QUANTIFYING USER EXPERIENCE OF LANE SUPPORT SYSTEMS

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ABSTRACT

As Lane Support Systems (LSS) technology has increased in prevalence in modern vehicles, ANCAP has also observed an increase in negative feedback from drivers and media sources regarding undesirable vehicle responses that they have experienced in day-to-day driving.

The feedback was categorised into three main topics.

1. The vehicle LSS response has put occupants in danger.
2. The vehicle is 'taking over' the steering (driver feels no longer in control).
3. The vehicle LSS response is disproportionately strong for the driving situation.

In many cases the driver reported switching off LSS because of their poor driving experiences.

ANCAP undertook a research program into the performance of LSS across a range of vehicle makes and models to objectively analyse the system characteristics against the subjective consumer feedback; and develop a method to identify and discourage systems that are likely to result in a negative user experience, or the driver deactivating the system.

The analysis was focused on parameters that had been recorded through robotic controls and sensors fitted to test vehicles and provided insights on steering characteristics and vehicle dynamics that related to occupant feeling and perception during an LSS intervention.

Vehicles whose LSS corrections provide one or more of the following characteristics are likely to be categorised as having poor user experience:

1. The LSS response has large and/or rapid steering change.
2. Occupants experience higher levels of acceleration from the LSS redirecting the vehicle path.
3. Higher force / torque is required from the driver to override steering inputs and maintain their intended direction.
4. The resultant lateral velocity after an LSS correction puts occupants in further danger.

ANCAP's research highlights the importance of the interaction between a vehicle and its occupants during an LSS response; and provides understanding on the human factors contributing to the broader acceptance of LSS design.

INTRODUCTION

Lane support systems are an active safety system that can either warn a driver of lane departure; or provide assistance or intervention to correct the vehicle's heading when the vehicle is leaving its lane of travel.

ANCAP has been encouraging fitment of lane support systems (LSS), a system designed to assist a driver in safely maintaining their intended path, as part of a star rating assessment since 2018. Vehicles are assessed for their ability to detect and avoid a severe crash through the presence and effectiveness of active lane support systems - Lane Keep Assist (LKA) and Emergency Lane Keeping (ELK).

The inclusion of LSS within ANCAP's assessment is to encourage the fitment in vehicles of systems with established life-saving benefits. However, ANCAP regularly receives some negative consumer feedback regarding undesirable vehicle responses that consumers were experiencing in their day-to-day driving.

The feedback is generally of a subjective and anecdotal nature, however common complaints and vehicle models have emerged.

Feedback could be categorised into three primary concerns:

1. The vehicle's LSS response has put occupants in perceived danger
2. The vehicle is 'taking over' the steering (driver feels no longer in control)
3. The vehicle LSS response is disproportionately strong for the driving situation.

Subsequently, consumers will also report that they are now actively switching off their LSS as a result of their poor user experience.

ANCAP's Lane Support System research project set out to benchmark a subset of vehicles in response to the rise in consumer feedback, and intended to:

- Objectively analyse vehicles with respect to the feedback received
- Compare and understand lane support system response characteristics; and identify differences between vehicles with positive and negative consumer acceptance / feedback.
- Understand if there are indicators within ANCAP's test suite, separate to the current assessment metrics, that will predict that an LSS system may be at risk of poor user experience.

Furthermore, ANCAP intends to use the results of this study to build confidence and acceptance of LSS systems in public communication – so consumers are more likely to utilise lane support systems, and their safety benefits are maintained.

Road Safety Challenge

While varying year on year, the number of deaths on Australian roads has remained relatively static since 2011; with a trend indicating that the road deaths in Australia are not likely to reduce significantly without further action.

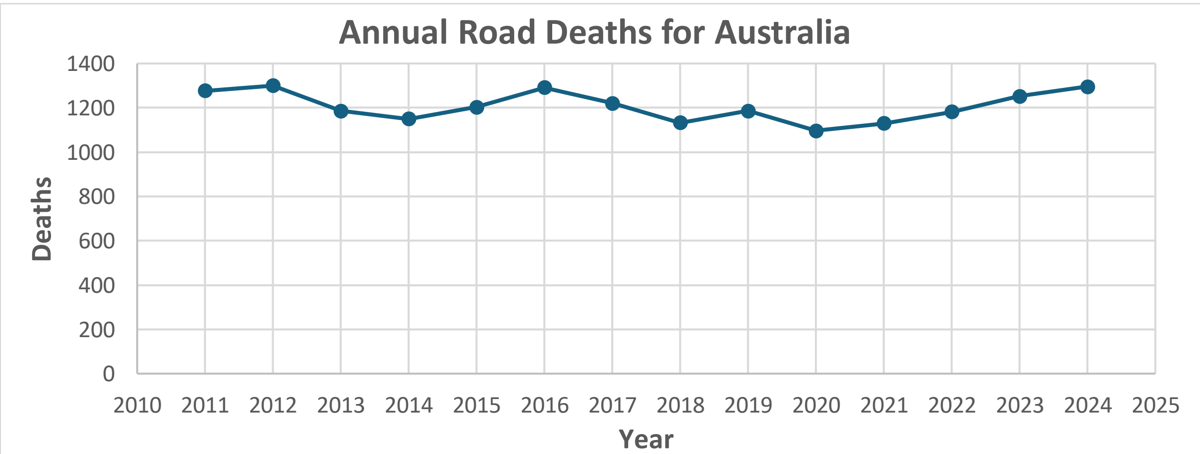

Figure 1: Annual Road Deaths on Australian Roads[1]

A large proportion of Australian road deaths are due to unintended lane departures; either as a single vehicle running off the road, or as a vehicle exiting their lane and into another road user in a side swipe or head on type collision.[2]

Two reports specifically detail the benefits of adopting and mandating effective LSS systems in Australia.

1) <u>The Potential Benefits of Lane Keep Assist Systems in Australian Light Vehicles</u>[2]

- This report analyses historical crash statistics (2013-2019) to determine the potential benefits associated to the widespread adoption of LSS systems.
- Statistics for unintentional lane departures were generated on:
    - Single vehicle run off, multiple vehicle head-on and sideswipe crashes
    - Crashes on sealed roads, with speed limits above 70km/h
    - Roads not covered with snow or ice
- Based on their analysis, 11% of all road crashes resulting in casualty were caused by unintentional lane departure.
- Unintentional lane departure crashes were found to have disproportionately high consequences for their representation in overall crash statistics.
    - These crashes account for 55% of all road fatalities, and 23% of serious injuries in Australia
    - When only considering crashes at highway speeds (≥100km/h), unintended lane departure crashes represent 72% of road fatalities, and 80% of serious injury cases.
- Implementation of emergency lane keeping (ELK) and lane keep assistance (LKA) systems, could reduce the occurrence of fatal unintended lane departure crashes by 22%.
    - In doing so, widespread LSS system adoption can result in an overall reduction of light vehicle fatalities by 11.9%.

