. Criticality (of a scenario) can be defined by aggregating the criticality of a time series of traffic situations.*
- *Remark-4: For example, by a maximum or average on a discrete number of time steps.*

Literature

41 Criticality Analysis

Definition. *The criticality analysis deals with methods and procedures for the identification, explanation, and evaluation of critical traffic situations and their interdependencies.*

Literature

42 Criticality Analysis Domain

Definition. *The criticality analysis domain is the part of the traffic area that a criticality analysis examines.*

Literature

43 Criticality Observer

Definition. *An observer is a module/component that looks at the simulation* from the outside*, evaluates situations or also monitors conditions and, if necessary, logs data and influences the simulation control / the simulation process.*

For the criticality analysis, for example, a criticality observer observes or calculates a criticality measure (e.g. the time to collision (TTC)) between agents or between agents and objects and stores it at defined times or reports it back to the simulation controller.

Literature

44 Criticality Phenomenon

Definition. *A criticality phenomenon is a concrete influencing factor in a scenario (or a combination thereof) which is associated with increased criticality.*

Literature

45 Criticality Threshold

Definition. *For a given criticality metric and a traffic situation or scenario, a threshold value quantifies the boundary between critical and uncritical.*

Literature

46 Cross-Cutting-Concern

Definition. *Concern, which initially cannot be separated at will and requires coordination between several solution providers.*

Literature

47 Data Structure and Parameters

Definition. *A data structure provides the means required to access, share or store data in a coordinated way. It can be utilized in a static or dynamic way. A data structure for static data for instance is a catalogue of components. A data structure for dynamic data for instance is the analysis of a simulation run that is only required instantaneously. Here, static data is required by the simulation, whereas dynamic data is created by the simulation.*

A parameter is the evaluation/quantification of an attribute during runtime. While a set of initial parameters can be perceived as static data, their function over time according to a simulation run can be perceived as dynamic data.

Literature

48 Databasemechanics

Definition. *The database mechanics is the sum of the processing steps and the application of algorithms and metrics that take place between the entry and playing of the data into/from the database. In addition to other malleable steps, logical/concrete scenarios are extracted and abstracted by attribute and parametrization and provided the appearance. Thus, this can also be referred to as* database processing chain*. Input/playback are exclusive here.*

Literature

PEGASUS Glossar

49 Decomposition

Definition. *Decomposition of a system/function into sub-systems/functions. In the context of the project, an automation function is specifically broken down into functional levels (e.g. according to [GDCH08]: information access, information acquisition, information processing, objective and action).*

Literature

50 Demand Reinforcing Factor

Definition. *A demand-reinforcing factor is an event or a circumstance that does not in itself induce a challenging scenario, but does lead to increased requirements and/or restrictions on action if the vehicle is forced to react by another, challenging scenario-inducing factor. Examples of factors that increase requirements can be a wet road or a narrow lane.*

Literature

Pegasus Glossar

51 Digital Twin

Definition. *In a broad sense, a digital twin is a comprehensive physical and functional description of a system. [BR16, p.59] More specifically, a digital twin represents traffic reality.*

It corresponds to an existing road network in a real environment. Comparisons with the real environment are performed aiming at realism and validity. [BDHK19, pp.679-680]

Literature

52 Direct Component Interface

Definition. *Components can interface each other directly if no monitoring or control from within the simulation system is required. Bypassing the simulation system*

1. *allows for real-time simulation and*
2. *accelerates the simulation by minimizing unnecessary overhead.*

Literature

53 Driver Equivalent (Human)

Definition. *For a specific context (e.g., a traffic scenario), the driver equivalent creates a relationship-comparative relationship between human drivers and automated driving functions with regard to the (requirements,) actions and skills for performing the driving task. The [totality of] behaviors of human drivers are abstracted by modeling, taking into account in particular the dimensions perception, intention, skills, expectations, legal obligations and norm behavior.*

Literature

54 Driver Equivalent (Machine)

Definition. *The representation of human drivers obtained via the driver equivalent (human) is the driver equivalent (machine) and forms the basis for checking the equivalence with the machine representation/the digital twin of the AD function. The driver equivalent is fulfilled when the automated function (machine representation) reaches a defined and verifiable maximum deviation from the driver representation in the comparison dimensions under consideration.*

Literature

55 Driving Demand Metrics

Definition. *In every time step of the input data, the driving requirement metric evaluates the driving requirements that result from the traffic constellation for the human driver or an automated driving function. In doing so, especially in a changing environment (e.g., due to the geometry of the road or other road users), it takes* *into account the necessary reaction time, possible evasive options and the braking potential to avoid an accident.*

Literature

56 Early Fusion

Definition. *This method fuses the data before processing or the pre-processed sensor data.*

Early fusion has several pros and cons. First, the processing uses joint features of multiple modalities at an early stage, fully exploiting the information of the data. Second, early fusion has low computation requirements and a low memory budget as it jointly processes the multiple sensing modalities. This comes with the cost of model inflexibility. As an example, when an input is replaced with a new sensing modality or the input channels are extended, the processing needs to be updated completely. Third, early fusion is sensitive to spatial-temporal data misalignment among sensors which are caused by calibration error, different sampling rate, and sensor defect. [FHSR+20, p.8]

Literature

- [FHSR+20]

57 Ego Vehicle

Definition. *The ego vehicle is a Vehicle Under Test (VUT).*

Literature

58 Ego Vehicle Model

Definition. *The ego vehicle model represents the simulation technology model of the VUT (SUT (highly ADF (hADF) system)).*

The model contains all the necessary aspects of the individual vehicle components that are relevant for the evaluation of the system under test in the respective concrete scenario at the required level of accuracy (digital twin). In addition to the driving behavior and the driving functions, these are typically vehicle dynamics, including steering, chassis and braking systems, and drive train.

Literature

59 Emergent Property

Definition. *A property of a system of elements that cannot be derived from the properties of the individual elements.*

Literature

60 Environment model

Definition. *Representation of the environment created based on perception. In a broader sense, the environment model describes the relevant factors on all layers of* *the scenario. In the narrower sense, the environment model denotes an object list that is created from merged sensor data. It includes the position and speed of the vehicles in the vehicle under test environment.*

Literature

61 Environmental Condition

Definition. *Environmental conditions include lighting conditions such as time of day as well as temperature and weather effects.*

The environmental conditions may influence other parameters such as friction or reflectivity of the road. [Sch17, pp.116-117]

Literature

62 Evaluation Module

Definition. *An evaluation module is part of the evaluation system and has the task of evaluating the simulation data according to the evaluation criteria. This can be done either online for simulation or offline with data from the external data storage.*

Assessment modules can be loaded from an assessment module library.

Literature

63 Evaluation System

Definition. *The evaluation system is part of the simulation platform and has the task of evaluating the simulation data based on specified criteria. The results of the evaluation can be transferred directly to the simulation platform controller for simulation control. The results of the evaluation are written in an evaluation report. This evaluation report represents the final result of the simulation.*

The evaluation system is configured and controlled by the simulation platform controller. The simulation data transmitted must conform to the evaluation criteria.

The rating system receives as input

- *one evaluation criteria (e.g. TTC<5 ms),*
- *one-time data for instantiation,*
- *simulation data (directly from the simulation system or from the external data storage) and*
- *runtime commands.*

The rating system consists of the rating module and the reporting.

Literature

64 Event

Definition. *Any change in the environment or in the state of the machine or people over time. The change does not necessarily have to be perceptible or measurable. But it has to be real, not just hypothetically or statistically expected.*

Literature

65 Evidence

Definition. *Evidence is the factual evidence for statements (assertions). In the context of a safety case, these are statements that are not broken down logically, but are validated by tests. In most cases, the evidence is based on tests. The tests must be fully described, including a precise description of the test environment, procedures and results. The description of the test environmentregarding simulations includes the platform, the framework and the instantiation. The tests must therefore (in principle) be made repeatable. This may also include proof that the test results are reliable. Other forms of evidence include systematically collected field data, known material properties or logical program analyses. For example, field data can serve as evidence for the reliability of test results.*

Literature

66 Exposure

Definition. *The exposure is a distance- or time-related frequency with which events occur in a logical or (semi-)concrete scenario. The exposure can be, for example, a frequency of parameter values of a scenario parameter or the frequency of entire scenarios in one or more recorded data sets.*

Literature

67 External Data Storage

Definition. *The external data storage is part of the simulation platform and is used to store data provided by the simulation system. The external data storage device can expand or supplement an internal data storage device.*

The data stored in the external data memory can be used, for example, for decisions on homologation, traceability or a subsequent evaluation of the recorded simulation data.

Literature

68 Feature

Definition. *The result of transformations applied to data as part of processing. Features include low-level local features as well as high-level features.*

An example of an low-level image feature is the direction of the local intensity gradient. Features can be arranged in an array to obtain a feature map. Recent approaches with convolutional neural networks attempt to learn a hierarchy of features.[AFG20]

Literature

- [AFG20]

69 Field of View

Definition. *The angle, from which a sensor is receiving information, for which a specified detection performance is reached. Typically, the angle is given as azimuth and elevation angle.*

Literature

70 Field Operational Test

Definition. *A study undertaken to evaluate a function, or functions, under normal operating conditions in road traffic environments typically encountered by the participants using study design so as to identify real world effects and benefits. ([FC18, p. 14])*

Literature

71 Frame

Definition. *Data collected over all spatial locations covered by a sensor. Only exactly one value per spatial location is permitted. However, the information from different spatial locations may correspond to different moments in time as in the case of a Lidar sensor where detections are aggregated over a time interval.*

Examples include camera images or Lidar range view images.

