INSTRUCTIONS:
Fill out the hazard analysis and risk assessment below.
HA-001 should be for the lane departure warning function as discussed in the lect
HA-002 should be for the lane keeping assistance function as discussed in the lec
Then come up with your own situations and hazards for the lane assistance syste
When finished, export your spreadsheet as a pdf file so that a reviewer can easily

Hazard ID	Situational Ana			
	Operational Mode	**Operational Scenario**	**Environmental Details**	**Situation Details**
HA-001	OM03 - Normal Driving	OS03 - Highway	EN01 - Normal conditions	SD03 - High speed
HA-002	OM03 - Normal Driving	OS03 - Highway	EN01 - Normal conditions	SD03 - High speed
HA-001	OM03 - Normal Driving	OS03 - Highway	EN01 - Normal conditions	SD03 - High speed
HA-002	OM03 - Normal Driving	OS03 - Highway	EN01 - Normal conditions	SD03 - High speed

l in the lecture.
d in the lecture.
ance system. Fill in the HA-003 and HA-004 rows.
can easily see your work.

alysis

Other Details (optional)	Item Usage (function)	Situation Description	Function	Deviation
n/a	IU01 - Correctly used	Normal Driving on highway during Normal conditions with high speed	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	DV04 - Actor effect is too much
n/a	IU01 - Correctly used	Normal Driving on highway during Normal conditions with high speed	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV03 - Function always activated
n/a	IU01 - Correctly used	Normal Driving on highway during Normal conditions with high speed	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback	DV05-Actor effect is too less
n/a	IU01 - Correctly used	Normal Driving on highway during Normal conditions with high speed	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV07-Actor action too late

Hazard Identification			
Deviation Details	**Hazardous Event (resulting effect)**	**Event Details**	**Hazardous Event Description**
haptic is too strong	EV04 - steering wheel is out of control	vehicle drive off the lane and collide with other cars	injury to driver and passengers
too good to be abused	EV04 - driver loss focus on the road	driver fail to respond when emergency happens	injury to driver and passengers
Driver fail to capture/ notice the haptic signal	EV-04 Car comes off the road	vehicle drive off the lane and collide with other cars	injury to driver and passengers
car already drive off the lane	EV-04 Car comes off the road	vehicle drive off the lane and collide with other cars	injury to driver and passengers

Hazardous Event Classification				
Exposure (of situation)	**Rationale (for exposure)**	**Severity (of potential harm)**	**Rationale (for severity)**	**Controllability (of hazardous event)**
E4 - High probability	keep in lane is a common practise	S3 - Life-threatening or fatal injuries	On highway speed of vehicle is expected to be high	C3 - Difficult to control or uncontrollable
E4 - High probability	keep in lane is a common practise	S3 - Life-threatening or fatal injuries	On highway speed of vehicle is expected to be high	C3 - Difficult to control or uncontrollable
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E4 - High probability	keep in lane is a common practise	S3 - Life-threatening or fatal injuries	On highway speed of vehicle is expected to be high	C3 - Difficult to control or uncontrollable

	Determination of ASIL and Safety Goals	
Rationale (for controllability)	**ASIL Determination**	**Safety Goal**
steering wheel out of control means serious out of control	ASIL D	reduce the upper limit spec of haptic salience, so that to prevent this case from happening.
driver loss focus means serious things can happen	ASIL D	reduce the time duration for the function so that driver had to pay attention to it.
steering wheel out of control means serious out of control	ASIL D	reduce the upper limit spec of haptic salience, so that to prevent this case from happening.
driver loss focus means serious things can happen	ASIL D	reduce the time duration for the function so that driver had to pay attention to it.

EXAMPLE DISCUSSED IN THE PROJECT INSTRUCTIONS - Headlamp System

Hazard ID		
	Operational Mode	**Operational Scenario**
HA-001	Normal Driving	City Road

MORE EXAMPLES - Headlamp System

Hazard ID		
	Operational Mode	**Operational Scenario**
HA-001	OM03 - Normal Driving	OS01 - City Road
HA-002	OM03 - Normal Driving	OS01 - City Road
HA-003	OM03 - Normal Driving	OS03 - Highway
HA-004	OM03 - Normal Driving	OS02 - Country Road
HA-005	OM03 - Normal Driving	OS02 - Country Road

Situational Analysis		
Environmental Details	**Situation Details (optional)**	**Other Details (optional)**
Normal Conditions	Low Speed	Night time + Obstacle

Situation Analysis		
Environmental Details	**Situation Details (optional)**	**Other Details (optional)**
EN01 - Normal conditions	SD03 - Low speed	Night time + Obstacle
EN04 - Snowfall (degraded view)	SD03 - Low speed	Night time + Obstacle
EN04 - Snowfall (degraded view)	SD03 - High speed	Night time + Obstacle
EN01 - Normal conditions	SD02 - High speed	Night time + Oncoming
EN04 - Snowfall (degraded view)	SD04 - High speed	Night time + Obstacle