2) <u>Regulation Impact Statement (RIS) – ADR 107/00</u>[3]

- The cost benefit analysis for mandating lane support system fitment through regulatory means (ADR 107/00) predicted in the 35years from a 2023 implementation, widespread fitment of LSS can result in:
    - 6989 lives saved
    - 23648 serious injuries avoided
    - 7385 minor injuries avoided
- The mandatory adoption of LSS features through ADR107/00 was forecast to provide the Australian community with a net benefit of at least $2.44 billion (AUD) over those 35 years.

METHODS

The tests conducted and analysed for the ANCAP Lane Support Systems research were selected for their comparability to the situations described in the feedback, as well as how they aligned to the concerns raised and their ability to isolate specific characteristics and behaviours of a vehicles LSS response.

To reiterate, the concerns raised by consumers were:

1. The vehicle's LSS response has put occupants in danger
2. The vehicle is 'taking over' the steering (driver feels no longer in control)
3. The vehicle LSS response is disproportionately strong for the driving situation.

Where possible, pre-existing test scenarios and test methods were selected for this research as this provided opportunity to apply this analysis to future test programs as well as broaden the datasets available for analysis from historical test programs.

The test scenarios, and rationale for selection, are as follows:

ELK Road Edge

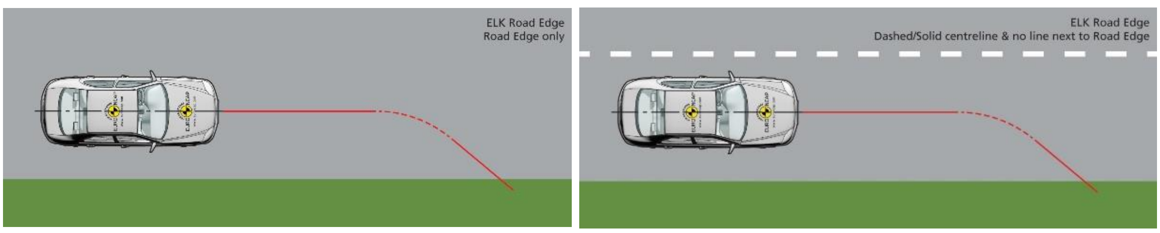

Figure 2: ELK Road Edge test scenarios for a left-hand drive vehicle shown for reference.

Test Method: Consistent with the 2023 LSS Testing Protocol, ELK (Emergency Lane Keeping) Road Edge Tests were be performed with 0.1 m/s incremental steps within the lateral velocity range of 0.2 to 0.6 m/s for departures to the front passenger side only.

ANCAP's current star rating assessment of this scenario is outcome based, where the pass / fail criteria is in relation to a vehicle's maximum distance to lane edge (DTLE).

While the intention was not to change the scenario itself, the project required ANCAP to analyse different metrics to understand consumer comfort and feedback. Please refer to the "Data Recording" section below for more detail on which channels are analysed.

Relationship to Consumer Experience: This test is selected to understand the users experience that the vehicle:

- "sends you closer to the centreline and an accident".
- is "quite aggressive with the steering corrections".

Reasoning: The purpose of conducting this test is:

- To gather objective data and address the real-world scenario where a vehicle response to the road edge may "push the vehicle into oncoming traffic".
- In some cases, a vehicle response to the ELK road edge test may exhibit the strongest LSS response while correcting the vehicle's heading.
- Analyse what is felt within the cabin during an ELK response.
- Determine objective metrics / predictors for poor consumer experience with respect to the LSS concerns:
    - The vehicle's LSS response has put occupants in danger
    - The vehicle is 'taking over' the steering (driver feels no longer in control)
    - The vehicle LSS response is disproportionately strong for the driving situation.

LSS Overactivity and Corrections on Curves – S-Bend Driving Test
Consumer feedback suggests that lane support systems can sometimes be overactive during corners, winding or narrow roads and provide corrections where unnecessary.

To simulate real world driving in these conditions, the test vehicle is driven through the S-Bend outlined in the Assisted Driving test and assessment protocol.

Figure 3: S-Bend track layout

Test Method: The vehicle is equipped with the motion pack only (no steering or pedal robots), and approaches the S Bend at 100km/h, in a central position to the lane The path is driven in natural manner, similar to how these corners would be taken in real world driving.

This is repeated 10 times per vehicle. If no LSS intervention is recorded, an additional 5 runs are conducted, where the driver actively tries to initiate an LSS response.

Relationship to Consumer Experience: This test is selected to understand the users experience that the vehicle:

- "on narrow roads it can over correct"
- on "winding, narrow New Zealand rural roads this emergency lane keeping assist in our opinion is outright dangerous"

Reasoning: The purpose of conducting this test is:

- To gather objective measurement data on the LSS response during curves, winding, or narrow roads.
- Analyse what is felt within the cabin during the S Bend if there is an ELK response.

- Determine objective metrics / predictors for poor consumer experience with respect to the LSS concerns:
  - The vehicle's LSS response has put occupants in danger
  - The vehicle LSS response is disproportionately strong for the driving situation.

