Examining Driver Behaviour along Motorway Exit Ramp Terminals

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Current motorway design guidelines still follow a deterministic approach for defining the lengths of entry and exit speed-change lanes, selecting a single conservative speed value (e.g., average or 85th percentile) based on kinematic laws. This method overlooks modern factors such as driver merging/diverging behaviour and vehicle performance.

This research investigates driver behaviour and speed profiles along motorway exit ramp terminals under free-flow conditions, with particular focus on the segment where vehicles enter the deceleration lane and diverge from the motorway through the controlling curve. Two exit ramps, corresponding to different interchanges with distinct geometric characteristics, were examined. Detailed speed–position–deceleration data were collected using a high-precision (10 Hz) accelerometer device. In total, 39 and 32 drivers participated in this naturalistic driving experiment for each exit ramp, respectively.

Regression models with satisfactory accuracy were developed to predict vehicle exit speed and deceleration rates during vehicle motion along the deceleration lane. The results highlight that speed and exit ramp geometry—such as taper length and controlling curve—and normalized deceleration distance—defined as the deceleration ratio along the deceleration lane—play a decisive role in driver behaviour.

These findings are expected to contribute to the development of design guidelines that more accurately reflect actual driver performance and expectations.

Future research should focus on expanding the experimental dataset by including a larger and more diverse sample of drivers and ramp configurations to strengthen the generalizability of the findings. Additional measurements should be conducted across ramps with varying geometric and traffic characteristics—such as different grades, curvature, and speed-change lane lengths—to capture a broader range of driving behaviours. Moreover, incorporating a wider demographic spectrum of participants, including different age groups and experience levels, would help better understand behavioural variability. Future studies could also benefit from combining accelerometer data with other advanced data collection techniques, such as vehicle-mounted sensors, to obtain more comprehensive and high-resolution behavioural measurements under real-world conditions.