

Final Event 21 / 22 November 2023

Design & Test Planning

Jürgen Nuffer, Fraunhofer LBF

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Assurance Framework





Role of the Test Planning



- During the test planning, the set of all functional test cases is defined
- A single or group of similar functional test cases is described by a functional test specification
- The functional test specifications represent the functional test space as the central output of the test planning.



Structuring of the Test Planning





Poster

































Assurance Framework





Detailing of Functional Architecture and Design





Detailing of Functional Design - System Requirements



Stakeholder Needs are collected from various sources, like e.g. functional use cases, an item definition or customer functions.

Safety Goals are top-level safety requirements as a result of the hazard analysis and risk assessment at vehicle level.



Behavioral Requirements specify stakeholder requirements towards behavior in a scenario-specific context.

Behavioral Safety Requirements specify solution-independent safety-related behavior or solution-independent safety measures including their safetyrelated attributes



Detailing of Functional Design – Quality Criteria





Quality criteria are derived by applying methods like the Goal/Question/Metric (GQM) method on selected Functional Requirements, formulated as:

- Functional Requirements : statements that identify what results a product or process shall produce.
- Performance Requirements : measurable criteria that identify how well functional requirements shall be accomplished.

Detailing of Functional Design – Functional Architecture





- > A Functional Architecture satisfies the System Requirements by defining sufficient functionality.
- While elaborating the Functional Architecture, the System Requirements are refined in parallel.

Handover to Test Orchestration: Functional Test Specification





Functional Test Specification – Verification Part (Example)



Test object

- Sense (before/after fusion): Perception / recognition of ...lane boundaries, center line, T-junction, crosswalk, Traffic signs (30 km/h, crosswalk) Cyclists, pedestrians, parked vehicles
- > Plan: keep lane, select speed
- Act: Decelerate, accelerate, change direction, displays
 Test environment
- FUC 2.3
- Braking without swerving / changing lanes
 Test objectives
- Purpose: (analysis), verification, validation
- Initial conditions: Positions, velocities, acceleration, (trajectories)
- End criteria: Standstill, collision, crossing crosswalk / Tjunction
- Measured variables/metrics: Speeds (longitudinal, lateral), distances, time-to-collision, time-to-break, absolute positions, dimensions

	Ethiopia America	Board		
6	Protecting C	er ust		
The	Induity Institut	Trhanning 7-Alphopertitementy to adjuncer fullmatur service and function (MC2.1)		
logistas Isaasta	kogupatuluk, jandulu kogupa	RC Stapp hang of 1 Course of Nakita Charge		ments insuling stars to the posters. Were set targets have us at set
Periode	alibratic forevents	Malah Saman Bala Saman Walan Saman Walanagaran Shataya (J. 1000) Shaha Panan Saman S		
treplet tig foreness	Mark Terroriging dis statistics Status India Status India Status India Status India India Status India India India India India Status India India India Status India India India Status India India India Status India India Status India India Status India India Status India India Status India India Status India	Experi Monitor default of sprundle Monitor default		
Security	Derest in Friddenike Artikela	PE-111.5 closels along of end-selected and halfs gettings eigens reception the descent of objects the term and the term of the terms of numbers, main methods	Product advants participance Ac	
Antonionengan (nil), felitan	In vannen, kalenbergere ze de fantigiet	He Alder Ald		
and in the second second	an atomatic list of 1996 in a second lister of billion on both lists and by the list of the list of the second s	And have seen as a second to be an addressed.		
distant in day didnet		Sectored was to receive a sector device a sectored and		
		G201 Receptang a a periodican encount in the age vehicle path		
		14 Safe	Houses of Sanity	and Really Drivin
		6205,1.1 January list the Posteroinadet many ana Datasettahan	Miselahung you Auhunospuation	Mater Minesthery (Ght)
		420(31 Memorycen Strategies	ba .	1 > NPC hat been Seld unter Kim Sellamong
		4221.3.) Alexinais Datate for Ohomory only Reliabilitying Disensing only	Restant	m Meanul printeres ripted as thereasy liter
		629.32 Managabede da Ziloataka	Misinger and Washington Maderal armst Residentifying Theoremoustering	m Meanune anderer - Eller Iac - Ore
		COLUMN TRANSPORTATION AND ADDRESS OF	forth and a first state of the	
			the second s	
		Sec. 4. Material Vestilating on the Data material second	Annual second from an entering second	
		Menore and the second s		
Kerline	geheniste Kontoleen Vir der Nachenn der Ellere Kontol aus der Schultstendelitikung	Bargest de Liber and ret anne Konkeate one WK tachtsonison, onto hare, auth dat Bergari 	uniter Tatabalar	
Testalais	202.01.07.40.0	un factoria		
	 Battels werter an toter and tarrayse platan 	 "Wise 18 226cmble enter stant of last on 50 Meanger". 		
Sublasses, Subsublader	Attraction of Sections	Vertilitäite Monore, 20 ili edite fa Essensei, alle and Monore and America)		