ELK / LKA Solid and Dashed Lines

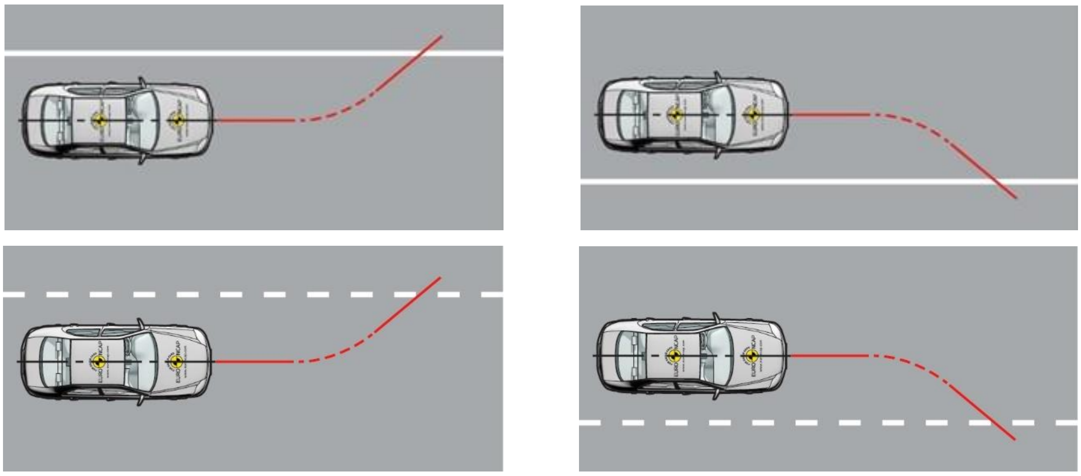

Figure 4: ELK / LKA Solid and Dashed Line test formats shown for reference

The suggested test conduct for the ELK / LKA Solid and Dashed lines scenario is based on the current (2023-25) ANCAP LSS Testing Protocol requirements for the LKA Solid and Dashed line assessment.

Test Method: Tests will be performed with 0.1 m/s incremental steps within the lateral velocity range of 0.2 to 0.6m/s for departures at both sides of the vehicle.

For this research project, the proposed conduct will only differ to the existing star rating assessment criteria in the vehicle settings, where ELK can remain on for a full vehicle system response, as opposed to targeting only LKA (Lane Keep Assist) performance.

Relationship to Consumer Experience: This test is selected to understand the users experience that the vehicle:

- "will try to prevent you from swerving and actively try to drive you into obstacles".
- is "quite aggressive with the steering corrections".

Reasoning: The purpose of conducting this test is:

- To gather objective data and address the real-world scenario where the vehicle response to road markings will counter a driver's intent to avoid a dangerous situation (i.e. cyclist, pothole, parked vehicle).
- Analyse what is felt within the cabin during an ELK response.
- Determine objective metrics / predictors for poor consumer experience with respect to the LSS concerns:
  - The vehicle's LSS response has put occupants in danger
  - The vehicle is 'taking over' the steering (driver feels no longer in control)
  - The vehicle LSS response is disproportionately strong for the driving situation.

Lane Departure Warning (adjusted)

In traditional Lane Departure Warning testing, the test method requires the steering robot to maintain a defined path while recording the time at which a lane departure warning is provided to the driver.

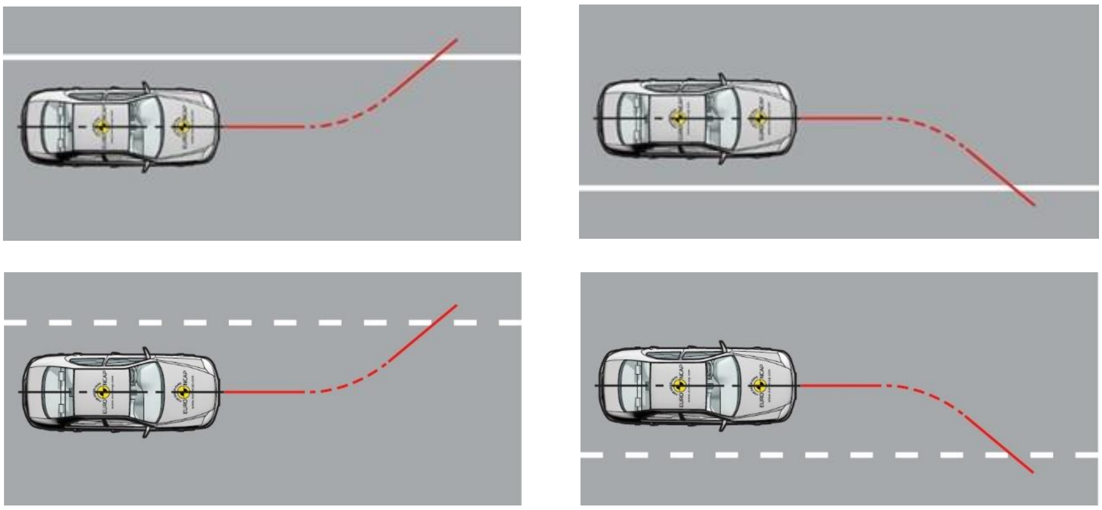

Figure 5: Lane Departure Warning (adjusted) test formats shown for reference

Test Method: The proposed test conduct for this project will maintain the base lane departure warning test method, however timing of any warnings recorded is not required; and will require the vehicle settings to allow ELK and LKA heading corrections.

ANCAP can utilise this test method to gain insight into the additional torque required by the steering robot to override the LSS response and maintain the desired test path.

Relationship to Consumer Experience: This test was selected to understand the users experience that the vehicle:

- is "quite aggressive with the steering corrections".
- "aggressively tugged" or "wrenched" the steering out of the driver's hands.

Reasoning: The purpose of conducting this test is:

- To gather objective data on the force / torque required to override an ELK or LKA response.
- To understand and address the anecdote that "the vehicle has taken over the steering and the driver is no longer in control".
- Determine objective metrics / predictors for poor consumer experience with respect to the LSS concern:
    - The vehicle is 'taking over' the steering (driver feels no longer in control)

RESULTS

The observations regarding lane support system response characteristics and consumer acceptance have been made through the analysis of:

- 655 individual tests
- 28 different vehicles spanning a range of market segments and use cases
- Data from 2 different continents
- Test programs conducted between 2019 and 2024

Vehicles Analysed

The vehicles analysed for this study are listed below:

