

Objective Workload Evaluation with Lane Keeping Assistance System Using Physiological Signal and Driving Performance

INTRODUCTION

The existing Advanced Driver Assistance System (ADAS) is supposed to assist driving tasks (e.g. adaptive cruise control) under driver's supervision. The Lane Keeping Assistance System (LKAS), for example, has been shown to reduce physical workload [1], yet it has also been found to reduce subjective driving pleasure in our pilot study due to unexpected system drop-off and inconsistent feedback [2]. Therefore, this present work aimed to understand the driver-LKAS interaction from the objective point of view. The question we tried to answer is: "Objectively, does LKAS really assist the driver?"

METHODS



The experiment was carried out

- With N = 16 participants
- Driving 2 laps with/without LKAS
- In 4 real-world scenarios (Fig. 1)



The mental workload was measured by

- Heart Rate (HR)
- Skin Conductance Response (SCR)



The driving performance was evaluated from

- Steering Reversal Rate (SRR)
- S.D. Lateral Position (SDLP)
- Steering Effort (SE)

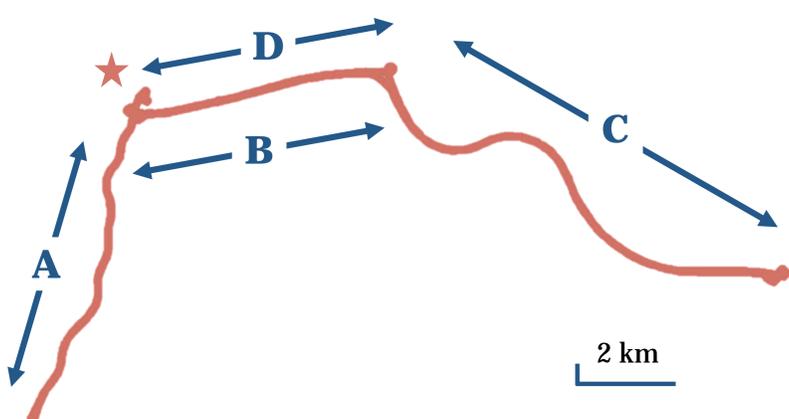


Fig 1. Total 4 real-world scenarios.
(The experiment began from the star)

	Scenarios	LKAS	Velocity	Curviness
Lap 1 / 2	A	ON/ OFF	120 km/ h	++
	A			++
	B			+
	C		160 km/ h	+++
	C			+++
	D			+

Table 1. LKAS and velocity setting in each scenario

RESULTS

- SE was greatly reduced with LKAS (Fig. 2L)
- However, counter steering was necessary (Fig. 2R)

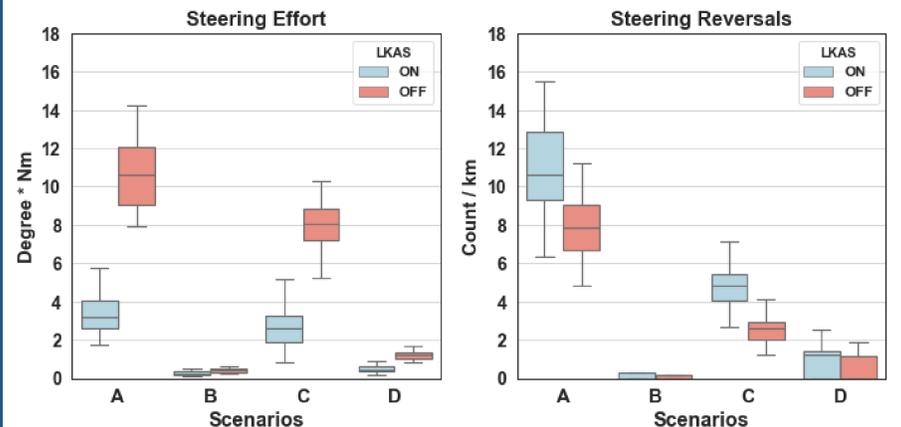


Fig 2. Steering effort & steering reversals

- SCR / km was higher driving with LKAS (Fig. 3)
- The acclimatization of HR was associated with the order of introducing LKAS. (Fig. not presented)

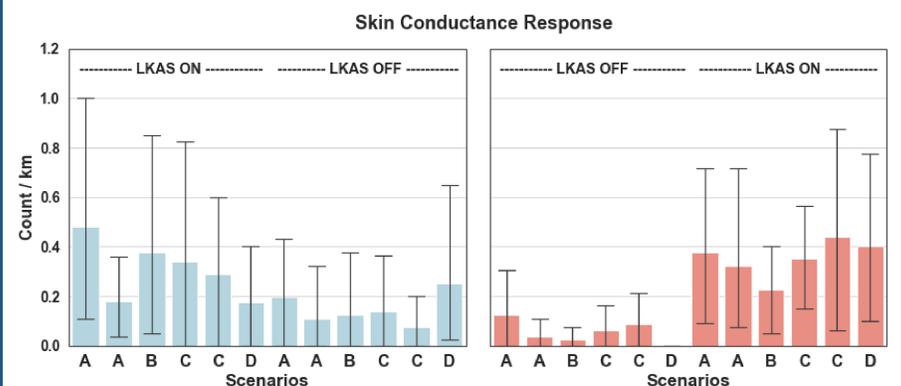


Fig 3. Average count of SCR in each scenario

CONCLUSION

Overall, LKAS has reduced physical effort significantly in all scenarios. However, additional mental effort was necessary to monitor LKAS and to perform counter steering. The associated mental workload can be observed from physiological data. To conclude, LKAS has still room for improvement

REFERENCE

- [1] Tanaka, J., Ishida, S., Kawagoe, H., & Kondo, S. (2000). Workload of using a driver assistance system. ITSC2000. 2000 IEEE Intelligent Transportation Systems. Proceedings (Cat. No.00TH8493), 382-386.
- [2] Seidler, C., & Schick, B. (2018). Stress and workload when using the lane keeping assistant: Driving experience with advanced driver assistance systems. 27th Aachen Colloquium, Germany.