Literature

VIVALDI intern

72 Free Driver

Definition. *The free driver is a logical scenario in which there are no other vehicles / objects (in the sense of layer 4) that are on a collision course with the VUT.*

This basic scenario is required in order to be able to test the challenges of the other layers of the scenario model (without Layer 4) on the VUT.

Literature

73 Functional Architecture

Definition. *Hierarchical arrangement of functions, their internal and external (external to the aggregation itself) functional interfaces and external physical interfaces, their respective functional and performance requirements, and their design constraints.*

Literature

74 Functional Design

Definition. *Process and result of defining the working relationships among the components of a system. In this case, components of a system refers to functional elements of a system.*

Literature

75 Functional Domain

Definition. *Solution-independent space for viewing content and scope to fulfill a functionality from the user's perspective*

Literature

76 Functional Mockup Interface (FMI)

Definition. *The functional mockup interface (FMI) specifies how components are to be connected to the simulation system.*

Literature

https://fmi-standard.org/

77 Functional Mockup Unit (FMU)

Definition. *A Functional Mockup Unit (FMU) is a component modeling the behavior of a dynamic entity within an concrete scenario while being executed. It contains an abstract model and can contain a solver. It connects via the Functional Mockup Interface (FMI) to the tool.*

Literature

https://fmi-standard.org/

78 Functional Requirement

Definition. *Statement that identifies what results a product or process shall produce.*

Literature

ISO/IEC/IEEE 24765f:2016

79 Functional Safety Concept

Definition. *The functional safety concept references safety-related parts of the functional design and describes their necessary interaction to achieve the safety goals.*

Literature

80 Functional Scenario

Definition. *A functional scenario describes relevant actors and their basic maneuvers under consideration. It is a (deliberately) unspecific description of a scenario in natural language, leaving not only concrete parameters or their spectra, but also* *some basic information open. Of the three levels of scenarios, functional scenarios are the coarsest level with least detail. For instance, a scenario "passive lane change" can describe the maneuver of a car changing its lane to the spot to be in front of the ego car. Or a scenario "turn right" can describe the maneuver of a car turning right while coping with other traffic. Important to functional scenarios is a thorough description of causal relations over time.*

Literature

81 Functional Test Requirement

Definition. *Specific element of a functional artifact that should be covered by functional testing.*

Literature

In Anlehnung an ISO/IEC 26554:2018 Information technology–Software and systems engineering-Tools and methods for product line testing: "Specific element of a domain (functional) artifact that should be covered by domain (functional) testing."

82 Generator Configuration

Definition. *The "Generator Configuration" is transferred from the "Simulation Platform Control" to the "Concrete Scenario Generator" and contains relevant information from the "Simulation Platform Configuration" and the "Analysis Task".*

These are: path to the logical scenario, storage location for the specific scenario(s), the target format of the specific scenarios and the strategy for the parameter variation for creating the specific scenarios.

Literature

83 Ground Truth

Definition. *Ground truth refers to a set of measures known to be more accurate than the measurements of the SUT. The ground truth represents a reference which is used as a standard for comparison. It is possible that the ground truth was not or cannot be checked.[CPIR14, pp.28-30] In context of driving datasets, ground truth typically refers to human annotation.[GLU12, p.3357][CBL$^+$, p.4]*

Literature

- [CPIR14]
- [GLU12]
- [CBL$^+$]

84 Ground Truth Data

Definition. *Ground truth data are of the same level of abstraction as "environment model data", but of significantly higher accuracy. The assumption applies to this data that it reflects reality sufficiently well.*

Literature

85 Hardware in the Loop

Definition. *The third in-the-loop method is used to transfer the developed models from the SiL environment to the real components or be replaced by them respectively. The method is referred to as Hardware-in-the-Loop (HiL). In distributed systems, this stage is typically performed in several steps. First, the individual components are tested independently against their respective specifications. Here, a simulation environment is used that provides the interfaces of the components that are to be tested. Once all components are verified with this method, they are partially integrated using the same method to also verify their interaction. At the end of this stage, the entire system exists in real components and is tested against its specification up to the level of the logical architecture.[HK15a, p.166]*

Literature

86 Harm

Definition. *Physical injury or damage to a person's health.*

Literature

87 Hazard

Definition. *A hazard is a source of potential harm in a traffic scenario.*

Literature

88 Homologation Data Scenario

Definition. *A homologation data scenario is a performance test that is specifically required for homologation and that arises from the regulations for the approval of the system class of the SUT. A homologation data scenario represents a semi-concrete or concrete scenario that can be assigned to a logical scenario.*

Literature

89 Influencing factor

Definition. *An influencing factor factor (parameter) which has an impact on a traffic situation.*

Literature

90 Infrastructure Ground Truth

Definition. *Data of the type "Ground Truth Data" taken from the source of an infrastructure sensor. The data must meet defined qualities.*

Literature

91 Input Data

Definition. *Input data is the data that is uploaded to the PEGASUS database in PEGASUS input data format and processed there by the database mechanics. This can be e.g. field operational test (FOT), NDS, accident or simulation data. The data must at least meet the requirements of the minimum data set.*

Literature

92 Input Generator

Definition. *The input generator is part of the simulation core and provides the simulation models and the simulation core extensions with a prepared world state. This processing can include filtering or an adaptation of the world state. The preparation of the world state is based on the defined inputs of the simulation models and simulation core extensions.*

Literature

93 Instantiation Data

Definition. *Instantiation Data is to be understood as messages that include all necessary information for the simulation system to instantiate a simulation / scene. Once it is instantiated it can be started by a runtime command.*

Literature

94 Internal Data Storage

Definition. *The internal data storage is part of the logging engine and is used to store the data recorded by the data logger. The internal data storage can be expanded or supplemented by an external data storage.*

Literature

95 IT Standard

Definition. *An IT standard is understood to be a standard of a standardization organization such as International Organization for Standardization (ISO), OMG, ASAM or Modelica that describes a data model, an IT interface or algorithms. In connection with automated driving, a distinction must be made between IT in the vehicle, IT in the backend and IT for the development or protection of vehicles or backends.*

Standards for IT in the vehicle are classified as product standards in connection with SET Level 4to5. Examples of IT standards are OpenSCENARIO, OpenDRIVE, OSI from ASAM or FMI and SSP from the Modelica Association.

Literature

96 Late Fusion

Definition. *This fusion scheme combines decision outputs of each domain specific processing of a sensing modality. Late fusion has high flexibility and modularity. When a new sensing modality is introduced, only its domain specific processing needs to be added, without affecting the processing of other modalities. However, it suffers from high computation cost and memory requirements. In addition, it discards rich intermediate features which may be highly beneficial when being fused. [FHSR$^+$20, p.8]*

Literature

- D. Feng, C. Haase-Schütz, L. Rosenbaum, H. Hertlein, C. Gläser, F. Timm, W. Wiesbeck, and K. Dietmayer. Deep multi-modal object detection and semantic segmentation for autonomous driving: Datasets, methods, and challenges. *IEEE Transactions on Intelligent Transportation Systems*, pages 1–20, 2020

97 Layer 1 - Road geometry and topology

Definition. *Layer 1 of the six layer model describes the physical properties of the road. This includes the road geometry and topology as well as the road surface. Furthermore, the condition and the limitation in the plane are defined.*

Literature

98 Layer 2 - Road furniture and rules

Definition. *Layer 2 of the six layer model describes the "where" and "how" to drive on the road within the traffic rules applicable there. Layer 2 supplements Layer 1 by the structural limitation of the roadway such as the guardrail, the lane such as lane markings (lines, nail strips, ...), traffic signs and applicable traffic rules including e.g. instructions from the police.*

Literature

99 Layer 3 - Temporary physical limitations

Definition. *Layer 3 of the six layer model describes temporary influences or impairment of the driving space. These include for instance: construction site markings (e.g. construction site beacons, temporary lane markings), lost cargo, fallen trees, dead animals.*

Literature

100 Layer 4 - Movable objects

Definition. *Layer 4 of the six layer model describes the behavior and movement of the relevant dynamic objects in relation to the VUT, which potentially and factually influence the behavior and movement of the automated vehicle. This includes for instance other vehicles and pedestrians that move relative to the vehicle.*

Literature

101 Layer 5 - Environment conditions (road weather)

Definition. *Layer 5 of the six layer model describes the influence of environmental conditions, e.g. rain or light conditions on the system performance. You can influence the properties of other layers. The parameters include, for example, the lighting conditions (brightness, glare, ...), the weather (rain, snow, fog, ...) and the temperature.*

Literature

102 Layer 6 - Digital Information

Definition. *Layer 6 of the six layer model describes the quality and availability of relevant digital information or its interference on the VUT or SUT. They can induce or influence a scenario. This digital information can be available via V2X communication or via a data storage in the vehicle. They also include digital maps and backend servers.*

Literature

103 Lead Vehicle Challenger (A)

Definition. *The lead vehicle challenger (A) is a logical scenario in which according to the relative path* A *in Fig. 3 on page 22 the vehicle/object is moving towards the front of the VUT, which at the beginning of the scenario was in the travel path in front of the VUT.*

Literature

104 Library for Evaluation Modules

Definition. *A library for evaluation modules stores evaluation modules that can be loaded by an evaluation system. The evaluation modules must be in a defined and executable form.*