ORGANISATION	VEHICLE	DRIVE	LSS CONTROL	PROGRAM	TEST YEAR
ANCAP	Toyota Camry	RHD	Steering	Star Ratings	2024
ANCAP	Chery Tiggo 7	RHD	Steering	Star Ratings	2023
ANCAP	Ford Ranger	RHD	Steering	Star Ratings	2022
ANCAP	JAC T9	RHD	Steering	Star Ratings	2024
ANCAP	Toyota Kluger	RHD	Steering	Star Ratings	2021
ANCAP	Toyota LandCruiser 300 Series	RHD	Brake	Star Ratings	2021
ANCAP	Mitsubishi Triton	RHD	Brake	Star Ratings	2024
ANCAP	Mitsubishi Outlander	RHD	Brake	Star Ratings	2021
ANCAP	Nissan Pathfinder	RHD	Brake	Star Ratings	2022
ANCAP	Toyota Prado	RHD	Steering	Star Ratings	2024
ANCAP	Lexus NX	RHD	Steering	LSS Research	2024
ANCAP	Chery Omoda5	RHD	Steering	LSS Research	2024
ANCAP	BYD Atto3	RHD	Steering	LSS Research	2024
ANCAP	MG MG4	RHD	Steering	LSS Research	2024
Euro NCAP	BMW 5 Series	LHD	Steering	Star Ratings	2023
Euro NCAP	Kia EV9	LHD	Steering	Star Ratings	2023
Euro NCAP	Lexus LBX	LHD	Steering	Star Ratings	2024
Euro NCAP	Volkswagen ID7	LHD	Steering	Star Ratings	2023
Euro NCAP	MG HS	RHD	Steering	Star Ratings	2019
Euro NCAP	Leapmotor C10	LHD	Steering	Star Ratings	2024
Euro NCAP	Maxus MIFA 7	LHD	Steering	Star Ratings	2024
Euro NCAP	Mercedes Benz E-Class	LHD	Steering	Star Ratings	2024
Euro NCAP	MG HS	LHD	Steering	Star Ratings	2024
Euro NCAP	Renault Symbioz	LHD	Steering	Star Ratings	2024
Euro NCAP	XPENG G9	LHD	Steering	Star Ratings	2023
Euro NCAP	ZEEKR X	LHD	Steering	Star Ratings	2024
EuroNCAP	Opel Astra	LHD	Steering	Star Ratings	2022

Table 1: Details of the vehicles and test programs analysed

As the data used for analysis comes from testing conducted pre-2025, it is expected that some vehicles would have undergone system updates since the test program was conducted. As a result, the performance reported on for any applicable vehicle models may be antiquated at the time of this publication.

Vehicle system updates are not expected to change the outcomes or observations of this study. Consumer acceptance concerns in relation to lane support systems have spanned the years that the test programs have occurred. The observations, therefore, remain relevant.

Observations and Findings

ELK Road Edge Test: A vehicle's lane support system responses are able to be characterised using the data from this test. The figure below depicts a comparison of vehicle paths from four separate vehicles. One, the Lexus NX, as a positive reference and three other vehicles with known user acceptance concerns.

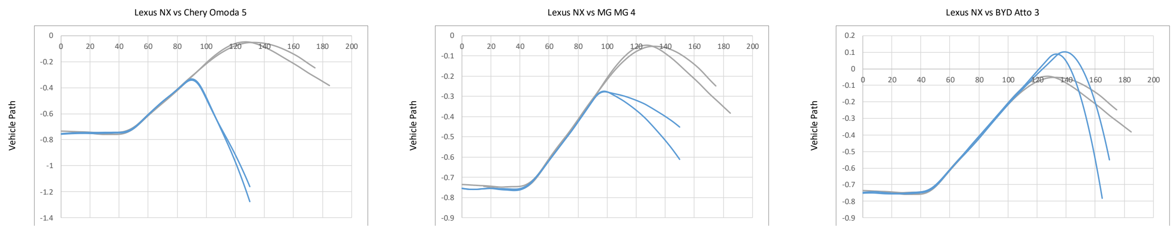

Figure 6: Vehicle path comparisons for ELK Road Edge tests

The differences in the LSS response can be further characterised within the data traces and peak values measured. Vehicles with acceptance concerns were typically found to exhibit higher values for:

