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# The impact of innovative lighting technologies on driver performance, behaviour, acceptance, and safety

by  
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## Abstract:

Innovative lighting technologies emerged as promising strategies to mitigate the high occurrence of accidents on roads, particularly during nighttime when low visibility and driver psychophysical conditions contribute to deteriorate driving capability. Statistics highlight that on urban roads the highest number of accidents involve pedestrians with cars, while rural roads face most accidents of car drivers along curved sections.

This PhD thesis aims to investigate and validate the safety benefits of two innovative lighting technologies, adapted for urban and rural environments in night-time conditions, using a driving simulator.

In rural settings, the study explores the effects of the active LED road studs' colour and layout on horizontal curves, both subjectively and objectively. Results indicate that the presence of white LED road studs, along with configurations facilitating centred trajectories within lane, significantly improved driver behaviour. Drivers perceived road studs as less risky, more pleasant, and less arousing compared to unlit condition, positively accepting their presence. These devices enhance lane perception, allowing drivers to anticipate curve shapes and adjust their trajectories accordingly.

In urban areas, the study investigates the effectiveness of LED strip signals at mid-block crosswalks, activated when pedestrians enter the crosswalk and deactivate upon their exit. The technology aims to alert drivers to pedestrian presence, facilitating prompt reactions. Results demonstrate that this lighting technology improves driver-pedestrian interaction, enabling earlier reactions and undisturbed passage between drivers and pedestrians, even under distracted driving conditions. Drivers showed high trust on the technology, maintaining a workload comparable to conditions without technology.

Overall, the adoption of these innovative lighting technologies in both urban and rural settings enhanced driver behaviour, performance, and overall safety. Driver acceptance underscores the potential usefulness of these technologies in augmenting road safety. Furthermore, the findings highlight the importance of conducting behavioural analyses to determine the optimal configuration of such technologies, ensuring maximal benefit for road users. It is expected that road agencies and transport departments will use the experience gained from this research to reap the maximum benefits in terms of road safety.