Literature

105 Library for Simulation Core Extensions

Definition. *Extensions are stored in a library for simulation core extensions, which can be connected to a simulation core. The extensions must be in a defined and executable form.*

Literature

106 Library for Simulation Models

Definition. *Simulation models are stored in a library for simulation models that can be connected to a simulation core. The simulation models must be in a defined and executable form.*

Literature

107 Logging Data

Definition. *Logging Data is to be understood as an umbrella term for everything that is logged. It consists of Simulation Data and Simulation Core Data, as well as Extension Data. Further information can be found on the corresponding pages Simulation Data, Simulation Core Data and Extension Data.*

Literature

108 Logging Engine

Definition. *The logging engine is part of the simulation core and is responsible for recording data. The data can be stored in an internal or external data memory. A distinction is made between data of the simulation core execution and data during the execution of a concrete scenario.*

Literature

109 Logical Domain

Definition. *Technology-independent space for considering the content and scope of a functionality, taking additional (to the functional domain) into account non-functional requirements (keyword RAMST: e.g. reliability, availability, manufacturability / maintainability, safety / security, testability) from the developer's perspective.*

Literature

110 Logical Scenario

Definition. *A logical scenario instantiates a functional scenario by precisely defining and confining relevant open and fixed parameters. It leaves (some) parameters open, but contains all other relevant information regarding setting (i.e. environment, e.g. map, climate) and participants (i.e. dynamic elements, e.g. cars and pedestrians). Open parameters are confined by parameter intervals (i.e. spectrums, possibly along with a probability distribution). From a logical scenario, sets of concrete scenarios can be derived/instantiated by selecting concrete parameters from the particular parameter interval.*

For instance, a functional scenario can account for a car changing from the left lane or from the right lane while the ego car is on the middle of three lanes (while further logical scenarios account for the diff rent possible positions of the ego car). Or in the right turn scenario, a more concrete version accounts of one pedestrian crossing the street the car turns into coming from the same direction as the car.

Literature

111 Logical Scenario Class

Definition. *Declaration of a logical scenario (sequence and attribute/parameter declaration). Also contains parameter limits, dependencies, etc. which are already clear before filling with data and declare the logical scenario.*

Literature

112 Logical Scenario Concept

Definition. *The logical scenario concept is a systematic description of the traffic or traffic area in a parameterized space. It allows an unambiguous classification of the relationships and should capture them sufficiently completely for a validation process. The concept is made up of a number of logical scenario classes.*

Literature

113 Logical Scenario Instance

Definition. *The logical scenario instance is a filled logical scenario class. I.e. the scenario belongs to the class and fills all declared parameters with concrete distributions. These distributions can also be the trivial distribution and thus represent semi-concrete or even concrete scenarios.*

Literature

114 Maneuver

Definition. *Description of the behaviour of an object as temporal sequence.*

Literature

115 Mathematical model

Definition. *The mathematical model comprises the mathematical equations, boundary values and initial conditions needed to describe the conceptual model. Therefore, the mathematical model can be seen as a subset of the conceptual model. Notably, there are divergent definitions present in literature, where these two model forms are considered separately from each other [Sch07].*

Literature

116 Measurement Data Scenario

Definition. *A measurement data scenario represents a concrete scenario recorded in the real environment, which was extracted from an input data record based on measurement data and can be assigned to a logical scenario by the database mechanics. A measurement data scenario is a concrete scenario extracted from measurement data.*

Literature

117 Method Standard

Definition. *A method standard is understood to be a standard of a standardization organization such as ISO or Deutsches Institut für Normung (DIN) that describes a procedure/an algorithm as a conceptual basis in order to achieve a specified goal as planned. In connection with virtual protection for automated driving, data models, interfaces or algorithms as well as for architectures, ontologies or the development* *of processes and tools (IT tools) can be derived from method standards. The term* method *should not be confused with the term* tool *or* tools*. Rather, the method describes the way in which specific tools or tools are used to achieve a goal. An example of a method standard is ISO 34502. This standard describes the method to achieve safety for automated driving functions through system analysis (operational design domain (ODD)), development of scenario-based tests and testing.*

Literature

118 Metric

Definition. *A metric is a function that results from given input values such as e.g. measured variables generate a clear value.*

Literature

119 Metric Observer

Definition. *A metric observer is a module/component which looks at the simulation from the outside, evaluates situations or also monitors conditions and, if necessary, logs data and influences the simulation control/the simulation process.*

Literature

120 Middle Fusion

Definition. *Middle fusion is the compromise of early and late fusion: It combines the feature representations from different sensing modalities at intermediate layers. This enables the processing to use different feature representations across modalities and at different depths. Although the middle fusion approach is highly flexible, it is not easy to find the „optimal" way to fuse intermediate layers. [FHSR+20, pp.8-9]*

Literature

- D. Feng, C. Haase-Schütz, L. Rosenbaum, H. Hertlein, C. Gläser, F. Timm, W. Wiesbeck, and K. Dietmayer. Deep multi-modal object detection and semantic segmentation for autonomous driving: Datasets, methods, and challenges. *IEEE Transactions on Intelligent Transportation Systems*, pages 1–20, 2020

121 Middleware

Definition. *Software that has an intermediary function between the various applications of a computer and its operating system. [Col21a]*

Literature

Collins English Dictionary. middleware: Definition of middleware, 2021

122 Milestone

Definition. *Milestones typically refer to points in time when new phases begin or when large planned events or series of events are completed. In addition, milestones usually define so-called „control gates“ at which point in time (design) decisions are made or reviews are carried out.*

Literature

123 Minimal Data Set

Definition. *The minimum data set defines the necessary input data signals and input data quality, which must at least be available in order to be able to guarantee processing by the database mechanics. In addition, minimum frequencies and minimum accuracies are defined.*

Literature

124 Mitigation Mechanism

Definition. *A mitigation mechanism can be driving maneuvers, options for action or features that are used in a class of scenarios e.g. for reducing the severity of an inevitable accident.*

Literature

125 Model Qualification

Definition. *Is intended to ensure that the simulation model works correctly according to specification and in the defined intended purpose. Taking into account the risk in relation to impact (which decision do I make based on the simulation results) and what options do I have to find the error (Error Detection)* $\Rightarrow$ *This means errors from the specification to the implemented simulation model (interface errors, numerical Mistake, ...).*

Literature

126 Object

Definition. *An object corresponds to the representation of a real object that influences the guidance of a vehicle. Objects can be divided into dynamic and static variants according to their use in the different scenario layers.*

Literature

127 Occlusion

Definition. *Occlusions (i.e. concealments) describe restrictions on the perception of the vehicle under test that are caused by other road users. An occlusion is a form of a reinforcing factor.*

Literature

128 Ontology

Definition. *Ontologies in the narrower sense of computer science are logic-based data representations. On the one hand, an ontology specifies a terminology (language) with classes and relations. In this terminology, objects are described with their properties and relationships, which results in a lot of data as an instantiation of the terminology. In addition to the terminology, there are axioms and rules that further describe the possible instantiations through objects. An essential part of an ontology tool is a reasoner (a reasoning component), which applies rules or checks their compliance. Terminology with axioms and rules are often referred to as T-Box (Terminological Box), the instance as A-Box (Assertional Box).*

Literature

129 Open Simulation Model Packaging

Definition. *Open Simulation Interface (OSI) Sensor Model Packaging specifies ways in which models (like e.g. environmental effect models, sensor models and logical models) using the OSI are to be packaged for their use in simulation environments using FMI. [Ass21]*

Literature

- Association for Standardization of Automation and Measuring Systems. Osi sensor model packaging, 2021

130 Operational Concept

Definition. *Description of a system in terms of its environment, the elements, their behavior, and their relationships to one another, with a focus on what the system does (not how it does it) and why. The characteristics of the system are described from the perspective of a higher-level observer (e.g. users and moderator and other participants).*

Literature

131 Operational Design Domain

Definition. *ODD is defined as the set of all "operating conditions for which a given SUT (driving automation system) is designed, including all restrictions regarding environmental, geography and time of day and/or the required presence or absence of certain traffic or road features". The ODD is the design area of a SUT with regard to its operation.*

Literature

132 Operational Domain

Definition. *The operational domain is the traffic area in which the ODD is defined restrictively. The operational domain contains all elements of the environment of* *the ADS and their relationships to each other. Scenarios and assigned parameter spaces are a suitable means of description.*

Literature

133 Organisational Capability

Definition. *An organization's potential to achieve a desired effect (e.g. continuous product safety improvment) realized through a combination of ways and means along with specified measures.*

Literature

134 Output Generation

Definition. *The Output Generation is the data that was generated with the database mechanics and serves as the basis for the test concept. The data played out include amongst others: Logical scenarios in the format OpenSCENARIO, OpenDRIVE, distributions for the parameters in the associated parameter spaces and evaluation metrics with the associated pass fail criteria. Restrictions can also be taken into account, e.g. refer to the limits of the driving function (ODD).*

Literature

135 Over the Air

Definition. *A (radio) signal is emulated based on a reproduction of the environment. The system under test receives the emulated signal by wireless transmission as opposed to using cables. The evaluation includes the antennas of the device under test. [KLHT11, pp. 1-2]*

Literature

W. A. T. Kotterman, M. Landmann, A. Heuberger, and R. S. Thomä. New laboratory for over-the-air testing and wave field synthesis. In *2011 XXXth URSI General Assembly and Scientific Symposium*, pages 1–4, 2011