- Steering Wheel Angle Change

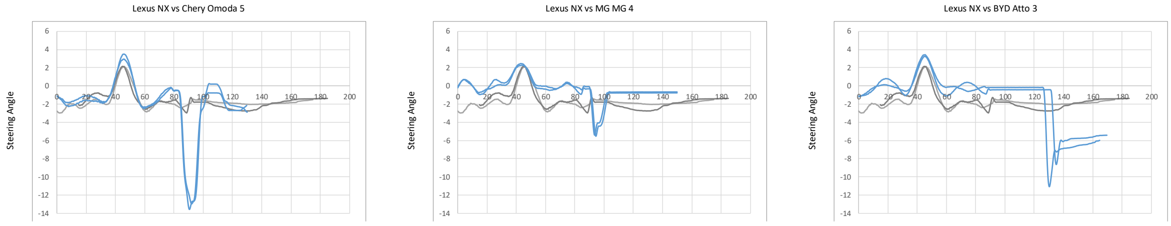

Figure 7: Steering Wheel Angle Change comparisons for ELK Road Edge tests

- Steering Wheel Velocity

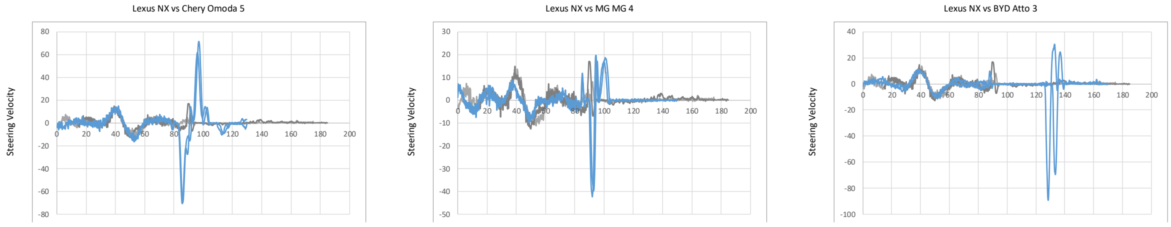

Figure 8: Steering Wheel Velocity comparisons for ELK Road Edge tests

- Resultant Lateral Velocity

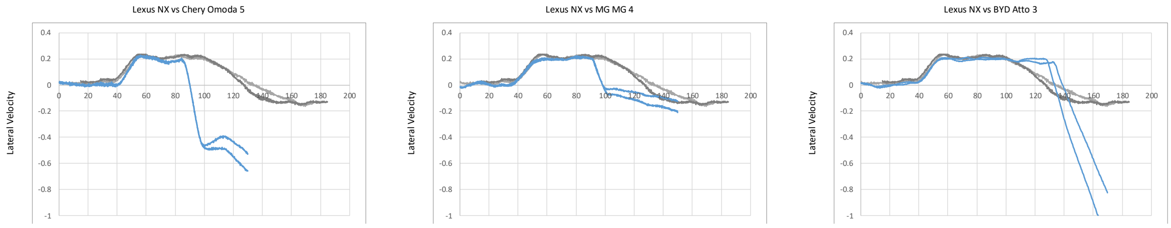

Figure 9: Lateral Velocity comparisons for ELK Road Edge tests

- Lateral (and Total) Acceleration

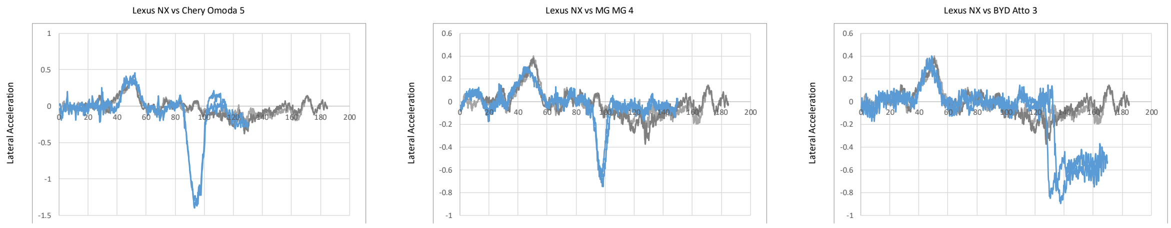

Figure 10: Lateral Acceleration comparisons for ELK Road Edge tests

No other noticeable differences were observed in vehicle dynamics as a result of LSS activity; the only exception to this being LSS responses that utilise differential braking to redirect of the vehicle. This system control strategy introduced additional pitch angle change because of the application of the brakes.

S-Bend Driving Test

From the data collected and analysed for all tests it was not possible to provide clear and objective conclusions with respect to the consumer acceptance feedback that the test was attempting to replicate.

Examples of this are below.

- Appropriateness of the LSS response during a cornering manoeuvre.

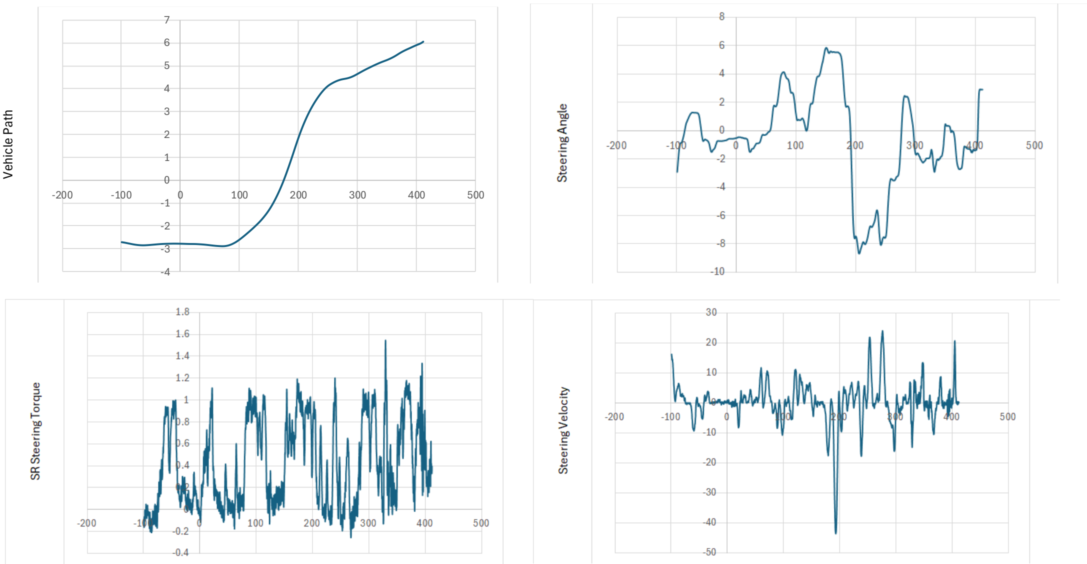

Figure 11: Example graphs from the S-Bend Driving Test analysis

- Peak acceleration loads

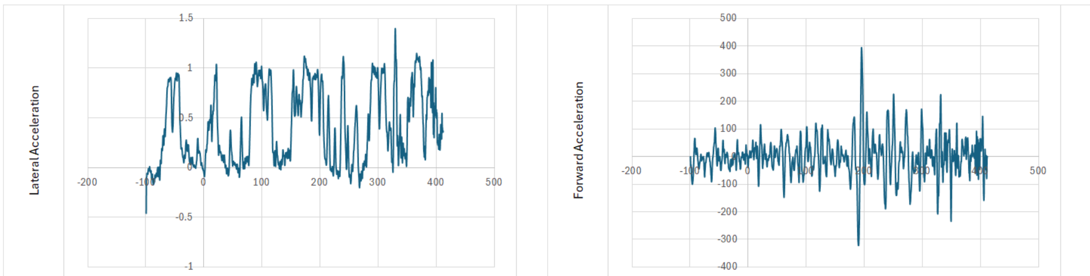

Figure 12: Example graphs from the S-Bend Driving Test analysis

- Rates of change (impulse / jerk characteristics)

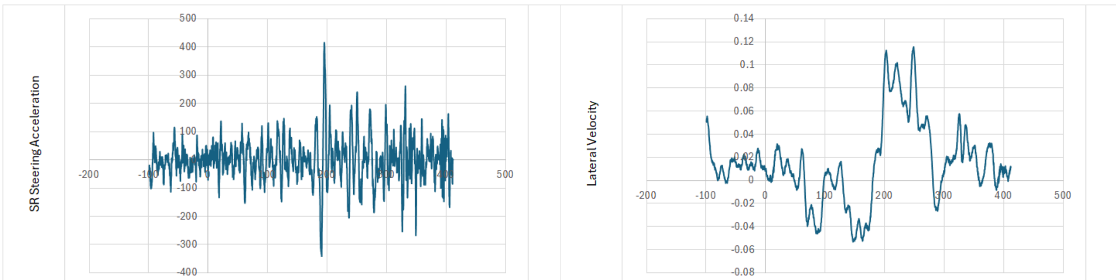

Figure 13: Example graphs from the S-Bend Driving Test analysis

- Vehicle dynamic response (uncomfortable body roll motion, jolt feeling through sudden pitch, etc)

