Valeo

FKFS
RESEARCH IN MOTION.

SALSA

Smart, Adaptive, and Learnable Systems for All

Topic block: Acceptance

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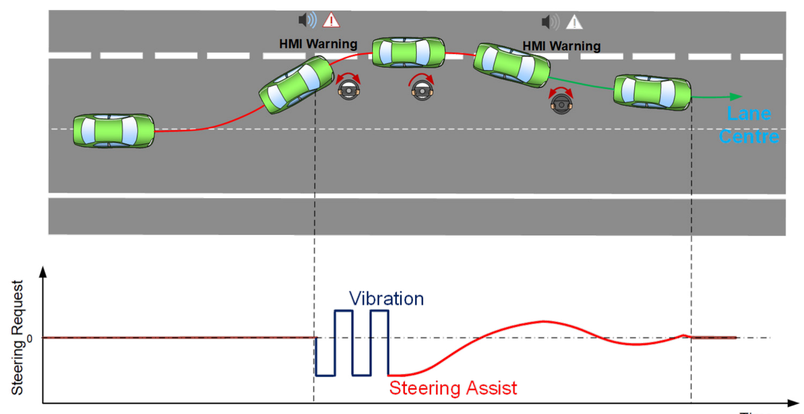
Driver Behavior Analysis to Enable Intuitive Lane Keeping Assistance

Advanced Driver Assistance Systems (ADAS), such as Lane Keeping Assistance (LKA), aim to improve road safety by correcting unintended lane departures. However, current systems often receive mixed user acceptance due to interventions that are perceived as harsh or misaligned with driver intent. This study analyzes driver behavior in lane-keeping scenarios to support the design of more intuitive, predictable, and less intrusive LKA systems.



Approach and experimental setup

This study analyzes driver behavior in lane-keeping scenarios using structured driving simulator experiments with 40 participants of diverse ages, genders, and driving experience. A comprehensive dataset of driver inputs, vehicle signals, and contextual information is analyzed to identify behavior patterns, which are mapped to Lane Keeping Assistance (LKA) with a focus on:

- Anticipating driver intention
- Identifying distraction related behaviors

The resulting insights are used to define relevant use cases

Test Environment & Test Procedure

The fully controllable and highly immersive Stuttgart Driving Simulator is employed to provide a comprehensive simulation environment. Vehicle motion is reproduced across all degrees of freedom, complemented by a realistic visual scenery, acoustic signals and a manually driven full-size vehicle mock-up with a real vehicle interior. All test scenarios are fully reproducible and could be conducted under safe and controlled conditions.

Stuttgart Driving Simulator

Stationary obstacle on right side and oncoming traffic

Mock-up inside dome

All test persons were exposed to multiple situations requiring lane departure on both, a rural road and a motorway section. The events were recorded using synchronized measurement systems, including eye-tracking data to capture gaze direction during the unintended lane departure.

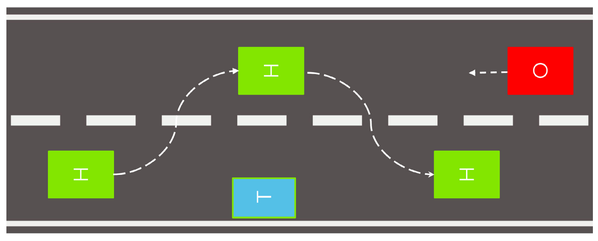
Various virtual scenarios are implemented to provoke unintended lane departures:

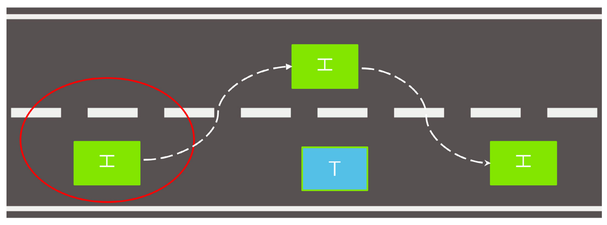
- Stationary obstacles, vehicles parked at the roadside, potholes or objects
- Dynamic obstacles, slow-moving road users
- Narrow road sections, w/o oncoming traffic
- Corner cutting situations, w/o oncoming traffic

Synthesised Use Cases from the study

Typical day-to-day driving use cases are illustrated below. In these scenarios, understanding driver intention is essential for determining appropriate ADAS actions.

Scenario: Oncoming vehicle encroaches into host lane
Driver Intention: Evasive lateral maneuver
System Response: LKA suppressed to avoid resisting safety maneuver

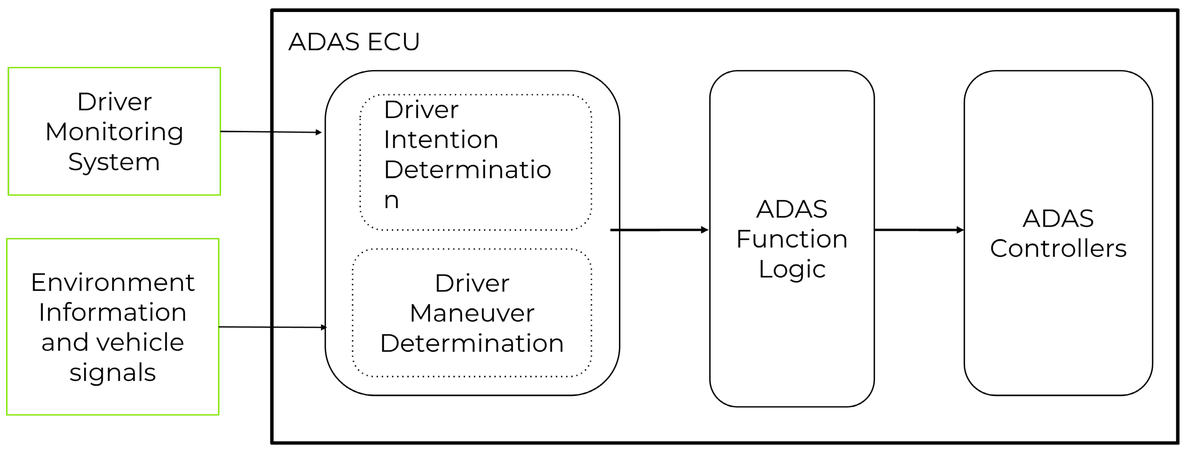




Scenario: Driver initiates lane change to overtake
Driver Intention: Intentional lane departure
System Response: LKA suppressed to allow smooth overtaking

Synthesised Use Cases from the study

This figure illustrates the functional architecture of the Driver State Link within the ADAS Electronic Control Unit (ECU). Driver state, environmental, and vehicle inputs are fused to interpret driver intent and vehicle maneuvers, which then drive ADAS function logic and controller actions for safety and driving assistance.



Approach to Results Generation

Driving simulator data are annotated and analyzed to identify driving patterns and infer driver intent. This information is fused with environmental data to determine the ADAS function's ideal operating state and enable intelligent intervention. Future integration with a driver monitoring system (DMS) can further enhance situational awareness and intervention decisions.