

Summary

In the field of road design and road safety, well designed and executed experimental activities using a driving simulator can support the evaluation of operational and behavioral effects of road geometrics.

This work aimed to analyze the effects of sight limitations on driver performance when negotiating horizontal curves. Although the effects of road design parameters, such as the radius or lane/shoulder width, have been the subject of investigation in the past, the influence of the available sight distance (ASD) over driver behavior has remained largely unexplored. The ASD is a fundamental parameter in road design and its assessment is fundamental for safe driving operations.

To begin with, the fixed base driving simulator at the *Politecnico di Torino* was validated. Behavioral parameters relating to speeds and trajectories of thirty-three volunteers were collected both in the field (by means of an instrumented vehicle with a Mobile Mapping System) and in a simulated environment. Comparative and statistical approaches were used to compare free-flow speeds and unconditioned traveled paths. Participants adopted greater speeds and were more inclined to anticipate steering maneuvers in simulated drives than on the real track. The analyses revealed a relative validity with respect to operating speed, anticipatory distance, and mean trajectory curvatures along bends. Simulator sickness phenomena were monitored during the experiments, and some countermeasures were adopted in advance to try to prevent it.

Afterwards, the main study focused on an analysis of operational effects (i.e., speed, trajectory, and vision mechanisms) of drivers when negotiating curves with sight limitations at the driving simulator. Different ASDs were obtained by combining the radius of curvature and the distance of lateral sight obstructions from the lane centerline. Seventy-seven drivers were involved in two separate and consecutive experiments carried out on selected road tracks. In the first investigation, only driving speeds and vehicle trajectories were observed; in the

second, eye-tracking glasses were used to monitor driver eye movements and fixations. Results showed that the greater the ASD, the higher the speeds, while the dispersion of trajectory decreased. Speeds were not influenced by ASD along sharp bends, and the presence of lateral sight obstructions was a significant factor in curve guidance. Driver fixations evidenced that the preferred visual strategy in relation to road curvature involved the use of tangential points with longitudinal road elements (i.e., horizontal markings, road edges, sight obstruction). For higher values of ASD, fixations moved towards more distant points of the future path or of the roadway, in accordance with more complex visual strategies. Different attitudes were also observed between the steering strategies adopted by novice and experienced drivers, and between the driving styles adopted by aggressive and cautious drivers. Driver behavior adjustments in response to different sight conditions are presented here and discussed.