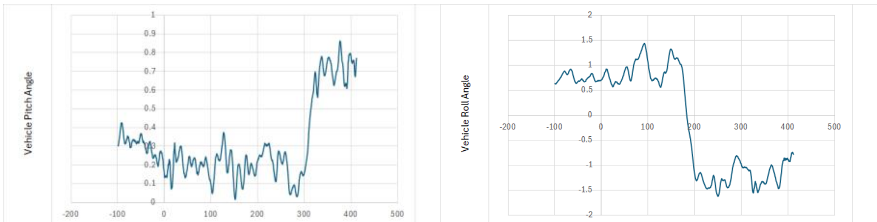

Figure 14: Example graphs from the S-Bend Driving Test analysis

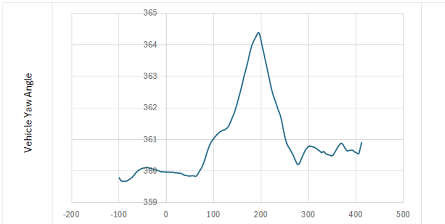

Figure 15: Example graphs from the S-Bend Driving Test analysis

As shown, the data traces are heavily affected by external variables and noise. This is likely due to the test being performed with the driver in control of the vehicle and with the instruction to replicate a natural driving style through the series of corners.

Differentiating LSS activity from the driver inputs is difficult, therefore insights regarding consumer experience from this test can only be subjective. The vehicle dynamics are as expected when a vehicle is piloted through a series of turns. Any lane support system response during these tests has had a negligible effect on the vehicle itself.

No objective conclusions regarding consumer acceptance of Lane Support Systems were found from this test.

ELK / LKA Solid and Dashed Lines

The ELK / LKA Solid and Dashed Line testing was conducted in a very similar fashion to the ELK Road Edge tests. The most notable points of difference between ELK Road Edge testing and this scenario are that the vehicle is being tested against single line markings in the middle of an asphalt test area (continuous road surface on either side of the lane boundary) and that the vehicle is tested on either side of the vehicle.

Observations regarding vehicle and system performance were consistent with the ELK Road edge test, however the system response was less severe against solid and dashed line markings than against road edge. This is demonstrated when comparing the LSS steering inputs for each scenario type via the comparably higher steering wheel velocities and steering angle changes for ELK Road Edge (against Solid and Dashed Lines).

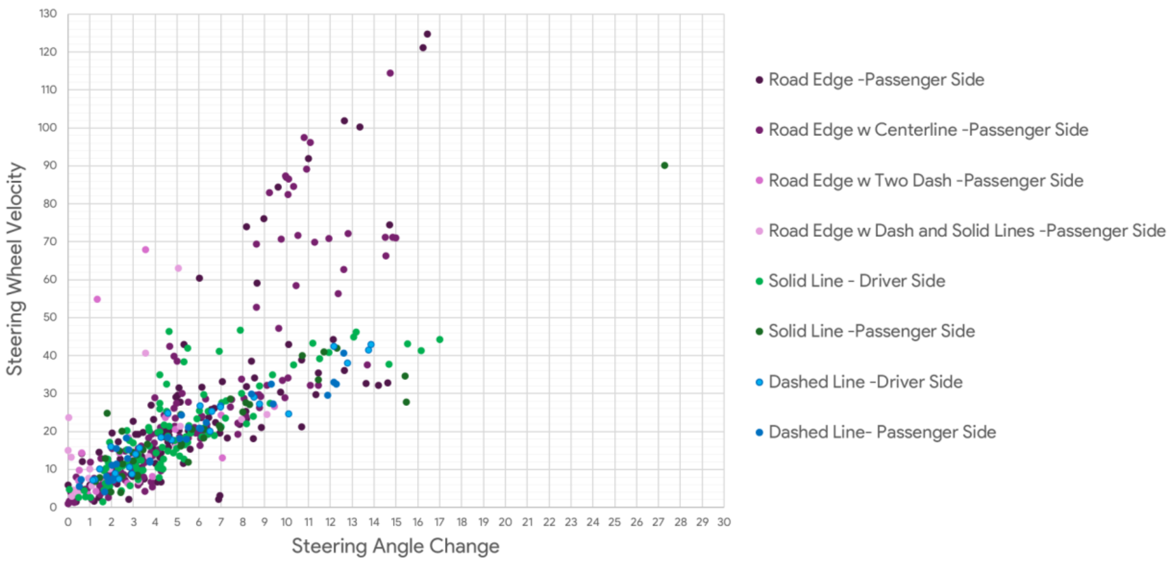

Figure 16: Steering inputs for each test scenario

Lane Departure Warning (Steering Override Torque Measurement)

In this test, some test vehicles (with known user acceptance concerns) were observed to require a driver to counter steer with a steering torque above 3.5Nm to intentionally override the lane support system heading correction.

A steering torque of 3.5Nm is the current acceptance limit for a driver to override the lane support system response in the ANCAP Star Rating assessment.

- ANCAP Assessment Protocol – Safety Assist: Collision Avoidance v10.4.1 – Clause 4.3.3.4
- ANCAP Assessment Protocol - Vulnerable Road User Protection v11.4 - Clause 2.3.1.6

This limit was chosen after benchmarking the European automotive industry for lane support system steering torque. The benchmarking activity was able to propose a widely accepted limit, which is both deemed easy to override and commonly achievable steering torque limits.

Figure 17: Observation of steering torque requirement - 0.6m/s – Solid line marking

DISCUSSION

Modes of Interaction

Figure 18: Visual depiction of the modes of driver interaction during a LSS response

When considering the user acceptance of Lane Support Systems, fundamental understanding is required on how a driver or occupant of the vehicle is likely going to interact with a vehicle. On a basic level, the main modes of interaction are through:

Haptic feedback through the steering wheel: For most systems (steering control type) this is the main source of interaction with LSS. It is also one of the primary points of control for a vehicle. Minimising difficulty in steering is imperative in maintaining a driver's sense of management of the vehicle.

Changes perceived through the seat (ie. vehicle dynamics): People feel the effects of change (acceleration, braking, cornering forces, etc.) primarily through the seat. This is no different to lane support system responses, however these changes are oftentimes unexpected and not related to any input from the driver.

Audible (sensory) cues: Many vehicles issue an audible alert every time new information is detected and provided to the driver. Quite often lane departure warnings and corrections are also coupled with audible warnings. These audible alerts, collectively, can become overbearing and annoying if issued too often and not in line with the driver's expectations.

Controlling of vehicle speed: Vehicles that use differential braking for yaw control are becoming less common, however those systems, when activated, will typically also reduce the vehicle's speed. This, coupled with any of the other interactions, could add to a driver's cognitive load as they would need to apply the accelerator to bring the vehicle back to the desired speed. after an intervention.