Functional Test Specification – Validation Part (Example)



Derivation of Validation Criteria (limited to safety scope)

Claims

- Operational Capabilities &
 Stakeholder Concerns (=Validation Criteria)
 - Safety Capabilities
 - Safety Requirements:
 - Compliance with traffic regulations
 - Maintain safe distances from other road users
 - Maintain a safe distance from the traffic area boundary
 - Do not endanger your own vehicle occupants
 - Reduce the severity of unavoidable accidents

Beispiel für eine Funktionale Testbeschreibung

		Erläuterung, Anmerkung	Beispiel
1	ID	Eindeutige ID	FT-101
2	Titel	Eindeutige Bezeichnung	Einhalten unkritischer lateraler Abstände im Kontext FUC2.3
3	Umgebung	Ziel im Rahmen der Validierung ist es, die ODD zufällig und vielseitig zu durchfahren, um kritische Unknowns finden zu können.	
4	Testobjekt	ADS-Funktion (Damit ist das gesamte funktionale System gemeint.)	TP4 AG9 AD Funktionale Systemarchitektur
4	Validierungskriterien (streggenommen sind Validierungs- <u>Maße</u> gemeint)	Es muss nachgewiesen werden, welche Sicherheitsresene im Faile einer Kollisionsvermeidung besteht. Als KPI müssen Krittikalifätsmaße herangezogen werden. Für dieses Beispiel ziehen wir folgenden KPI heran: • benötigte Verzögerung als Funktion von Geschwindigkeit und Abstand im Verhältnis zur max. möglichen Verzögerung • max. mögliche Verzögerung hängt vom Reibwert ab – wenn der Reibwert nicht mit gemessen werden kann, muss hier eine Vorgabe gemacht werden	zu messen: Geschwindigkeit des Fahrzeugs in XRichtung Abstand zum Fußgänger in XRichtung Bezugsgröße gehärnen Strecke, gehärnen Zeit, durchfahrene Szenaries zu berechnen: Denötigte Verzögerung, um Kollision zu vermeiden benötigte Verzögerung / max, möglicher Verzögerung
4	Gütekriterien	 Gütekriterlum (z.8. Schweitwert für die Kritikalität). Statistische Auswertung (inki. Konfidenzbestimmung): Überschreitung des Gütekriterlums (z.8. Schweilwerti) e km, h, Anzahl Szenarten. 	1. Schweilwert liegt bei 0,3 (30% der max. möglichen Verzögerung) 2. tbd
4	Messdaten/Messgrößen	2023_07_17: Zelle neu eingefügt Für die Auswertung benötigte Informationen, 28: • um die Utsachen analysieren zu können, warum das Gütekriterium eines Validation Criteria verletzt wurde	Bsp: Kameramateria/Bildaufzelchnungen Daten aus dem Ego-Fahrzeug zu o Bewegung o Umfeld

Handover to Test Orchestration







Thank you!

Jürgen Nuffer, Fraunhofer LBF juergen.nuffer@lbf.fraunhofer.de Björn Filzek, Continental Martin Mai, ZF Martin Dörr, ZF





A project developed by the VDA Leitinitiative autonomous and connected driving Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag