

**INSTRUCTIONS:**

Fill out the hazard analysis and risk assessment below.

HA-001 should be for the lane departure warning function as discussed in the lecture.

HA-002 should be for the lane keeping assistance function as discussed in the lecture.

Then come up with your own situations and hazards for the lane assistance system. Fill in the HA-003 and HA-004 rows.

When finished, export your spreadsheet as a pdf file so that a reviewer can easily see your work.

Hazard ID	Situational Analysis					
	Operational Mode	Operational Scenario	Environmental Details	Situation Details	Other Details (optional)	Item Usage (function)
HA-001	OMD3 - Normal Driving	OS4 - Highway	EN6 - Rain (slippery road)	SD2 - High Speed		IU01 - Correctly Used
HA-002	OMD3 - Normal Driving	OS3- Country Road	EN1 - Normal conditions	SD2 - High Speed		IU02 - Incorrectly Used
HA-003	OMD3 - Normal Driving	OS4 - Highway	EN4 - Snowfall (degraded view)	SD2 - High Speed		IU01 - Correctly Used
HA-004	OMD3 - Normal Driving	OS01- Any road	EN09- NA	SD6 - High Braking		IU01- Correctly Used

		Hazard Identification			
Situation Description	Function	Deviation	Deviation Details	Hazardous Event (resulting effect)	Event Details
Normal Driving on a highway during rain(slippery road) with high speed and correctly used system	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	DV04 - Actor Effect is too much	The LDW function applies an oscillating torque with very high torque (above limit)	EV00 - Colission with other vehicle	High haptic feedback can affect drivers ability to steer as intended. The driver could lose control of the vehicle and collide with another vehicle or with road infrastructure
Normal Driving on a country road during normal conditions with high speed and incorrectly used system	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV03 - Function is always activated	The LKA function is always activated	EV00 - Colission with other vehicle	Driver use the function as an autonomous driver function and loses driving attention. The driver could collide with another vehicle or with road infrastructure
Normal Driving on a highway during snowfall (degraded view) with high speed and correctly used system	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	DV11 - Actor effect is wrong	The LDW function applies an oscillating torque to provide haptic feedback when lane is not deviated.	EV00 - Colission with other vehicle	Lanes are not clear during snowfall conditions and this can result in false LDW warnings. The haptic feedback might confuse the driver into an evasive maneuver or vehicle stability can be compromised due to slippery roads
Normal driving on any road during Any conditions with high braking and correctly used system	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV02- Function unexpectedly activated	The LKA function is not required in high braking conditions	EV03- Car spins out of control	The LKA function applies a steering torque to stay in lane but during high braking conditions, any form of steering can compromise vehicle stability. This makes the system highly uncontrollable

	Hazardous Event Classification				
Hazardous Event Description	Exposure (of situation)	Rationale (for exposure)	Severity (of potential harm)	Rationale (for severity)	Controllability (of hazardous event)
The LDW function applies an oscillating torque with very high torque (above limit)	E3- Medium Probability	Driving on a highway with rain could happen between 1% to 10% of the time operating the vehicle	S3 - Life threatening or fatal injuries	Driver is travelling at high speed. Collisions at high speeds could cause fatal injuries.	C3 - Difficult to control or uncontrollable
The LKA function is always activated and driver is not forced to keep hands at the steering wheel. When the driver loses focus on driving, chances of collision are high.	E2 - Low probability	The combination between driving on a country road and misusing system should not happen often. Less than 1 % of the time operating the vehicle.	S3 - Life threatening or fatal injuries	Driver is travelling at high speed. Collisions at high speeds could cause fatal injuries.	C3 - Difficult to control or uncontrollable
The LDW function has false diagnosis and Driver feels a false haptic feedback without any lane deviation. This might also cause the driver to falsely try and perform a corrective maneuver and collide with road or road infrastructure.	E2- Medium Probability	Driving in snowfall on a highway does not occur that often. Occurs few times a year for majority of drivers	S3 - Life threatening or fatal injuries	Driver is travelling at high speed. Collisions at high speeds could cause fatal injuries.	C3 - Difficult to control or uncontrollable
The LKA function is NOT required during hard braking conditions.	E3- Medium Probability	Hard braking during driving occurs once a month or more often for an average driver	S2 - Severe and life threatening injuries	Driver is braking hard and any form of steering input can cause the vehicle to lose grip with the road. This can result in non-steerable scenario	C2 - Normally Controllable

	Determination of ASIL and Safety Goals	
Rationale (for controllability)	ASIL Determination	Safety Goal
When the steering wheel is oscillating at high amplitude at high speeds, it is difficult to stay calm or react properly. Also it is very difficult to avoid harm.	ASIL C	The oscillating steering torque from the LDW function shall be limited in amplitude.
When the steering wheel is oscillating at high amplitude at high speeds, it is difficult to stay calm or react properly. Also it is very difficult to avoid harm.	ASIL B	LKA function shall apply additional steering torque that will be time limited and shall end after a given timer interval so that the driver cannot misuse the system for autonomous driving.
When the steering wheel oscillates on slippery surface, less than 90 % of the drivers can control the car. It is very difficult to avoid harm	ASIL B	The oscillating steering torque from the LDW function shall stop when the driver is trying to control the car in bad weather conditions.
With ABS available in the car, steerability of this component is restored and more than 90 % of the drivers can control the car without getting into any serious harm	ASIL A	LKA function shall not apply any steering torque and function shall be temporarily shut down when the driver is braking.