The LSS response has large and/or rapid steering change.

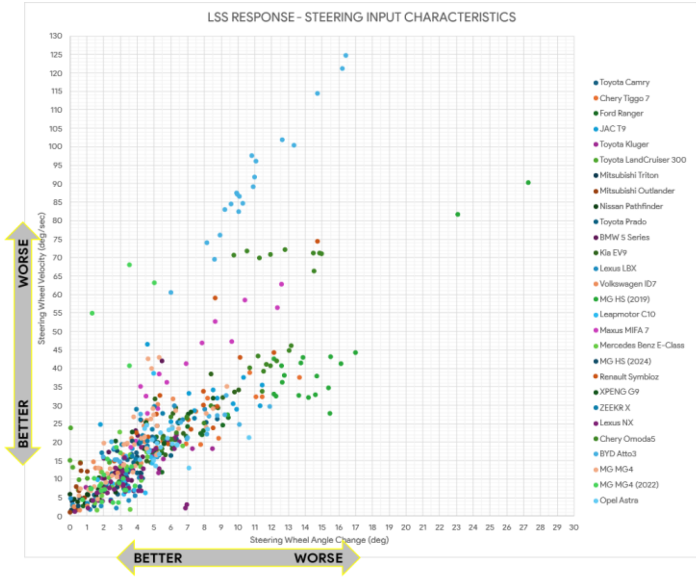

Figure 19: Steering inputs with respect to consumer acceptance

Demonstrable differences in the steering wheel movement were observed in the analysis of the ELK Road and ELK / LKA solid and dashed line marking tests.

Oftentimes more aggressive lane support systems responses were identifiable through larger steering angles and higher steering wheel velocities. These translated into shorter duration responses and, overall, a more rapid correction felt by the driver (vie the steering control and through the vehicle's dynamic response to the LSS input).

In isolation, steering wheel angle change and steering wheel velocity may not be a good marker for user acceptance alone. Through the analysis, there was less correlation with poor user experience if a vehicle had a large steering angle change with low steering wheel velocity; or if the vehicle had low steering angle change but high steering velocities.

It's assumed that low steering angle changes become less perceivable to the driver, and therefore less annoying with higher steering velocities. Vehicle manufacturers sometimes implement this type of input as a haptic feedback in addition to the traditional lane departure warnings, with few concerns raised as a result. Similarly, higher steering angle changes with lower steering velocities are an indication of a gradual response, leading to a greater sense of control and less intrusive correction for the driver.

Therefore, perceivable magnitudes of change in the steering wheel during an LSS response, coupled with high steering velocities are likely to result in a lost sense of control from the driver and are an appropriate marker (together) for driver acceptance concerns.

Occupants experience higher levels of acceleration from the LSS redirecting the vehicle path.

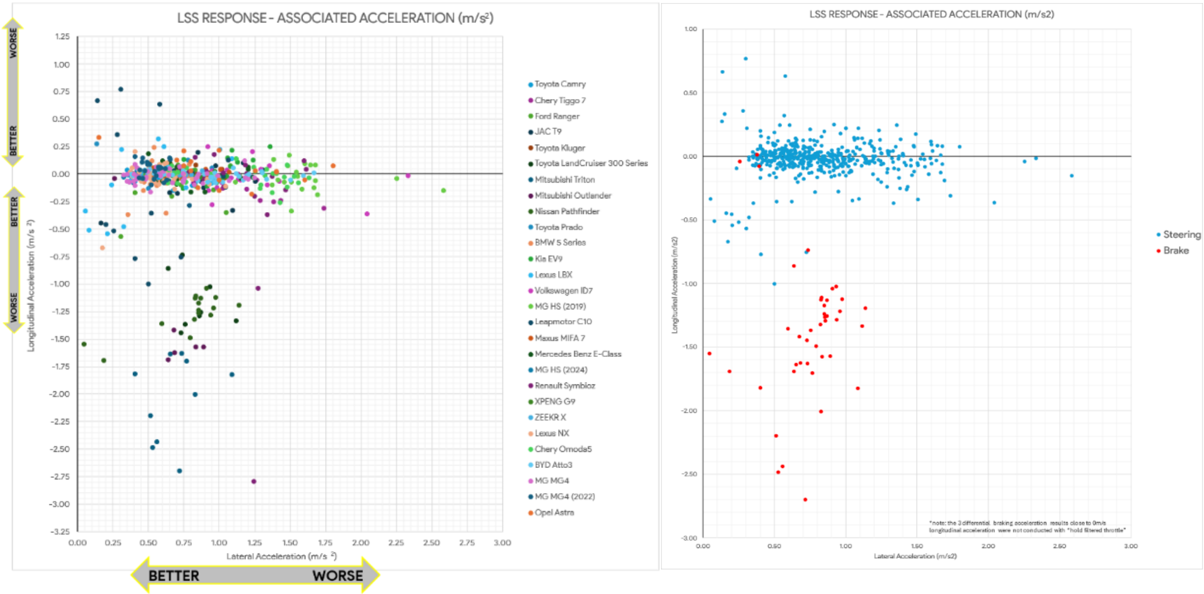

Figure 20: Peak acceleration (with direction) during a LSS response

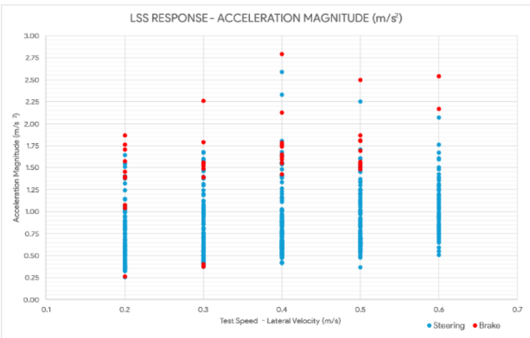

Figure 21: Comparison of acceleration magnitude between different system types

Varying levels of acceleration are experienced because of a lane support system response. Acceleration is connected to the force of change felt by occupants of the vehicle during a response.

There is less overall correlation to user acceptance of lane support system because of acceleration levels due to the presence of differing vehicle types and designs. To elaborate, occupants of a sports car are more exposed to higher levels of lateral acceleration and are therefore less likely to report concerns relating to acceleration than occupants of, for example, a light commercial vehicle.

Acceleration does become a good marker of acceptance concerns when we compare different LSS control strategies though. There are very clear and separate clusters of data when comparing Steering and Differential Braking LSS control systems.