Item Usage (function)	Situation Description	Function
Correctly Used	Normal Driving on a City Road in Normal	Low beam illuminates the

Item Usage (function)	Situation Description	Function
IU01 - Correctly used	Normal Driving on City Road during	Low beam illuminates the
IU01 - Correctly used	Normal Driving on City Road during	Low beam illuminates the
IU01 - Correctly used	Normal Driving on Highway during	Low beam illuminates the
IU01 - Correctly used	Normal Driving on Country Road during	Low beam illuminates the
IU01 - Correctly used	Normal Driving on Country Road during	Low beam illuminates the

Hazard Identification		
Deviation	**Deviation Details**	**Hazardous Event (resulting effect)**
Function not activated	Both headlights stop working	Front collision with obstacle

Hazard Identification		
Deviation	**Deviation Details**	**Hazardous Event (resulting effect)**
DV01 - Function not	Both headlights stop working	EV04 - Front collision with obstacle
DV01 - Function not	Both headlights stop working	EV04 - Front collision with obstacle
DV01 - Function not	Both headlights stop working	EV04 - Front collision with obstacle
DV01 - Function not	Both headlights stop working	EV08 - Collision with other vehicle
DV01 - Function not	Both headlights stop working	EV04 - Front collision with obstacle

Event Details	Hazardous Event Description	Exposure (of situation)	Rationale (for exposure)
Vehicle crashes into	Total loss of low	E4 - High probability	night driving in the city is a

Event Details	Hazardous Event Description	Exposure (of situation)	Rationale (for exposure)
Vehicle crashes into	Total loss of low	E4 - High probability	night driving in the city is a
Vehicle crashes into	Total loss of low	E1 - Very low probability	night driving in the city on
Vehicle crashes into	Total loss of low	E2 - Low probability	High driving is part of regular
Vehicle crashes into	Total loss of low	E4 - High probability	country driving is part of
Vehicle crashes into	Total loss of low	E2 - Low probability	country driving is part of

Hazardous Event Classification	
Severity (of potential harm)	**Rationale (for severity)**
S1 - Light and moderate injuries	In city traffiic, speed of vehicle is expected to be

Hazardous Event Classification	
Severity (of potential harm)	**Rationale (for severity)**
S1 - Light and moderate injuries	In city traffiic, speed of vehicle is expected to be
S1 - Light and moderate injuries	In city traffiic, speed of vehicle is expected to be
S3 - Life-threatening or fatal injuries	On highway speed of vehicle is expected to be
S3 - Life-threatening or fatal injuries	On country roads speed of vehicle is expected
S3 - Life-threatening or fatal injuries	On country roads speed of vehicle is expected

Controllability (of hazardous event)	Rationale (for controllability)
C0 - Controllable in general	At city speed, most drivers will be

Controllability (of hazardous event)	Rationale (for controllability)
C0 - Controllable in general	At city speed, most drivers will be
C1 - Simply controllable	On completely unilluminated city
C2 - Normally controllable	When driving on highway with low
C1 - Simply controllable	Since there is usually no other form
C3 - Difficult to control or uncontrollable	Since there is usually no other form

Determination of ASIL and Safety Goals	
ASIL Determination	**Safety Goal**
QM	Total Loss of Beam

Determination of ASIL and Safety Goals	
ASIL Determination	**Safety Goal**
QM	Total loss of low
QM	Total loss of low
A	Total loss of low
B	Total loss of low
B	Total loss of low

Hazard & Risk Analysis D

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)
EN08	Glace (slippery road)
EN09	N/A

lysis Definitions

Remarks
Car is parked, ignition is off
Car is parked, ignition is on
Car is driving
Car is driving
Limp home mode
Towing another car
Beeing towed by another car
Vehicle is in repair garage
not applicable or not relevant

Remarks
road type
road type
road type
road type
road type
road type
road attribute
road attribute
road attribute
road attribute
not applicable or not relevant

Remarks
driving attribute
driving attribute
driving attribute
driving attribute
driving attribute
driving attribute
not applicable or not relevant

Remarks
Intended usage
Unintended usage (foreseeable)
not applicable or not relevant

Remarks
weather attribute
weather attribute
weather attribute
weather attribute
weather attribute
road attribute

road attribute
road attribute
not applicable or not relevant

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)
EN08 - Glace (slippery road)
EN09 - N/A