136 Overtaking Side Swipe Challenger (F)

Definition. *The overtaking side swipe challenger (F) is a logical scenario in which according to the relative path* F *shown in Fig. 3 on page 22 a vehicle/object at the end of the scenario moves relatively to the side of the VUT, which at the beginning of the scenario moves outside the Driving hose behind the VUT.*

Literature

137 Overtaking Turn Into Path Challenger (C)

Definition. *The overtaking turn into path challenger (C) is a logical scenario in which according to the relative path "C" in Fig. 3 on page 22 a vehicle/object cuts in front of the VUT, which at the beginning of the scenario was outside the vehicle path behind the VUT.*

Literature

138 Parameter

Definition. *Parameter refers to the Ancient Greek $\pi\alpha\rho\alpha$: "beside", "subsidiary"; and $\mu\epsilon\tau\rho o\nu$: "measure". A parameter describes generally any characteristic that supports to define or classify a particular system. If a system is modeled by equations, the system is described by parameters. In computer programming, a parameter used in a subroutine to refer to one of the pieces of data provided as input to the subroutine.*

Literature

139 Parameter Range

Definition. *The parameter range defines valid value range of a parameter. This can be formalized as parameter $p \in [Min, Max]$ where Min is minimum and Max is maximum of the paramater value. For computer programming a value [range] of an argument is [...] the allowable range of values as defined by the invoked method.*

Literature

140 Parameter Space

Definition. *The parameter space describes the scenario parameter combinations occurring in the test specifications within a logical scenario. As part of this representation, dependencies between the scenario parameters can also be described.*

Literature

141 Pass/Fail Criteria

Definition. *Passing criteria are the criteria that the SUT (or VUT) must meet within a specific test case in order to pass it.*

Literature

142 PEGASUS data base system

Definition. *The PEGASUS database consists of a database, the processing chain, the back end and the front end. It can be accessed by the user via the front end (the database website).*

Literature

143 PEGASUS Input data format

Definition. *The input data format/PEGASUS format is a uniform format into which the input data must be transformed before being uploaded to the database in order to be processed by the database mechanics. Among other things, it defines the file format, the signal designations and the conventions for designating the surrounding vehicles. The signals are defined using JSON files. The file format is MAT or HDF5.*

Literature

144 Physical Architecture

Definition. *A physical architecture is an arrangement of physical elements (system elements, including software and physical interfaces) which provides the design solution for a product, service, or enterprise, and is intended to satisfy logical architecture elements and system requirements. It is implemented through technologies.*

Literature

145 Physical Domain

Definition. *Consideration of the specific implementation (configuration) that meets the technical requirements and serves the technical interfaces.*

Literature

146 Platform Runtime Control

Definition. *The platform runtime control is part of the simulation platform control and coordinates the execution of the analysis tasks in cooperation with the scenario manager. This is done using a defined schedule.*

The platform runtime control is superordinate to the simulation core runtime control, for example for co-simulation.

Literature

147 Plausibility

Definition. *Plausibility is a criterion for evaluating the justifiability of statements. A statement is classified as plausible if its justification is plausible, comprehensible, understandable (i.e. capable of a majority).*

Literature

148 Post Encroachment Time

Definition. *The post encroachment time (PET) is a metric to assess scenarios (e.g. in a simulation). It is the time span between the moment a first traffic participant leaves a point (or area) of interest and a second traffic participant enters the point (or area) of interest.*

Input:

- *An area (or point) of interest* A_c
- *The time point* t_l *an agent leaves* A_c
- *The time point* $t_e \geq t_l$ *another agent enters* A_c

Calculation: $t_e - t_l = PET$
Output: PET

Literature

149 Probability of occurence

Definition. *The probability of occurrence includes exposure to a hazardous situation, the occurrence of a hazardous event, and the probability of mitigating damage.*

Literature

Safety aspects — Guidelines for their inclusion in standards. Standard, International Organization for Standardization, Geneva, CH, April 2014

150 Process

Definition. *A process describes a collection of activities that should lead together to the achievement of goals in a project. The next finer level in the process is represented by phases.*

Literature

151 Process Standard

Definition. *A process standard is understood to be a standard of a standardization organization such as ISO or DIN that describes a process on the basis of defined functions/work steps as well as their input and output parameters.*

Applying a process results in a product. In connection with the virtual safeguarding for automated driving, functions can be described in process standards that can be supported by IT tools.

An example of a process standard is ISO 26262. This standard describes the process to ensure safety for E/E-based functions in vehicles. Other process standards for E / E processes are e.g. CMMI or A-SPICE.

Literature

152 Processing

Definition. *Performing mathematical and logical operations on data according to programmed instructions in order to obtain the required information.[Col21b] For radar sensors, typically several functional stages are passed that affect the characteristics and representation format of information. [HSD19, p.124] Similar considerations are applicable to lidar sensors. [RHZ+19, p.139]*

Literature

- Collins English Dictionary. processing: Definition von processing, 2021
- Martin Holder, Zora Slavik, and Thomas D'hondt. Radar signal processing chain for sensor model development. In Andrea Leitner, Daniel Watzenig, and Javier Ibanez-Guzman, editors, *VALIDATION AND VERIFICATION OF AUTOMATED SYSTEMS*, pages 119–133. SPRINGER NATURE, [Place of publication not identified], 2019

- Philipp Rosenberger, Martin Holder, Marc René Zofka, Tobias Fleck, Thomas D'hondt, Benjamin Wassermann, and Juraj Prstek. Functional decomposition of lidar sensor systems for model development. In Andrea Leitner, Daniel Watzenig, and Javier Ibanez-Guzman, editors, *VALIDATION AND VERIFICATION OF AUTOMATED SYSTEMS*, pages 135–149. SPRINGER NATURE, [Place of publication not identified], 2019

153 Product Standard

Definition. *A product standard is understood to mean a standardization organization standard such as ISO or DIN, which describes product features such as properties, functions, interfaces, or technical products for technical products to be observed. In connection with the virtual hedging for the automated driving, terms to be used from product standards, data models, interfaces or algorithms and for architectures, ontologies or the development of processes and methods are derived.*

Standards for the IT in the vehicle (embedded software on the vehicle ECU) are classified as a product standard in the context of SET LEVEL 4TO5. Examples of product standards are requirements for functions for the automated driving as e.g. ACC.

Literature

154 Project

Definition. *A project describes an extensive but time-limited undertaking that is designed to achieve a defined goal. It is characteristic of a project that a number of different tasks, which can be dependent on each other, have to be processed.*

Literature

ISO 15288

155 Proof of Release

Definition. *The proof of release is an assurance case that requires the fulfillment of several specific top-level claims relevant to release (not just safety). Therefore, the proof of safety is a necessary part of the proof of release, but not sufficient, since next to safety other claims must be fulfilled for the release (traffic regulation compliance, positive risk balance, [⇒ reference other claim types/top goals]).*

Literature

156 Quality Assumption

Definition. *Preamp of the categories "Reference" or "Ground Truth" and "Under Test" for perception data.*

Literature

157 Quality Criterion

Definition. *Quality criteria define distinguishing features of a quality for a condition, a decision or a fact. Example: Falling below a value is necessary for a release.*

Literature

158 Range

Definition. *A sensor range specifies an interval of radial distance from the sensor in which a specified detection performance is reached. The range may differ for different angles of a sensor. Detections or sensor readings may occur outside of the specified sensor range.*

Literature

159 Real Environment

Definition. *All scenarios performed with/within non virtual vehicle/environment. This includes both controlled conditions such as a proving ground and the real world.*

Literature

160 Real Perception Technology

Definition. *Actual perception of the world including secondary dirt effects that arise through a concrete implementation of the technology.*

Literature

161 Real World

Definition. *Real traffic, possibly including other traffic participants. Real world testing has the advantage that the whole system is tested under realistic conditions. However, it is difficult to trigger challenging situations, so for most of the time, the tested situations are easy to handle for most systems. [JWKW18, p.493]*

Literature

P. Junietz, W. Wachenfeld, K. Klonecki, and H. Winner. Evaluation of different approaches to address safety validation of automated driving. In *2018 21st International Conference on Intelligent Transportation Systems (ITSC)*, pages 491–496, 2018

162 Real-Time Simulation

Definition. *For real-time simulation, a simulation with discrete time steps and constant step duration is assumed. The simulator must accurately produce internal variables and outputs within the wall-clock duration of the given time step. Any idle* *time due to faster simulation is lost, as opposed to accelerated simulation.[BVP10, pp.37-38]*

Literature

J. Bélanger, P. Venne, and J. Paquin. The what , where and why of real-time simulation. 2010

163 Rear End Challenger (I)

Definition. *The rear-end challenger (I) is a logical scenario in which according to the relative path "I" shown in Fig. 3 on page 22 a vehicle/object moves relatively towards the rear of the VUT that was in the driving hose behind the VUT at the beginning of the scenario.*

Literature

164 Rear End Turning Into Path Challenger (H)

Definition. *The rear end turning into path challenger (H) is a logical scenario in which according to the relative path "H" shown in Fig. 3 on page 22 a vehicle/object at the end of the scenario, viewed relative to the rear of the VUT moved to, which was outside the driving envelope behind the VUT at the beginning of the scenario.*

Literature

165 Redundancy

Definition. *A system configuration where parallel system components are used. Only one component is required in order for the system to be functional. This means that the other component may serve as backup if one of the components fails. Redundancy is commonly introduced as a measure to increase the overall system reliability. [Sta09, p.48-50]*

