

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							Hazard Identification						Hazardous Event Classification								Determination of ASIL and Safety Goals			
	Operational Mode	Operational Scenario	Environmental Details	Situation Details	Other Details (optional)	Item Usage (function)	Situation Description	Function	Deviation	Deviation Details	Hazardous Event (resulting effect)	Event Details	Hazardous Event Description	Exposure (of situation)	Rationale (for exposure)	Severity (of potential harm)	Rationale (for severity)	Controllability (of hazardous event)	Rationale (for controllability)	ASIL Determination	Safety Goal				
HA-001	OM03 - Normal driving	OS04 - Highway	EN06 - Rain (slippery road)	SD02 - High speed		IU01 - Correctly used	Normal Driving on a Highway at High Speed during Rain with active Lane Departure Warning function	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	DV04 - Actor effect is too much	Oscillating steering torque exceeds limit	EV08 - Collision with other vehicle	Vehicle crashes into traffic or road infrastructure with injury to driver and any others present	Driver loses control of vehicle	E3 - Medium probability	Activation of the lane departure warning system during highway driving at high speed is a medium probability event.	S3 - Life-threatening or fatal injuries	On highway, speed of vehicle is expected to be high	C3 - Difficult to control or uncontrollable	Since the steering wheel rotates uncontrollably, it will be difficult for the average driver to control the vehicle at high speed in the rain	C	The oscillating steering torque from the LDW function shall be limited				
HA-002	OM03 - Normal driving	OS03 - Country Road	EN01 - Normal conditions	SD02 - High speed		IU02 - Incorrectly used	Normal Driving on cuntry roads during normal conditions with high speed and the system is incorrectly used.	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV03 - Function always activated	LKA is always active. Driver is taking hands off the wheel.	EV08 - Collision with other vehicle	The lane keeping assistance function is always activated and the driver loses control of the vehicle.	Driver loses control of vehicle	E2 - Low probability	Driver abusing the LKA as Autopilot during highway driving at high speeds is a low probability event	S3 - Life-threatening or fatal injuries	On highway, speed of vehicle is expected to be high	C3 - Difficult to control or uncontrollable	Since driver has his hands off the wheel, he cannot control the vehicle	B	The LKA function shall be time limited and the additional steering torque shall end after a given time interval				
HA-003	OM03 - Normal driving	OS04 - Highway	EN04 - Snowfall (degraded view)	SD02 - High speed		IU01 - Correctly used	Normal Driving on a Highway at High Speed during Snowfall with active Lane Keeping Assistance function	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV10 - Actor effect is reverse	Steering torque applied but in the wrong direction	EV08 - Collision with other vehicle	Vehicle crashes into traffic or road infrastructure with injury to driver and any others present	Driver loses control of vehicle	E2 - Low probability	Activation of the lane departure system while driving on highway during snowfall at high speed is a low probability event	S3 - Life-threatening or fatal injuries	Collision at high speed in highly constrained space	C3 - Difficult to control or uncontrollable	Since LKA generates an entirely unexpected steering input and with little time to react, a driver will typically not be able to control the vehicle	B	The LKA function shall be deactivated during snowfall (degraded view) conditions				
HA-004	OM03 - Normal driving	OS03 - Country Road	EN06 - Rain (slippery road)	SD03 - Low speed		IU01 - Correctly used	Normal Driving on a Country Road at Low Speed during Rain with active Lane Keeping Assistance function	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV02 - Function unexpectedly activated	LKA corrects driver input while driver attempts to evade obstacle	EV11 - Car spins out of control	Vehicle crashes into traffic or road infrastructure with injury to driver and any others present	Driver loses control of vehicle	E1 - Very Low probability	Evading obstacle on a country road in the rain at low speed is a very low probability event	S3 - Life-threatening or fatal injuries	The vehicle hitting onto an obstacle on country road.	C3 - Difficult to control or uncontrollable	Driver does not expect extra torque in steering wheel and loses control in already difficult to control situation	A	The LKA function shall be deactivated during heavy steering				

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Hazard & Risk Analysis Definition

Operational Mode

ID	Mode
OM01	Parked
OM02	Ignition on
OM03	Normal driving
OM04	Backward driving
OM05	Degraded driving
OM06	Towing (active)
OM07	Towing (passive)
OM08	Service
OM09	N/A