Activating the brakes on one side of the vehicle to correct the vehicle path introduces an additional longitudinal acceleration vector. Differential Braking systems are, therefore, prone to providing comparably higher magnitudes of acceleration during an LSS response, and more uncomfortable response.

Higher force / torque is required from the driver to override steering inputs and maintain their intended direction.
In the analysis of the Lane Departure Warning (adjusted) tests, some vehicle systems require the driver to provide greater steering inputs to maintain their intended path. Comparable difficulty in overriding the vehicle system could result in lane support system being perceived as overbearing and contribute to a driver's sense that they are not in full control of the driving task, even though they could be 100% engaged in what they are doing.

As a result, a driver could feel that the vehicle is not collaborative, and that they need to fight the lane support system. The measurement of steering override torque is a good marker for user acceptance concerns.

The resultant lateral velocity after an LSS correction puts occupants in further danger.
Analysis of the ELK Road Edge and ELK / LKA Solid and Dashed Line tests showed that there are currently three different strategies employed by vehicle manufacturers after a lane support correction.

- Limited or no additional control after the first response

After a lane departure is prevented, the vehicle does not attempt to straighten the trajectory along the lane. Residual steering angles remain in place, effectively accelerating a vehicle back towards the opposing lane boundary. Oftentimes, the resultant lateral velocity was observed to exceed a vehicle's operational capability.

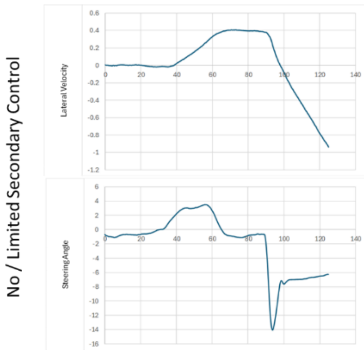

Figure 22: Exmaple of limited or no additional control after LSS correction

- Gradual and controlled return to the centre of the lane

This strategy is characterised by comparably low steering angles that result in a longer duration of correction and a more gradual return to the centre of the lane. Vehicles will often return the steering angle back after the lane departure is prevented, typically to ensure a lower resultant lateral velocity.

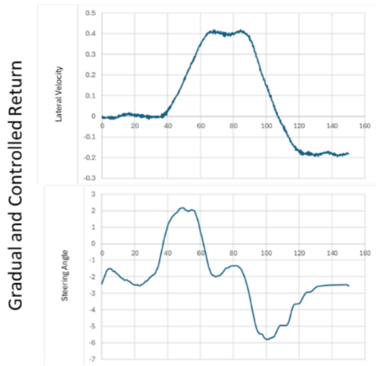

Figure 23: Example of a gradual and controlled return

- Multiple stages of lane departure prevention and lane centering.

This strategy can be observed through step changes in the vehicle's path and subsequent lateral velocity traces. In this, a vehicle will initially provide a lane departure correction, then build an offset within the lane, effectively reducing risk of further lane departures, before straightening the vehicle trajectory along the lane path.

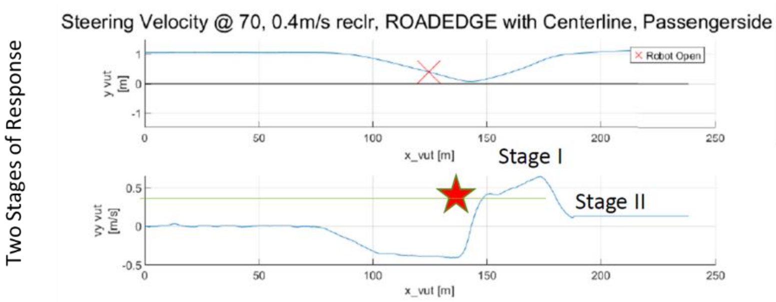

Figure 24: Example of a multiple stage redirection

How a vehicle returns back into the lane after a lane support system response can contribute to a perceived amplification of risk or even generate a secondary collision (avoidance) event. Design strategies that provide greater levels of control can alleviate this risk and oftentimes provide a driver with a great sense of comfort after the vehicle initially intervenes.

False Positive Reactions

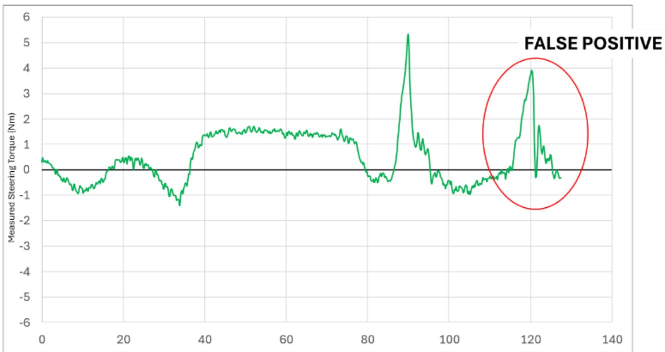

Figure 25: Observation of steering torque requirement – false positive reaction

In measuring the lane support system steering torque, one vehicle was found to consistently issue multiple lane support system responses during a single test.

On further review, ANCAP was able to determine that this second reaction was a false positive response, with heading correction being requested by the vehicle system in response to the construction seams in the tarmac.

While 100% response accuracy is not expected, drivers may be alarmed in the event of a false positive response and could lose confidence in the vehicle system if false positive reactions were regularly occurring.

Figure 26: Example of the test track's tarmac construction seam

CONCLUSIONS

The research and benchmarking program found observable differences in the data analysed, providing insights into vehicle responses that are relatable to the user experience and overall acceptance of lane support systems.

Vehicles whose LSS corrections provide one or more of the following characteristics are likely to be categorised as having poor user experience:

1. The LSS response has a combination of large andrapid steering change.
2. Occupants experience higher levels of acceleration from the LSS redirecting the vehicle path.
3. Higher force / torque is required from the driver to override steering inputs and maintain their intended direction.

4. The resultant lateral velocity after an LSS correction puts occupants in further danger.

ANCAP's research highlights the importance of the interaction between a vehicle and its occupants during an LSS response; and provides understanding on the human factors contributing to the broader acceptance of LSS design.

ANCAP intends to use the results of this study to provide insights to vehicle manufacturers for tuning their Lane Support Systems and to build greater confidence and acceptance of LSS systems – so consumers are more likely to leave LSS active and maintain the safety benefits that this system provides.

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