

THE HIGHWAY-CHAUFFEUR



The Highway-Chauffeur

What functionality does the test object „Highway-Chauffeur“ contain?

➔ Motivation:

- Highway-Chauffeur as an example for a conditional automated driving function (SAE level 3)
- Standard scenarios, critical scenarios and automation-risks are the basis to fill the scenario-database

➔ Level of Automation: Level 3 – Conditional Automated

Driving Task	The System performs the longitudinal and lateral driving task.
Monitoring Task	The driver does not need to monitor the system at all times. Tasks besides driving are limitedly possible.
Use Case Limits	The system recognizes its limits but is not able to establish a risk-minimal state from every initial situation. Thus, the system requests the driver to take back the driving task with a sufficient time margin. The automated vehicle handles emergency situations successfully if a human driver could handle the situation.

Role of the Human Driver	Role of the Automated Driving Function
<ul style="list-style-type: none"> • Decides when the activation of the automated driving system is reasonable • Takes the driving task back after a system-request with a sufficient time margin • Is able to deactivate the automated driving system 	<ul style="list-style-type: none"> • Captures the driving environment if activated • Allows the system activation only under such conditions (use cases) it was designed for • Performs longitudinal and lateral driving task if activated • Only deactivates itself if the driver was requested to take over the driving task with a sufficient time margin

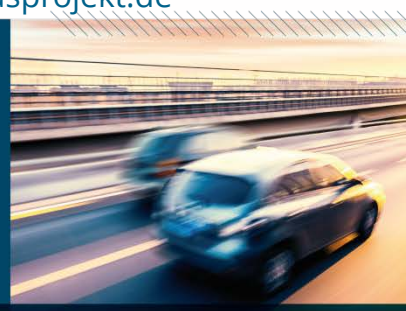


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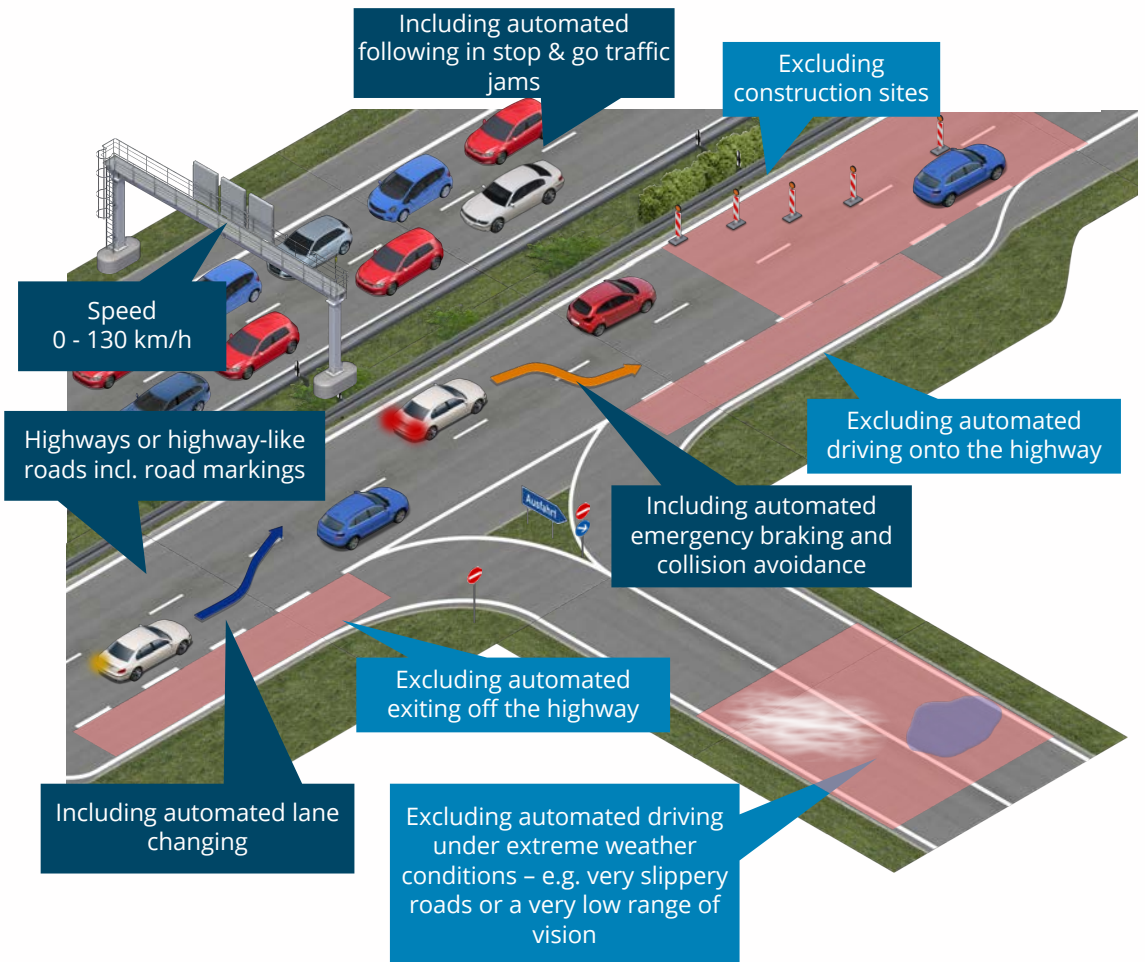
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Basic Functionality:



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REQUIREMENTS AND CONDITIONS – Booth No. 04

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➔ Basic Functionality:

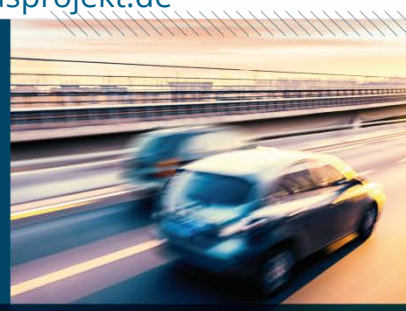


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What functionality does the extended test object „Highway-Chauffeur“ contain?