Deviation

ID	Deviation (Guideword)	Remarks
DV01	Function not activated	Activation error
DV02	Function unexpectedly activated	Activation error
DV03	Function always activated	Activation error
DV04	Actor effect is too much	Quantitative error
DV05	Actor effect is too less	Quantitative error
DV06	Actor action too early	Timing error
DV07	Actor action too late	Timing error
DV08	Actor action before	Sequence error
DV09	Actor action after	Sequence error
DV10	Actor effect is reverse	Logical error
DV11	Actor effect is wrong	Logical error
DV12	Sensor sensitivity is too high	Quantitative error
DV13	Sensor sensitivity is too low	Quantitative error
DV14	Sensor detection too early	Timing error
DV15	Sensor detection too late	Timing error
DV16	Sensor detection before	Sequence error
DV17	Sensor detection after	Sequence error
DV18	Sensor detection is reverse	Logical error
DV19	Sensor detection is wrong	Logical error
DV20	N/A	not applicable or not relevant

Hazardous Events (possibe effects)

ID	Hazardous Event	Remarks
EV-07	None	
EV-06	Front collision with oncoming traffic	
EV-05	Front collision with ahead traffic	
EV-04	Front collision with obstacle	
EV-03	Rear collision with trailing traffic	
EV-02	Side collision with other traffic	
EV-01	Side collision with obstacle	
EV00	Collision with other vehicle	
EV01	Collision with train	
EV02	Collision with pedestrian	
EV03	Car spins out of control	
EV04	Car comes off the road	
EV05	Car catches file	
EV06	N/A	

Reference
DV01 - Function not activated
DV02 - Function unexpectedly activated
DV03 - Function always activated
DV04 - Actor effect is too much
DV05 - Actor effect is too less
DV06 - Actor action too early
DV07 - Actor action too late
DV08 - Actor action before
DV09 - Actor action after
DV10 - Actor effect is reverse
DV11 - Actor effect is wrong
DV12 - Sensor sensitivity is too high
DV13 - Sensor sensitivity is too low
DV14 - Sensor detection too early
DV15 - Sensor detection too late
DV16 - Sensor detection before
DV17 - Sensor detection after
DV18 - Sensor detection is reverse
DV19 - Sensor detection is wrong
DV20 - N/A

Reference
EV-07 - None
EV-06 - Front collision with oncoming traffic
EV-05 - Front collision with ahead traffic
EV-04 - Front collision with obstacle
EV-03 - Rear collision with trailing traffic
EV-02 - Side collision with other traffic
EV-01 - Side collision with obstacle
EV00 - Collision with other vehicle
EV01 - Collision with train
EV02 - Collision with pedestrian
EV03 - Car spins out of control
EV04 - Car comes off the road
EV05 - Car catches file
EV06 - N/A

Exposure

ID	Description	Duration (of situation)
E0	Incredible	
E1	Very low probability	Not specified
E2	Low probability	<1 % of average operating time
E3	Medium probability	1 % to 10 % of average operating time
E4	High probability	>10 % of average operating time

Severity

ID	Description	Remarks
S0	No injuries	No injuries
S1	Light and moderate injuries	Light and moderate injuries
S2	Severe and life-threatening injurie	Severe and life-threatening injuries (survival probable)
S3	Life-threatening or fatal injuries	Life-threatening injuries (survival uncertain), fatal injuries

Controllability

ID	Description	Remarks
C0	Controllable in general	Controllable in general
C1	Simply controllable	99 % or more of all drivers or other traffic participants are
C2	Normally controllable	90 % or more of all drivers or other traffic participants are
C3	Difficult to control or uncontrollab	Less than 90 % of all drivers or other traffic participants ar

Frequency (of situation)	Reference
	E0 - Incredible
Occurs less often than once a year for the great majority c	E1 - Very low probability
Occurs a few times a year for the great majority of drivers	E2 - Low probability
Occurs once a month or more often for an average driver	E3 - Medium probability
Occurs during almost every drive on average	E4 - High probability

Probability of Injuries	Reference
AIS 0 and less than 10 % probability of AIS 1-6	S0 - No injuries
More than 10 % probability of AIS 1-6 (and not S2 or S3)	S1 - Light and moderate injuries
More than 10 % probability of AIS 3-6 (and not S3)	S2 - Severe and life-threatening injuries
More than 10 % probability of AIS 5-6	S3 - Life-threatening or fatal injuries

	Reference
	C0 - Controllable in general
cipants are usually able to avoid harm	C1 - Simply controllable
cipants are usually able to avoid harm	C2 - Normally controllable
rticipants are usually able, or barely able, to avoid harm	C3 - Difficult to control or uncontrollable

Controllability	Exposure	Severity			
		S0	S1	S2	S3
C1	E1	QM	QM	QM	QM
	E2	QM	QM	QM	QM
	E3	QM	QM	QM	A
	E4	QM	QM	A	B
C2	E1	QM	QM	QM	QM
	E2	QM	QM	QM	A
	E3	QM	QM	A	B
	E4	QM	A	B	C
C3	E1	QM	QM	QM	A
	E2	QM	QM	A	B
	E3	QM	A	B	C
	E4	QM	B	C	D