Literature

Rudolph Frederick Stapelberg. *Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design.* Springer London, London, 2009

166 Replay2Sim

Definition. *Replay2Sim is a method that makes it possible to transfer recorded real data into a concrete scenario (measurement data, abstract scenario description) and to transfer it directly to the playback format.*

Literature

167 Replay2Sim Scenario

Definition. *A Replay2Sim scenario is based on a measurement data scenario, in which the input data can be directly interpreted in a machine-readable format (eg. ASAM OpenX). It contains old trajectories and no scenarios parameters.*

Literature

168 Reporting

Definition. *Reporting is responsible for generating the evaluation report. The reporting is part of the evaluation system and consists of the result generator and the report generator.*

Literature

169 Reporting Generator

Definition. *The report generator is part of the reporting. It parses the results (raw data) according to a certain goal (goal metrics) evaluation and produces a report accordingly.*

Literature

170 Requirement

Definition. *A requirement is a textual or model-based description of what is expected of a system to be developed.*

Literature

ISO 15288 / ProSTEP

171 Resolution

Definition. *Smallest difference in measured quantity which can be distinguished by a sensor. Examples of commonly occurring resolution include, but are not limited to angular resolution, distance resolution or velocity resolution.*

Literature

172 Result Generator

Definition. *The result generator compiles the results generated by the evaluation modules. This compilation can be given to the simulation platform controller (to support the intelligent simulation control). They are also made available to the report generator.*

Literature

173 Risk

Definition. *Risk measures the danger that a traffic situation poses. Risk is a combination of the likelihood of harm occurring and the severity of the harm.*

Literature

Safety aspects — Guidelines for their inclusion in standards. Standard, International Organization for Standardization, Geneva, CH, April 2014

174 Runtime Command

Definition. *Runtime Commands are to be understood as the commands that have to be sent to the respective modules to do something at runtime (e.g. start a simulation).*

Literature

SetLevel

175 Safety Argument

Definition. *Constructs a safety case (including claims, arguments, and evidence) that a particular requirement has been met. The resulting argument shows that evidence supports the claims.*

Literature

Underwriters' Laboratories. *UL 4600: Standard for Evaluation of Autonomous Products*. Standard for safety. Underwriters Laboratories, 2020

176 Safety Case

Definition. *A safety case is a structured argument that a SUT is safe for a specific application/function in a specific/confined environment (including weather). It is complete, reproducible (i.e. in case probabilism is involved, the seeds have to be logged) and conclusive. With regards to simulation, safety cases can be composed of simulation runs (execution traces). In case probabilism is involved in the concrete scenarios of which the safety case is composed, the confidence in such a safety case correlates with the number of simulation runs.*

Evidence in this sense is factual (Nils: empirical?) proof for propositions. With regards to safety cases, it is atomic in the sense that it cannot be further divided logically. Evidence can be composed via test cases (i.e. consolidated via testing). (Nils: test cases, or the results of simulation runs?)

Literature

Underwriters' Laboratories. *UL 4600: Standard for Evaluation of Autonomous Products*. Standard for safety. Underwriters Laboratories, 2020

177 Safety Goal

Definition. *A safety goal is a top-level safety requirement as a result of the hazard analysis and risk assessment at the vehicle level.*

Note 1: One safety goal can be related to several hazards (3.75), and several safety goals can be related to a single hazard

Literature

Organización Internacional de Normalización. *ISO 26262: Road Vehicles : Functional Safety*. ISO, 2018 [3.139]

178 Safety Principle

Definition. *Safety principles describe an implication (If X, then Y.), the application of which supports the achievement of a safety goal. This can be e.g. driving maneuvers or options for action that reduce criticality in a class of scenarios (cf. mitigation action).*

Literature

VVM intern

179 Safety Relevant Traffic

Definition. *A safety-relevant traffic event describes a real time sequence in road traffic that lead to a critical situation, such as, e.g., an emergency braking or a traffic accident.*

Literature

Pegasus Glossary

180 Scan Line

Definition. *Curve in space along which lidar points are arranged.*

Literature

Vivaldi intern

181 Scattering Center

Definition. *Scattering centers are a model to describe the environment in a simplistic way. Large radar targets can be approximated with a sparse set of points called the scattering centers.*

Literature

M. Jasiński. A generic validation scheme for real-time capable automotive radar sensor models integrated into an autonomous driving simulator. In *2019 24th International Conference on Methods and Models in Automation and Robotics (MMAR)*, pages 612–617, 2019[p.614]

182 Scenario

Definition. *Description of the temporal development between several scenes in a sequence of scenes. Every scenario starts with an initial scene. Actions/events, as well as goals/values, can be specified to characterise this temporal development within a scenario.* SOTIF

A scenario is the description of the development over time in a sequence of scenes. Each scenario begins with an initial scene. Actions/events as well as goals/values can be set to determine the development of the scenario over time.

Unlike a scene, which describes a moment, a scenario describes a period of time.
VVM

A scenario is a more or less abstract description of

- *what is to be happen and*
- *what is to be measured.*

This includes a starting scene (which does not has to be deterministic) along with a description what is about to happen (which needs not necessarily be deterministic).

A scenario describes ***what*** *is to happen, not* ***how*** *(e.g., concrete information regarding a simulation platform is not required). A scenario is a mandatory part of a test case (article 241).*

Literature

S. Ulbrich, T. Menzel, A. Reschka, F. Schuldt, and M. Maurer. Defining and substantiating the terms scene, situation, and scenario for automated driving. In *2015 IEEE 18th International Conference on Intelligent Transportation Systems*, pages 982–988, 2015 Organización Internacional de Normalización. *ISO 21448:2022 Road vehicles — Safety of the intended functionality.* ISO, 2022

183 Scenario Description Language (SDL)

Definition. *A scenario description language (SDL) specifies, how a (logical or concrete) scenario can/has to be described syntactically. Two standards selected for SETLevel4to5 are OpenSCENARIO and OpenDRIVE.*

Literature

Association for Standardization of Automation and Measuring Systems. Asam opendrive, 2020 Association for Standardization of Automation and Measuring Systems. Asam openscenario, 2020

184 Scenario Engine

Definition. *A Scenario Engine is controlling the running of a scenario in the simulation. It can be part of the simulation core or come as an application connected to it.*

During the simulation initialization phase, the role of a scenario engine is to:

- *Read in and parse files needed to simulate a scenario: the open scenario file providing the scenario structure and the OpenDRIVE and OpenCRG Map files providing the road definition.*
- *Provide map data to the simulation core*
- *Provide to simulation core the list and definition of all agents needed in the scenario.*
- *Provide all simulation initialization information: initial Ground Truth including initial location on the Map of all agents within scenario, start time for scenario*

During simulation runtime, the scenario engine is:

- *Reading in from simulation core trigger command together with current time step and Ground Truth to proceed with next scenario iteration step.*
- *Processing the next scenario iteration step according to scenario schema contained in open Scenario file*
- *Sending a feedback to the simulation core with the Delta Ground Truth to be implemented in the environment*
- *Sensing simulation control requests, like stop simulating the scenario if scenario engine detected that the scenario reached end criteria.*

Literature

VVM / SetLevel intern

185 Scenario Generator

Definition. *A scenario generator is a tool allowing for automatized building (generating) of input files for the simulation framework (scenarios). It is an optional component of the simulation framework. Its output are concrete scenarios (and possibly additional information) that serve as input for the simulation framework. Its input are either a set of instructions for batch operations or input provided by the analysis.*

The scenario generator can be implemented in three complexities: Light, medium and heavy.

Light complexity: In a simplistic version, the scenario generator generates a batch of concrete scenarios based on permuting discretized parameter vectors of a logical scenario. For instance, consider a logical scenario "turn right" with one car and one pedestrian. Discretized input vectors might be velocities for the car (e.g., $v \in [10, 15, 20, 25, 30] km/h$*) and for the pedestrian (e.g.,* $v \in [3, 4, 5, 6, 7] km/h$*). A simplistic scenario generator takes the logical scenario and builds concrete scenarios, one for each combination of elements of both lists, resulting in 25 concrete scenarios.*

Medium complexity: A more sophisticated version exploits an upstream analysis. The scenario generator is then located in a feedback loop between simulation framework and analysis. Based on the analysis of previous simulation runs, it generates new scenarios that it makes available to the simulation framework. The exploration of the scenario space can be based on genetic algorithms or on optimal control strategies. Exploiting the scenario generator in this manner is analogous to the CEGAR approach (Counter Example Guided Abstraction Refinement) introduced by Edmund Clarke [CGJ+00].

Heavy complexity: In order to minimize simulation overhead, it is desirable to fork/branch simulation runs to approach areas of interest more efficiently (rare event simulation). To achieve this, the scenario generator does not only provide a concrete scenario to the simulation framework, but also control commands at runtime to enforce those simulation traces that approach a desired (e.g., critical region) best. A tight coupling with the simulation framework and the analysis function is required, providing for additional exchange of information that is required for manipulating/controlling the simulation during runtime.

Literature

Edmund Clarke, Orna Grumberg, Somesh Jha, Yuan Lu, and Helmut Veith. Counterexample-guided abstraction refinement. In E. Allen Emerson and Aravinda Prasad Sistla, editors, *Computer Aided Verification*, pages 154–169, Berlin, Heidelberg, 2000. Springer Berlin Heidelberg

186 Scenario Manager

Definition. *The scenario manager is part of the simulation platform control and manages the analysis tasks and scenarios to be carried out.*

To process logical scenarios, the scenario manager can interact with a specific scenario generator so that the logical scenario is converted into one or more concrete scenarios.

