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

| Hazard ID | Si | | |
|---|---|---|---|
| | **Operational Mode** | **Operational Scenario** | **Environmental Details** |
| HA-001 | OM03 - Normal driving | OS04 - Highway | EN06 - Rain (slippery road) |
| HA-002 | OM03 - Normal Driving | OS03 - Country Road | EN01 - Normal conditions |
| HA-003 | OM03 - Normal Driving | OS02 - City Road | EN01 - Normal conditions |
| HA-004 | OM03 - Normal Driving | OS04 - Highway | EN01 - Normal conditions |

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**:e system. Fill in the HA-003 and HA-004 rows.**
**ı easily see your work.**

**ituational Analysis**

| Situation Details | Other Details (optional) | Item Usage (function) | Situation Description |
|---|---|---|---|
| SD02 - High speed | Other vehicles present | IU01 - Correctly used | Normal driving on a highway during rain (slippery road) with high speed and correctly used system. |
| SD02 - High speed | Other vehicles present | IU02 - Incorrectly Used | Normal driving on country roads during normal conditions with high speed (the driver is misusing the lane keeping assistance function as an autonomous function) |
| SD01 - Low speed | Other vehicles present | IU02 - Incorrectly used | Normal driving on a city road during normal conditions with a low speed and incorrectly used system (The system is being activated outside of a highway context) |
| SD02 - High speed | Other vehicles present | IU01 - Correctly used | Normal driving on a highway during normal conditions with a high speed and correctly used system. |

| Hazard | | |
|---|---|---|
| **Function** | **Deviation** | **Deviation Details** |
| 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). |
| Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane | DV03 - Function always activated | Driver is taking both hands off the wheel and incorrectly treating the car as a fully autonomous vehicle. |
| 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 applies potentially erroneous steering torques in a city context, for which it was not designed. |
| Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback | DV12 - Sensor sensitivity is too high | The LDW function applies an oscillating torque when deviation from the center of the lane is negligable. |

**Identification**

| Hazardous Event (resulting effect) | Event Details | Hazardous Event Description |
|---|---|---|
| EV00 - 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. | The LDW function applies too high an oscillating torque to the steering wheel (above limit). |
| EV00 - Collision with other vehicle | Driver inattention from incorrectly treating the system as fully autonomous can cause the driver to lose control of the vehicle and collide with another vehicle or with road infrastructure. | The driver incorrectly treats the car as a fully autonomous vehicle. |
| EV00 - Collision with other vehicle | The complicated nature of city streets are too difficult for a simple lane keeping system to interpret, and therefore activation in a city context could lead to dangerous steering commands, leading the car to collide with another vehicle. | The driver incorrectly engages the LKA functionality on a city street. |
| EV03 - Car spins out of control | Haptic feedback being applied persistently may cause the driver's attention and ability to control the steering wheel to be compromised, risking the car spinning out of control | The LDW function applies an oscillating torque to the steering wheel when the lane is being kept within tolerances. |

| Hazardous Event Classificat | | | |
|---|---|---|---|
| **Exposure (of situation)** | **Rationale (for exposure)** | **Severity (of potential harm)** | **Rationale (for severity)** |
| E3 - Medium probability | Highway driving on wet roads occurs quite often, and is therefore considered E3 | S3 - Life-threatening or fatal injuries | The driver is travelling at high speeds, (> 40 km/hr) therefore the risk of life threatening injuries is high. |
| E2 - Low probability | The combination of driving on a country road and misusing the system would not occur very frequently. | S3 - Life-threatening or fatal injuries | The driver is travelling at high speeds, (> 40 km/hr) therefore the risk of life threatening injuries is high. |
| E2 - Low probability | Though driving on a country street is relatively common, incorrectly engaging the LKA functionality for a city street would not occur very frequently. | S1 - Light and moderate injuries | The driver is travelling at low speeds, and therefore the risk of severe injuries is low. |
| E4 - High probability | Highway driving during normal conditions occurs very often (Almost every day; >10% operating time), and is therefore considered E4 | S3 - Life-threatening or fatal injuries | The driver is travelling at high speeds, (> 40 km/hr) therefore the risk of life threatening injuries is high. |

| tion | | Determin |
|---|---|---|
| **Controllability (of hazardous event)** | **Rationale (for controllability)** | **ASIL Determination** |
| C3 - Difficult to control or uncontrollable | Because the steering wheel is violently vibrating, it would be very difficult for a driver to regain control of the vehicle. | ASIL C |
| C3 - Difficult to control or uncontrollable | Because Driver's hands are not on the wheel at high speeds, a vehicle accident would not be controllable | ASIL B |
| C1 - Simply controllable | Because the system is designed to be overcome easily by a human operator, it should be easy for an attentive driver to control the vehicle, though the unexpected actuation may be startling to some drivers, impeding ability to take over control, preventing it from being generally controllable. | QM |
| C3 - Difficult to control or uncontrollable | The persistent oscillation of the steering wheel at high speeds would make it very difficult to control a spin out. | ASIL D |

| ation of ASIL and Safety Goals |
| --- |
| **Safety Goal** |
| The oscillating steering torque from the lane departure warning function shall be limited. |
| 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 autnonomous driving. |
| The lane keeping assistance function shall be location limited to highway areas, and shall be disabled for non highway driving. Furthermore; the applied steering torque shall be easily overcome by a human driver. |
| The LDW shall be time limited so that if it has been engaged continuously for a long period of time, it shall deactivate, so that the oscillatory torque does not impede steering or cause a distraction. It shall also be appropriatly calibrated so that it does not activate when deviation from center of lane is slight. |