

**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	Normal driving	Highway	Rain (slippery road)	High speed		Correctly used
HA-002	Normal driving	Country Road	Normal conditions	High speed		Incorrectly used
HA-003	Normal driving	Country Road	Snow	High acceleration		Correctly used
HA-004	Normal driving	Mountain Pass	Fog (degraded view)	Low speed		Correctly used

Hazard Identification					
Situation Description	Function	Deviation	Deviation Details	Hazardous Event (resulting effect)	Event Details
Normal driving on a highway in rain (slippery road) at high speed with a correctly used system	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	Actor effect is too much	The LDW function applies an oscillating torque with very high torque (above limit).	Collision with other vehicle	High haptic feedback can affect driver's 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 in normal conditions at high speed with incorrectly used system	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	Function always activated	The lane keeping assistance function should add extra steering torque but does not subside after a set amount of time.	Collision with other vehicle	The steering assist being always on can lead to misuse by the driver leading to erratic steering and collisions with other vehicles.
Normal driving on a country road in the snow at high acceleration with a correctly used system	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	Sensor detection too Late	The LDW function detects veering from lane after the car has already exited the lane.	Front collision with oncoming traffic	Late sensor detection will alert the driver too late that the car is heading into the oncoming traffic, which may result in a collision with another vehicle.
Normal driving over a mountain pass in fog (degraded view) at low speed with a correctly used system.	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	Actor action too late	The lane keeping assistance function is delayed in providing the extra steering torque	Front collision with oncoming traffic	The delay in the lane keeping assist can cause the vehicle to veer into an oncoming lane and get hit by oncoming traffic.

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 too high an oscillating torque to the steering wheel (above limit).	E3 - Medium probability	Driving in rain has a medium probability of occurrence.	S3 - Life-threatening or fatal injuries	Driving at high speeds could be fatal.	C3 - Difficult to control or uncontrollable
The lane keeping function provides an assistive torque to the steering wheel but the function remains always on.	E2 - Low probability	Driving on a country road and misusing the system is not a normal occurrence.	S3 - Life-threatening or fatal injuries	Driving at high speeds could be fatal.	C3 - Difficult to control or uncontrollable
The LDW function sensor detects the exit of the lane without a signal in a delayed time.	E2 - Low probability	Driving on a road with high acceleration in the snow has a low probability	S3 - Life-threatening or fatal injuries	driving with high acceleration in the snow can cause a fatal accident.	C3 - Difficult to control or uncontrollable
The lane keeping function activates too late.	E3 - Medium probability	Driving over a mountain pass at low speed in foggy situations happens at a medium occurrence.	S2 - Severe and life-threatening injuries	Driving into oncoming traffic at a low speed can be life threatening.	C2 - Normally controllable

Determination of ASIL and Safety Goals		
Rationale (for controllability)	ASIL Determination	Safety Goal
Most drivers will find it difficult to gain control of the vehicle with strong steering wheel oscillations.	C	The oscillating steering torque from the lane departure warning function shall be limited.
It will not be easy for a driver to regain control of the vehicle at high speeds.	B	The lane keeping assistance function shall be time limited and the additional steering torque shall end after a given time interval so that the driver cannot misuse the system for autonomous driving.
It is not easy to gain control of a vehicle quickly in snowy conditions.	B	The sensor detection for the LDW system should be timed to detect earlier.
At low speed, the driver should have enough time to fix the vehicle error and re-enter the correct lane.	A	The timing of the lane keep assistance torque assist shall be corrected to not be delayed.