The scenario manager is also the component that transfers the evaluation criteria to the evaluation system and interacts with the evaluation system.

Literature

SetLeven intern

187 Scenario Parameter

Definition. *A scenario parameter is a value that is used to characterize a scenario (e.g. trajectory course).*

Literature

Pegasus method: An overview. last accessed 2023/05/16

188 Scenario Parameter Set

Definition. *A scenario parameter set is a vector in which a concrete value is assigned to all parameters of a logical scenario. It is a point in the parameter space or in other words a concrete scenario. The values for passing metrics and passing criteria can also be added to the scenario parameter set.*

Literature

Pegasus method: An overview. last accessed 2023/05/16

189 Scenario-defining Factor

Definition. *Scenario-defining factors are the parts of a scenario that define the affiliation to a scenario type/class. These can be defined on one or more layers. All parts that belong to a scenario but do not define it do not belong. The scenario-defining factor dictates the limits of cutting from a continuous drive, in the case of extraction from measurement data. By considering the scenario-defining factor, the affiliation of a scenario to a class (in particular a logical scenario class) can be clearly determined. Example: Scenario type/class cut-in. The scenario-defining factor is the cut-in challenger, which cuts in before the ego. Other elements such as occlusions or the road etc. can be part of the scenario, but are not a scenario-defining factor.*

Literature

VVM intern

190 Scene

Definition. *A scene is a snapshot at one discrete time point within a simulation run.*

Literature

S. Ulbrich, T. Menzel, A. Reschka, F. Schuldt, and M. Maurer. Defining and substantiating the terms scene, situation, and scenario for automated driving. In *2015 IEEE 18th International Conference on Intelligent Transportation Systems*, pages 982–988, 2015

191 Sensor

Definition. *Technical component that records certain physical properties in its environment as a measurement.*

Literature

Merriam-Webster.com Dictionary. Sensor, 5 2023

192 Sensor Fusion

Definition. *Combination of different signals within the perception chain into an integrated overall version. See also late fusion, middle fusion, early fusion.*

Literature

L.A. Klein. *Sensor and Data Fusion: A Tool for Information Assessment and Decision Making.* Press Monographs. Society of Photo Optical, 2004

193 Sensor under Test Raw Data

Definition. *Data of the type "Sensor Raw Data" from the source "Sensor (s) under Test".*

Literature

VVM intern

194 Sensor under Test Raw Data Labels

Definition. *"Sensor Raw Data Labels" data from the Sensor(s) under Test source.*

Complemental description: In VVM, this can be an interim result of the research partners who want to process "Sensor raw data" (SRD) into perception under test (PUT) data.

Literature

VVM/SetLevel intern

195 Separation of Concerns

Definition. *Principle of the architecture for solving concerns by dividing them into organizationally assignable solution elements, so that the system created with it is suitable for solving the concerns addressed.*

Literature

Edsger W. Dijkstra. *Selected Writings on Computing: A personal Perspective.* Springer New York, 1982

196 Setup Routine

Definition. *The setup routine is part of the simulation control and starts the components required for the simulation execution in the simulation core. In addition, the setup routine connects the simulation models, the simulation core extensions and the system under test based on a configuration, instantiates and parameterizes them. The setup routine also calls the consistency checker and the scenario engine (to initialize the world state).*

Literature

VVM/SetLevel intern

197 Severity

Definition. *Assessment of the extent of damage to one or more people that may occur in a potentially dangerous event.*

Literature

Organización Internacional de Normalización. *ISO 26262: Road Vehicles : Functional Safety.* ISO, 2018[3.154]

198 Side Swipe Challenger (E)

Definition. *The side swipe challenger (E) is a logical scenario in which according to the relative path "E" shown in Fig. 3 on page 22 a vehicle/object relative to the side of the VUT, which is at the beginning of the scenario next to the VUT.*

Literature

199 Simulated Ground Truth

Definition. *"Ground Truth Data" generated from the source of a simulation.*

Literature

The pegasus method, 2019. last accessed 2023/05/16[Test HAD-F: Simulation, Proving Ground, Real World Drive]

200 Simulation Control

Definition. *The simulation control is part of the simulation core, which controls the simulation sequence. The tasks of simulation control are, for example, the connection and initialization of the simulation models and simulation core extensions, the initialization of the start scene, the implementation of the specific scenario, consistency checks and runtime control of the simulation core.*

Literature

SetLevel

201 Simulation Core

Definition. *The simulation core is a minimal software component that provides all the generic functions that are required to carry out a simulation run.*

Examples of generic functionalities can be the control of the simulation, the mapping of the current scene at a specific simulation time step and the recording of data. Simulation models and simulation core extensions can be connected to the simulation core via defined interfaces. The simulation core initializes, uses and controls these connected simulation models and simulation core extensions. These simulation models and simulation core extensions do not have to be permanently stored in the simulation core, but can be connected and instantiated by external specifications.

Literature

SetLevel intern

202 Simulation Core Data

Definition. *Simulation Core Data is to be understood to hold information about the Simulation Core and its environment. This includes meta information about performance of the (simulation) software. It also can be seen as monitoring data.*

Literature

SetLevel intern

203 Simulation Core Extension

Definition. *A simulation core extension provides functionality that is used (or even absolutely required) to carry out a simulation run. These can also be functionalities that are already available in the simulation core (in this case the simulation core component is expanded). Simulation core extensions can also provide mechanisms for evaluating the simulation run. A simulation core extension is software that is separate from the simulation core and that serves an interface provided by the* *simulation core. Simulation core extensions can be stored in a library for simulation core extensions.*

Literature

SetLevel intern

204 Simulation Core Runtime Control

Definition. *The simulation core runtime control is part of the simulation control and, in cooperation with the scenario engine, coordinates the execution of the simulation run. This is done using a defined schedule and ensures the progress of the simulation time.*

The simulation core runtime control can be subordinated to a platform runtime control, for example for co-simulation.

Literature

205 Simulation Data

Definition. *Simulation Data is to be understood as the data that is interesting and important for the factual assessment of a simulation run. It includes, for example, information about what happened in the simulation and which messages were exchanged.*

Literature

SetLevel intern

206 Simulation Data Logger

Definition. *The simulation data logger is part of the logging engine and is responsible for recording all data during the execution of a specific scenario.*

Data during the execution of a concrete scenario is data that the world state contains and data that simulation models and simulation core extensions output.

Literature

SetLevel intern

207 Simulation Goal

Definition. *A Simulation Goal is the purpose for the creation and execution of simulation runs. Simulation Goals may be sub-dividable into (sub)simulation goals.*

Examples for Simulation Goals

- *classification of traffic situations into critical or noncritical*
- *verification of a system against its requirements*

Literature

SetLevel intern

208 Simulation Model

Definition. *A simulation model describes the simulation of the behavior of a real element exclusively by software. Since a simulation model can never exactly encompass all properties of the real counterpart, a simulation model is always an abstraction of the real element.*

Simulation models must provide mechanisms for external configuration and interaction.

Simulation models can be stored in a library for simulation models.

Literature

SetLevel intern

209 Simulation Platform

Definition. *The simulation platform is the combination of all components that are required to perform a simulation task. The simulation platform consists of the simulation system, the system under test, the simulation platform manager, the evaluation system, the external data storage, the library for simulation models, the library for simulation core extensions and the library for evaluation modules.*

The simulation platform has an interface for the configuration of the simulation platform and for the analysis task and an output interface for the test report.

Literature

SetLevel intern

210 Simulation Platform Configuration

Definition. *Simulation platform configuration refers to those machine-readable files that contain all the necessary information needed to run a simulation.*

Literature

211 Simulation Platform Control

Definition. *The simulation platform control is part of the simulation platform manager, which controls the entire simulation platform.*

It is the entry point for the analysis of a logical scenario or a concrete scenario.

The tasks of the simulation platform control are the initialization and the setup of the simulation platform by the simulation setup routine, the simulation runtime control and the administration of the scenarios by the scenario manager.

Literature

SetLevel intern

212 Simulation Platform Management

Definition. *The simulation platform management is the generic term for software that serves to control / manage the simulation platform.*

The simulation platform management consists of the simulation platform control and the optional concrete scenario generator.

Literature

SetLevel intern

213 Simulation Principle

Definition. *A simulation principle describes a process that automatically explores a large scenario space. Such principles are needed because the number of test cases required in the main simulation applications is too high to be defined manually.*

Explanations

An example application of the simulation is the risk assessment of a highly automated driving function in the room, which is spanned by a logical scenario. Criticality-driven exploration is a good option. For this, the entire room is initially roughly covered. Where criticalities emerge, coverage is systematically condensed until a sufficiently precise assessment of the risk is possible. The realization of criticality control requires a close integration of the different components of the simulation architecture.

Another principle would probably be used when testing a function. There the focus is probably more on broad coverage and the procedure would be different.

Literature

SetLevel intern

214 Simulation Quality

Definition. *Simulation quality is understood to mean the degree to which various quality criteria of a simulation model are met during development and execution. The aim of high quality is to create trust in the simulation results that arise from it.*

The relevant criteria and their weighting vary with the purpose of the simulation and the results generated with it.