Extended Functionality

One of the goals of the PEGASUS project was to also ensure that our tools and methods can be adapted to different domains. To avoid spending time and effort on defining a completely new system, we analyzed our Highway chauffeur's key capabilities and defined 5 exemplary functional scenarios which would differ from the original system on different levels. Describing the new system in scenarios helped us not only to efficiently describe the desired functionality and performance but also allowed us to systematically generate executable and therefore testable concrete scenarios which then could be used in simulation without additional effort.

We ended up picking functional scenarios that would extend the ODD to highway and rural roads and chose 5 specific situations our SUT could encounter there. Fig [tbd] shows a description of those scenarios.

Scenario Representation

Description Level \ Name of Scenario	FS-E01	FS-E02	FS-E03	FS-E04	FS-E05
	rural road with oncoming traffic	Animal crossing	Intersection – going straight (un- / protected)	Intersection – left turn (un- / protected)	Overtaking with oncoming traffic
L1: Road Geometry	EKL2 (1 lane per direction, dotted line)	EKL2 (1 lane per direction, dotted line)	EKL2 (1 lane per direction, dotted line)	EKL2 (1 lane per direction, dotted line)	EKL2 (1 lane per direction, dotted line)
L2: Guidance infrastructure (e.g traffic signs)	None (100km/h, guidance posts)	None (100km/h, guidance posts)	Traffic lights, signs, stop line	Traffic lights, signs, stop line	None (100km/h, guidance posts)
L3: Temporary restrictions (e.g. construction)	none	none	none	none	none
L4: dynamic objects	Car, truck, motorbike, bicycle	Car, truck, motorbike, bicycle, animals	Car, truck, motorbike, bicycle	Car, truck, motorbike, bicycle	Car, truck, motorbike, bicycle
L4: dynamic base maneuvers	Follow lane	Follow lane, safe stopping	Approach, accelerate, pass	Approach, accelerate, turn, pass	Follow, accelerate, change lane, pass
L5: weather	n.a.	n.a.	n.a.	n.a.	n.a.



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➔ Basic Functionality:

Stabilization Layer	<ul style="list-style-type: none">• Speed keeping• Distance keeping• Lane keeping
Path Guidance	<ul style="list-style-type: none">• Speed and distance adaption<ul style="list-style-type: none">• Relevant and irrelevant speed limits• Cornering speed• Vehicle ahead when following• Traffic jam following• Merging traffic• Lane changing<ul style="list-style-type: none">• Existence of neighboring lanes• Occupancy of neighboring lanes• Safe and comfortable lane changing• Termination of lane changes• Obligation to drive on the right• Clearance of hard shoulders• Overtaking<ul style="list-style-type: none">• Relevant and irrelevant prohibitions of overtaking• Prohibition to overtake on the right side• Dangerous areas (traffic jams, corners,...)



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➔ Driver Qualification and Activation of the Driving Function:

Driver Qualifications	<ul style="list-style-type: none">• Driving license• Driving capabilities• Closed seat harness buckle• General capability to take over the driving task
Requirements to activate the Driving Function	<ul style="list-style-type: none">• Drives on highways or highway-like roads (based on German standards)• Does not drive faster than the speed limit• Does not drive backwards• Does not drive in construction sites• Does not drive under bad road or weather conditions (e.g. very slippery roads)• Does not drive under very low visibility conditions of the sensors• Does not drive with coverings of the sensors• Does not drive without a network connection• Does not drive without a proper state of the vehicle (e.g. overheated brakes, low fuel level)• Does not drive with defective relevant system components• Does not drive without a human driver inside (e.g. closed seat harness buckle, driver seat is occupied)• Does not drive with open doors• Does not drive with a trailer



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➔ Summary of the System Boundaries:

- Activation only on highways
- Driving task handover to the human driver only with a sufficient time margin
 - At the end of highways
 - At junctions
 - At highway interchanges
 - At construction sites
 - At toll or customs stations
- No activation outside of the system boundaries (e.g. highway acceleration lanes)
- Top speed is the recommended velocity. No activation at higher speeds.
- No trailers
- No lane changes in dense traffic
- No reverse driving
- Driver takes back the driving task (no handover by the system) in case of emergency vehicles
- No activation:
 - Without a proper state of the vehicle
 - Under bad road conditions
 - Under bad weather conditions (system handover + speed reduction)
 - Under very low visibility conditions of the sensors
 - Wrong-way driver
 - If doors are open
 - If no human driver is present
 - Heavy coverings of the sensors
 - If no traffic-, map- or GNSS-data were received over a longer period of time



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