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STUDY OF THE DRIVER'S BEHAVIOR WHEN CORNERING AND CHARACTERIZATION OF SAFE SPEED PERCEPTION

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ABSTRACT

Research and /or Engineering Questions/Objective:
Recently, there has been a growing interest in research towards autonomous vehicles, aiming to improve efficiency, safety, comfort and to eliminate human errors. However, a question arises: what should set the speed of the vehicle? The road legal limit, the maximum possible given the traffic conditions, the road critical speed or other matter? Moreover, it has been mentioned in literature that drivers feel unsafe when using cruise control systems, namely in cornering conditions. Therefore, the objective of this work is to study the driver's behaviour when cornering, to define a more human-like control strategy of the vehicle speed.

Methodology:
To study the driver's behaviour as a function of the vehicle dynamics, a test vehicle was equipped with a data acquisition system to acquire the tri-axis accelerations, the yaw, roll and pitch angular velocities, the speed of the vehicle, the position of the accelerator pedal, the activation of the brake pedal and the driver heart rate. Trials with volunteers have been carried out on a selected 22 Km route consisting of multiple road types, from city roads to highways. The volunteers were instructed to comply with road legal limits and to do a typical everyday driving. The diverse route profile (speeds, curves, and inclinations) enables us to characterize the driver's safe speed perception when cornering as a function of the accelerations of the vehicle.

Results:
From the test data a "comfort curve" was characterized for each volunteer, correlating the curvature radius with its accelerations and the volunteer's heart rate. The median, considering the results for all volunteers, will be proposed as an optimal function for the vehicle speed, function of the vehicle reference speed and its dynamic conditions.

Limitations of this study:
In further work the characterization of the safe speed perception should be extended to the occupants of the vehicle.

What does the paper offer that is new in the field in comparison to other works of the author:
This work was carried out considering a diversified sample of volunteers (sex and age). The test route includes a selection of curves covering multiple driving velocities and vehicle longitudinal inclinations. The behaviour of the volunteers was analysed based on the test vehicle dynamics (speed, accelerations and angular velocities), the actuation on the test vehicle pedals and the driver's heart rate.

Conclusion:
This work analyses the vehicle dynamics and the reactions of multiple volunteers on a preselected route. Upon the results, we propose a new control strategy for the vehicle's speed when cornering, to be adopted by cruise control systems and autonomous vehicles. Rather than circulating at constant velocities, the reproduction of a human-like behaviour will enhance the drivers and vehicle occupants' safety perception, leading to a more comfortable and superior driving experience.