Literature

SetLevel intern

215 Simulation Quality Criteria

Definition. *A simulation framework and its components can be evaluated according to various quality criteria. The relevant criteria and their weighting vary with the intended use of the simulation and its results. The main quality criteria are:*

- *Precision of a simulation run: accuracy with which the data series correspond to real data. Example: What uncertainty does the position of the ego vehicle have at any given time?*
- *Reproducibility of a simulation run:*
  - *Validity of a simulation method: The uncertainty (taking into account the precision of the simulation framework) which affects the result*
  - *Stability of a simulation framework: probability with which a simulation task is carried out without crashing.*

The above list does not claim to be complete.

Literature

SetLevel intern

216 Simulation Run

Definition. *A simulation run is the execution of a concrete scenario on a simulation framework. It is a result if finished or ongoing. It is reproducible if seeds for resolving probabilism are provided. In case the concrete scenario from which the simulation run was instantiated contains no probabilism, all simulation runs of a concrete scenario resolve in the same execution trace (i.e. reproducibility is implied).*

In case of the ego car having exclusively concrete values and deterministic behavior (i.e. absence of probabilism), simulation runs of concrete scenarios provide equal results.

Literature

SetLevel intern

217 Simulation Sequence

Definition. *The simulation sequence, like a cooking recipe, determines how a simulation is carried out and how the data is recorded.*

Literature

SetLevel intern

218 Simulation Setup Routine

Definition. *The simulation setup routine is part of the simulation platform control and starts the components required for performing the analysis task in the simulation platform. In addition, the simulation setup routine starts the specific scenario generator, if it is listed in the configuration of the simulation platform.*

Literature

SetLevel intern

219 Simulation Status

Definition. *Under Simulation Status is to be understood a message that can be (for example) "RUNNING", "IDLE"/"READY" or "ERROR".*

Literature

SetLevel intern

220 Simulation Step

Definition. *Within a simulation step, necessary calculations of the simulation system are carried out to advance the specific scenario.*

A simulation step can be a fixed or a variable time period. A variable time span can occur, for example, in event-driven simulation.

Literature

SetLevel intern

221 Simulation Step Sequence

Definition. *The simulation step sequence describes the sequence of execution of the various components during a simulation step.*

Literature

SetLevel intern

222 Simulation System

Definition. *The simulation system forms the generic term for software that can execute simulation runs. The simulation system consists of the simulation core, from (several) simulation models (e.g. driving dynamics model, sensor model, environmental model) and optional extensions. The system under test and other components can be connected to the simulation system.*

Literature

SetLevel intern

223 Simulation Time

Definition. *The simulation time represents the time advancing in the real system. The simulation time is increased in the form of simulation time steps. The simulation time steps are triggered by the simulation core runtime control.*

Literature

SetLevel intern

224 Simulation Time Step

Definition. *The simulation time step denotes the increment of the simulation time.*

Literature

SetLevel intern

225 Simulator

Definition. *A simulator interactively models the behavior of a component, an environment, or both. It is autonomous/closed in the sense that it does not necessarily rely on external input. Yet, it may provide interfaces for in- and output. A simulator requires a simulation platform to be executed.*

Literature

SetLevel intern

226 Situation

Definition. *A situation is a constellation in traffic that requires a decision. The situation can be seen as a point in time, it is not a process.*

Literature

[UMR+15]

227 Slower Rear End Challenger (G)

Definition. *The slower rear end challenger (G) is a logical scenario in which according to the relative path "G" shown in Fig. 3 on page 22 a vehicle/object at the end of the scenario moves relatively towards the rear of the VUT, which at the beginning of the scenario moves outside the driving hose in front of the VUT.*

Literature

228 Slower Side Sweep Challenger (D)

Definition. *The slower side sweep challenger (D) is a logical scenario in which according to the relative path "D" shown in Fig. 3 on page 22 a vehicle/object moves at the end of the scenario relatively viewed on the side of the VUT, which was located at the beginning of the scenario away from the driving hose in front of the VUT.*

Literature

229 Slower Turn into Path Challenger (B)

Definition. *The slower turn into path challenger (B) is a logical scenario in which according to the relative path "B" in Fig. 3 on page 22 the object cuts in front of the ego vehicle, which at the beginning of the scenario was outside the travel path in front of the VUT.*

Literature

230 Software in the Loop

Definition. *The Software-in-the-Loop method (SiL) allows for an assurance up to the level of the individual components. This is achieved by transferring the previously created models into a simulation environment that is very similar to the technical characteristics of the target system in terms of computing power, real-time behavior, or resolution accuracy but is still hardware independent (Martinus et al. 2013). Therefore, the software in the loop (SiL) method offers the possibility to check the specifications of the individual components of a system prior to its implementation and adjust them if necessary.[HK15a, p.165]*

Literature

Stephan Hakuli and Markus Krug. Virtuelle integration. In Hermann Winner, Stephan Hakuli, Felix Lotz, and Christina Singer, editors, *Handbuch Fahrerassistenzsysteme*, pages 125–138. Springer Fachmedien Wiesbaden, Wiesbaden, 2015

231 Standard

Definition. *A standard is understood to be a document from a standardization organization such as ISO or DIN that describes, for a technical field of application, what is to be understood by the terms used and what relationships exist in the context of the realization of technical products. A standard is seen as the state of the art and describes the fundamentals for teaching, implementation, design and approval of technical products. In connection with the virtual validation for automated driving, terms to be used for data models, interfaces or algorithms as well as for architectures, ontologies or the development of processes and methods can be derived from standards.*

The National Platform - Future of Mobility (NPM) created an overview of the relevant standards for automated driving in 2020: see here[19]*. This differentiates*

- *Management / engineering standards (→ method standards),*
- *Fahrer Assistenzsysteme (FAS) functions (→ product standards),*
- *Testing (→ Process Standards),*
- *Systems, networks, data and their interfaces (→ IT standards) and*
- *Human Machine Interface (→ human machine interface (HMI))*

Literature

SetLevel intern

232 System Architecture

Definition. *Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution.*

[19] `https://www.plattform-zukunft-mobilitaet.de/2download/schwerpunkt-roadmap-automatisiertes-und-vernetztes-fahren/`

Literature

[ISO11]

233 System Capability

Definition. *A system's potential to achieve a desired effect (e.g. target behavior) realized through a combination of ways and means along with specified measures.*

Literature

[Sys]

234 System under Test

Definition. *The system under test (SUT) is, like components, not necessarily part of the simulation framework. While the simulation must be able to execute without the SUT, the SUT acts as an independent agent. [SL]*

The system to be tested is called the system under test. The complexity of the SUT used depends on the tests to be carried out. [VVM]

Literature

[ISTa]

235 Tactical Limitation

Definition. *An tactical limitation describes a static or dynamic object in the environment of the ego vehicle, which restricts the options for action of the ego vehicle to avoid a collision.*

A restriction of action for the SUT in the VUT is another form of a requirement-increasing factor.

Literature

SetLevel intern

236 Target Behavior

Definition. *Target behavior is the behavior to be implemented by an actor in a scenario-specific context, derived from legal, social and ethical rules and security mechanisms.*

Literature

[SHR+22]

237 Task

Definition. *A task describes a work order in a phase. Tasks thus define a process as the smallest unit. A task can have predecessors and successors and is completed by its generated output.*

Literature

[ISO15]

238 Taxonomy

Definition. *A taxonomy is a set of terms, including their definition, setting these terms into mutual relation.*

Literature

[AL73]

239 Technical Test Specification

Definition. *Detailed formulation (complete, precise, verifiable) describing the activities to determine characteristic technical properties according to the technical requirements of a specific use. Technical test specification includes for example*

- *Test preconditions*
- *test procedure*
- *Test end criteria*
- *parameters*
- *Measurands*
- *Number of repetitions*

Literature

[ISTd]

240 Test Automation

Definition. *Test automation is a method for the automated generation and execution of specific test cases. The concrete test cases are created by deriving the test case from the logical test case within a parameter space.*

Literature

[PEGc]

241 Test Case

Definition. *A test case is a document specifying*

- *what has to be tested (i.e., SUT, and concrete/logical scenario)*
- *how it has to be tested (i.e., test specification, the setup/configuration of the simulation environment and - in case a logical scenario is provided - rules for traversing the parameter space), and*
- *what the expected/desired outcome is.*

Literature

SetLevel intern

242 Test Class

Definition. *Categorizes test methods for specific purposes, e.g.:*

- *Verification/Validation*
- *Positive/negative tests*
- *Uncover emergences in development/in the field*

Literature

VVM intern

243 Test Concept

Definition. *The test concept determines in which test environment (e.g. simulation, test, field) the logical scenarios with the associated parameter values are tested and sets the requirements for these. For example, the test sequence can be determined and the relevance of individual tests and uncertainties can be determined.*

Depending on the ODD of the SUT, the areas of validity are planned, the general procedure, the definition of the application limits of the test environments, the identification of resources and the scheduling of the intended tests. Furthermore, depending on the choice of test environment, risks and deficiencies are described.