Operational Scenario

ID	Scenario
OS01	Any Road
OS02	City Road
OS03	Country Road
OS04	Highway
OS05	Mountain Pass
OS06	Off Road
OS07	Road with gradient
OS08	Road with bump
OS09	Road tunnel
OS10	Road with construction site
OS11	N/A

Situation Details

ID	Scenario
SD01	Low speed
SD02	High speed
SD03	Normal acceleration
SD04	High acceleration
SD05	Normal braking
SD06	High braking
SD07	N/A

Item Usage

ID	Mode
IU01	Correctly used
IU02	Incorrectly used
IU03	N/A

Environmental Details

ID	Scenario
EN01	Normal conditions
EN02	Sun blares (degraded view)
EN03	Fog (degraded view)
EN04	Snowfall (degraded view)
EN05	Cross-wind (lateral force)
EN06	Rain (slippery road)
EN07	Snow (slippery road)

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Reference	
OM01 - Parked	
OM02 - Ignition on	
OM03 - Normal driving	
OM04 - Backward driving	
OM05 - Degraded driving	
OM06 - Towing (active)	
OM07 - Towing (passive)	
OM08 - Service	
OM09 - N/A	
Reference	
OS01 - Any Road	
OS02 - City Road	
OS03 - Country Road	
OS04 - Highway	
OS05 - Mountain Pass	
OS06 - Off Road	
OS07 - Road with gradient	
OS08 - Road with bump	
OS09 - Road tunnel	
OS10 - Road with construction site	
OS11 - N/A	
Reference	
SD01 - Low speed	
SD02 - High speed	
SD03 - Normal acceleration	
SD04 - High acceleration	
SD05 - Normal braking	
SD06 - High braking	
SD07 - N/A	
Reference	
IU01 - Correctly used	
IU02 - Incorrectly used	
IU03 - N/A	
Reference	
EN01 - Normal conditions	
EN02 - Sun blares (degraded view)	
EN03 - Fog (degraded view)	
EN04 - Snowfall (degraded view)	
EN05 - Cross-wind (lateral force)	
EN06 - Rain (slippery road)	
EN07 - Snow (slippery road)	

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Exposure	
ID	Description
E0	Incredible
E1	Very low probability
E2	Low probability
E3	Medium probability
E4	High probability
Severity	
ID	Description
S0	No injuries
S1	Light and moderate injuries
S2	Severe and life-threatening injuries
S3	Life-threatening or fatal injuries
Controllability	
ID	Description
C0	Controllable in general
C1	Simply controllable
C2	Normally controllable
C3	Difficult to control or uncontrollable

Duration (of situation)
Not specified
<1 % of average operating time
1 % to 10 % of average operating time
>10 % of average operating time
Remarks
No injuries
Light and moderate injuries
Severe and life-threatening injuries (survival probable)
Life-threatening injuries (survival uncertain), fatal injuries
Remarks
Controllable in general
99 % or more of all drivers or other traffic participants are usually able
90 % or more of all drivers or other traffic participants are usually able
Less than 90 % of all drivers or other traffic participants are usually able

Frequency (of situation)
Occurs less often than once a year for the great majority of drivers
Occurs a few times a year for the great majority of drivers
Occurs once a month or more often for an average driver
Occurs during almost every drive on average
Probability of Injuries
AIS 0 and less than 10 % probability of AIS 1-6
More than 10 % probability of AIS 1-6 (and not S2 or S3)
More than 10 % probability of AIS 3-6 (and not S3)
More than 10 % probability of AIS 5-6

Reference			
E0 - Incredible			
E1 - Very low probability			
E2 - Low probability			
E3 - Medium probability			
E4 - High probability			
Reference			
S0 - No injuries			
S1 - Light and moderate injuries			
S2 - Severe and life-threatening injuries			
S3 - Life-threatening or fatal injuries			
Reference			
C0 - Controllable in general			
C1 - Simply controllable			
C2 - Normally controllable			
C3 - Difficult to control or uncontrollable			

	Controllability	Exposure	Sev	
			S0	S1
	C1	E1	QM	QM
		E2	QM	QM
		E3	QM	QM
		E4	QM	QM
	C2	E1	QM	QM
		E2	QM	QM
		E3	QM	QM
		E4	QM	A
	C3	E1	QM	QM
		E2	QM	QM
		E3	QM	A
		E4	QM	B

erity	
S2	S3
QM	QM
QM	QM
QM	A
A	B
QM	QM
QM	A
A	B
B	C
QM	A
A	B
B	C
C	D