

**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

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

Hazard ID	Situational Analysis			
	Operational Mode	Operational Scenario	Environmental Details	Situation Details
HA-001	OM03 - Normal driving	OS04 - Highway	EN06 - Rain (slippery road)	SD02 - High speed
HA-002	OM03 - Normal driving	OS03 - Country Road	EN01 - Normal conditions	SD02 - High speed
HA-003	OM03 - Normal driving	OS04 - Highway	EN01 - Normal conditions	SD02 - High speed
HA-004	OM03 - Normal driving	OS02 - City Road	EN04 - Snowfall (degraded view)	SD01 - Low speed

the HA-003 and HA-004 rows.  
work.

Analysis			
Other Details (optional)	Item Usage (function)	Situation Description	Function
	IU01 - Correctly used	The vehicle is driving on a highway, so it would be expected to drive at a high speed. The slippery road conditions can affect the control of the vehicle and rain may also hamper the driver's visibility.	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback
	IU02 - Incorrectly used	The driver is misusing the LKA by relying on it completely for an extended period of time, being unattentive and not keeping his hands on the steering wheel.	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane
	IU01 - Correctly used	The vehicle is driving on a highway, so it would be expected to drive at a high speed. Depending on other circumstances, traffic density could be high or low.	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback
	IU01 - Correctly used	The vehicle is being driven on a city road with snowfall conditions, thus it is expected that the driver would tend to drive at a low speed.	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane

Hazard Identification			
Deviation	Deviation Details	Hazardous Event (resulting effect)	Event Details
DV04 - Actor effect is too much	The LDW applies a very high torque to the steering wheel, making it difficult for the driver to control the vehicle.	EV00 - Collision with other vehicle	The loss of vehicle control leads it to stray from its path onto another vehicle, resulting in a direct collision.
DV03 - Function always activated	The LKA being on for an extended period lulls the driver into a false sense of security, which makes it more likely for them to lose control of the vehicle at high speeds.	EV00 - Collision with other vehicle	The loss of vehicle control leads it to stray from its path onto another vehicle, resulting in a direct collision.
DV07 - Actor action too late	The LDW torque is applied late, with a significant delay. Thus the driver is not alerted to the lane change as quickly as desired.	EV00 - Collision with other vehicle	The loss of vehicle control leads it to stray from its path onto another vehicle, resulting in a direct collision.
DV19 - Sensor detection is wrong	The camera sensors which determine whether the vehicle is maintaining the lane malfunction and activate even when the car is within the designated lane.	EV00 - Collision with other vehicle	The loss of vehicle control leads it to stray from its path onto another vehicle, resulting in a direct collision.

Hazard			
Hazardous Event Description	Exposure (of situation)	Rationale (for exposure)	Severity (of potential harm)
Due to the unexpected high haptic feedback from the steering wheel, the vehicle would tend to swerve into another vehicle if the driver is unable to control it.	E3 - Medium probability	Highways are frequently traversed by drivers, especially around urban areas. Depending on the driver's location, it may be a very common occurrence.	S3 - Life-threatening or fatal injuries
Since the driver is not attentive, any change in the surrounding conditions or traffic could cause the ego vehicle to move into the path of another vehicle.	E2 - Low probability	The combination of a driver using the LKA for an extended period along with a country road may not happen very frequently.	S3 - Life-threatening or fatal injuries
Since the driver is not alerted in time to the lane change, they may not be able to take over the control of the vehicle in time.	E3 - Medium probability	Highways are frequently traversed by drivers, especially around urban areas. Depending on the driver's location, it may be a very common occurrence.	S3 - Life-threatening or fatal injuries
There is an unexpected torque on the steering, which will drive the vehicle out of its lane.	E2 - Low probability	Depending on the location, driving on a city road during snowfall would be an uncommon occurrence.	S1 - Light and moderate injuries

### Hazardous Event Classification

Rationale (for severity)	Controllability (of hazardous event)	Rationale (for controllability)
A direct vehicle collision at high speed is known to cause serious injuries and fatalities.	C3 - Difficult to control or uncontrollable	The steering torque is higher than expected and would be completely unexpected for the driver. As the haptic feedback might oppose the driver's intentions, it would be extremely difficult to bring the vehicle under control.
A direct vehicle collision at high speed is known to cause serious injuries and fatalities.	C3 - Difficult to control or uncontrollable	Since the driver is not prepared to immediately take over the steering, the delay would make it impossible to bring the vehicle in control within the required time.
A direct vehicle collision at high speed is known to cause serious injuries and fatalities.	C2 - Normally controllable	Since the warning from the LDW comes too late, it is up to the LKA alone to maintain the lane. This does not account for the behaviour of other vehicles. Without the timely intervention of the driver, the vehicle could lose control. However, in most cases, the LKA could be sufficient to maintain the lane.
Since the drive speed is low and is on a city road, the injuries would not be severe.	C2 - Normally controllable	The LKA does not apply sharp turns, this should alert the driver and allow him to rectify the LKA's steering and switch off the Lane Assistance System after identifying the malfunction.

Determination of ASIL and Safety Goals	
ASIL Determination	Safety Goal
C	The oscillating steering torque from the Lane Departure Warning function shall be limited.
B	The Lane Keeping Assistance function shall be time limited so that the driver will remain alert towards the surroundings - road and traffic movement.
B	The LDW will send the steering torque as soon as possible with minimum latency to alert the driver.
QM	The LKA shall accurately determine the vehicle's position in the lane and apply steering torque only when required.