Literature

[PEGd]

244 Test Data

Definition. *Data created or selected to satisfy the input requirements for executing one or more test cases, which can be defined in the test plan, test case, or test procedure.*

Literature

[IEE21]

245 Test Instance

Definition. *Specification of a generic test platform (hardware in the loop (HiL), SiL, test site, field) by application-oriented naming of specific parts of it (e.g., simulation environment x, software y).*

Literature

VVM intern

246 Test Means

Definition. *All artifacts/test tools with requirements and other documents needed to perform tests.*

Literature

[ISTb]

247 Test Plan

Definition. *Organizational planning or scheduling of tests.*

Literature

[ISTc]

248 Test Specification

Definition. *A test specification comprises a setup and configuration for a simulation system that are compliant with a specific test case.*

Literature

[ISTd]

249 Test Tool

Definition. *Describes a specific technical aid that is required for the execution of tests (e.g. external reference sensors, PC, etc.)*

Literature

VVM intern

250 Threat

Definition. *Potential cause of an unwanted incident that may result in harm to a system or organization.*

Literature

[ISO17]

251 Time-to-Collision (TTC)

Definition. *The TTC is a measure to assess a traffic scenario (e.g. in a simulation). It predicts the time to collision between objects according to dynamics models.*

Input:

- *Initial situation (N static/dynamic objects and their status (position, form,..) at time t_0*

- *dynamics model for all objects*
- *time span $T = [t_0, t_0 + t_H)$ for which a trajectory prediction shall be made*

Literature

[BHS]

252 Tool Qualification

Definition. *Tool qualification is intended to ensure that the tool works correctly in accordance with the specification and in the defined purpose. Tool classification levels are used that take into account the risk with regard to impact and error detection and derive measures from this. Depending on the level, these can take into account the following things:*

- *Increased confidence from use,*
- *evaluation of the tool development process,*
- *validation of the software tool,*
- *development in accordance with a safety standard*

Literature

SetLevel intern

253 Trace Link

Definition. *Trace links define a relationship between two artifacts.*

Literature

[ISO15]

254 Traceability Method

Definition. *The "traceability method" is an optional component of the "evaluation system" and is used to establish traceability in the context of the "credible generic simulation process".*

Literature

SetLevel intern

255 Traffic Simulation Vehicle (TSV)

Definition. *Traffic simulation vehicles are all vehicles in a simulation/on the test site that surround the VUT (e.g. challengers, action-restricting vehicles, surrounding traffic).*

Literature

[PEG19]

256 Use Case

Definition. *A use case describes the externally visible (technical) desired behavior of a system from the perspective of one or more actors. An actor is a user or anything that can exchange information with the system to be developed. One use case bundles possible scenarios, i.e. multiple scenarios can be derived from a use case. In particular, the use case describes what the actor wants to achieve with the system and not how the goal is to be achieved.*

- *A use case can be validated for example utilizing test cases.*
- *Components of a use case description:*
  - *Title*
  - *Short description*
  - *Actors*
  - *Preconditions*
  - *Description of the externally visible (technical) desired behavior*
  - *Effects (causality)*
  - *Additional comments*

Literature

[Mera]

257 Validation

Definition. *The (model) validation describes the process of determining the degree to which a model or simulation is an accurate representation of the real world from the perspective of the intended uses of the model and simulation. Phase-dependent, the validation can be divided in the conceptual validation and the operational validation.*

Literature

[Merb]

258 Validation Method

Definition. *A validation method describes a systematic procedure, as a sequence of activities, which must be undertaken to fulfill the goal of validation of a model with respect to the intended use. Thereby, the method describes "what" is to be done to achieve this goal ("why"). A method itself contains experience, as well as constraints. In addition, methods can contain other methods.*

Literature

SetLevel intern

259 Validation Technique

Definition. *A validation technique describes the concrete implementation of an activity defined in the validation method. Thereby, the technique includes "how" to contribute to the goal of demonstrating the validity of a model with respect to the intended use. Validation techniques can be used in multiple validation methods to generate artifacts.*

Literature

SetLevel intern

260 Variation and Exploration Module

Definition. *The variation and exploration module generates concrete parameter values for one or more concrete scenarios based on a logical scenario in accordance with the variation or exploration strategy.*

Literature

SetLevel intern

261 Vehicle in the Loop

Definition. *Vehicle-in-the-Loop (ViL) is a newer method for usefully complementing and enhancing the development of advanced driver assistance systems with the V-model. It addresses the need of many driver assistance functions for a complex test drive and a high standard of functional safety. This group of driver assistance functions will progress in importance and size. A major reason for this is the growing number of vehicle variants that offer driver assistance functions and which must remain safe even with the ever-increasing degree of automation and network integration. The ViL method allows the operation of the real test vehicle in a virtual environment. The coupling between the vehicle and the virtual environment can be done in two ways. One way is by creating an interface to the available environment sensors and, thus, replacing the real sensors. At this interface, the simulation environment is feeding simulated sensor signals, which correspond to the sensor response from a real environment. [HK15a, pp.166,167] Otherwise it is possible to maintain the real sensors and stimulate them artificially, as it is possible for Radar sensors [BAB+21], Lidar sensors, camera and ultrasonic sensors [RGN17]. In both variants, the real test vehicle responds to attributes and events of the virtual environment. This way, critical driving maneuvers with obstacles or objects on a collision course can be tested reliably and reproducible. The created interface can also be used to generate the sensor signals as they would occur due to a changed position in a vehicle variant or due to different tolerances. This method therefore offers the possibility to test these variants or tolerances with a single test vehicle. In addition to the considerably more safe test operation, this allows efficient testing and application of advanced driver assistance systems. This results in a substantial economic gain with respect to the test drive when it comes to driver assistance systems. [HK15a, pp.166,167]*

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- Romain Rossi, Clement Galko, and Hariharan Narasimman. 11 vehicle hardware-inthe-loop system for adas virtual testing. 2017

262 Vehicle Top Box

Definition. *The Vehicle Top Box is a vehicle-mountable device containing high accuracy sensors.*

Supplement: It is located in VVM on the AVL vehicle. It is to be used to record "Sensor Raw Data" in VVM, from which a "Dynamic Ground Truth" is created.

Literature

VVM/SetLevel intern

263 Vehicle Top Box Raw Data

Definition. *Sensor Raw Data data from the Vehicle Top Box source. Supplement: In VVM input for Understand. AI to determine the dynamic ground truth (DGT).*

Literature

VVM/SetLevel intern

264 Vehicle Top Box Raw Data Labels

Definition. *'Sensor Raw Data Labels' data from the 'Vehicle Top Box' source. Supplement: In VVM intermediate result of Understand. AI for determining the DGT.*

Literature

VVM/SetLevel intern

265 Vehicle under Test (VuT)

Definition. *The Vehicle Under Test (VUT) is the vehicle whose automated driving function is being tested. Data recorded by a VUT describe the traffic situation from its perspective relative to its own state.*

Literature

VVM/SetLevel intern

266 Virtual Environment

Definition. *Being on or simulated on a computer or a computer network. [Mer21]*

Literature

Merriam-Webster.com Dictionary. Virtual, 12.04.2021

267 Virtual Validation

Definition. *Validation activity performed in a virtual environment.*

Literature

268 Visibility

Definition. *Visibility is the amount of available sensor data corresponding to an object. It therefore always corresponds to a given observer, sensor or sensor setup. The number of image pixels or detections of Lidar or Radar sensors may be used to quantify visibility. [CBL+] Visibility may be reduced by environmental conditions such as weather or by occlusion.*

Literature

[CBL+]

269 Visualization

Definition. *The "Visualization" is an optional "Simulation Core Extension" for connection to the simulation core. It enables, e.g., a 2D or 3D representation of the map, objects, agents etc.*

Literature

SetLevel intern

270 World Model

Definition. *A representation of the perceived or captured environment.*

Literature

[AHW92]

271 World State

Definition. *The world state is part of the simulation core and maps the current scene at a specific simulation time step. The current scene consists of the scenery, the dynamic elements, the self-representation of all actors and observers as well as the linking of these entities.*

The world state can be subordinated to an external world state, for example for co-simulation.

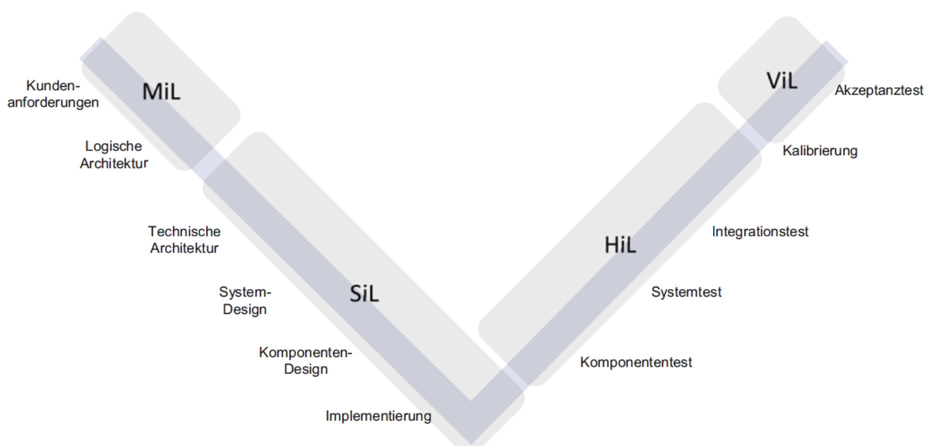
Literature

VVM/SetLevel intern

272 X in the loop

Definition. *X in the loop (XiL) is representative of all in-the-loop methods. The different types may be categorized according to the V-Model as shown in Figure 4.[HK15b, p.130]*

Figure 4: X-in-the-Loop [HK15b, p.130]



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[ISTc] ISTQB. Testplan.

[ISTd] ISTQB. Testspezifikation.

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