Crash avoidance by Electronic Stability Control on Australian high speed rural roads: an analysis of braking interventions

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ABSTRACT

International and Australian research has found that there are significant benefits to road safety associated with the addition of Electronic Stability Control (ESC) to passenger vehicles. The greatest benefit to Australia is for crashes on high speed rural roads that occur due to a loss of control.

An investigation of what variables in the South Australian statewide crash database are associated with high injury severity for vehicle occupants during crashes on high speed rural roads was conducted. For specifically single vehicle crashes on high speed rural roads, a higher speed limit, the hours of darkness, and an earlier crash year were found to be the major indicators of a high injury severity outcome.

A complementary investigation of high speed rural road crashes that were a result of a loss of control was also conducted. This required the development of a method for identifying loss of control crashes using available variables from the South Australian statewide crash database. It was estimated that, per year in South Australia, 561 injury crashes on high speed rural roads are the result of a loss of control including 33 fatal crashes and 208 crashes resulting in injuries requiring hospital admission.

While literature from ESC manufacturers clearly explains the theory behind how ESC operates, no research has directly investigated what braking

interventions are made by ESC during real world situations where a vehicle not equipped with ESC would have crashed. More specifically, no research has investigated how braking interventions affect vehicle trajectory and enable a collision to be avoided. Also of interest is how the effect of interventions are altered when combined with other rural road safety features such as lower travelling speeds, sealed roadside shoulders, and sealed roads.

Crash scenarios, developed based on high speed rural road crashes, were simulated using a vehicle model (with a corresponding ESC model) supplied by Bosch Australia. The simulation method included processes such as dynamic testing of the vehicle model, use of a driver model, and trajectory matching through optimisation. Each crash scenario was simulated using the vehicle model without ESC active and then again using the vehicle model with ESC active. The differences in vehicle trajectory and the braking interventions responsible for those differences were then analysed. The crash scenario simulations were also altered to represent the presence of specific rural road safety measures in order to investigate how ESC braking interventions were affected. However, this process was found to render the results unreliable and no analysis of how ESC was affected by the rural road safety measures was possible.

The results of simulating each crash scenario were presented in figures that show when braking interventions are made and how they affect vehicle trajectory. Vehicle trajectory was analysed by investigating how ESC affected vehicle sideslip, lateral offset, and yaw. The strength and duration of individual braking interventions were then analysed which included an investigation of how they were affected by travelling speed and how they compare to braking interventions elicited during ESC effectiveness tests.

STATEMENT OF ORIGINALITY

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to James Mackenzie and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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LIST OF ABBREVIATIONS

CASR	Centre for Automotive Safety Research
ESC	Electronic Stability Control
FWD	Front wheel drive
LOC	Loss of control
NHTSA	National Highway Traffic Safety Authority
RWD	Rear wheel drive
SAPOL	South Australian Police
TARS	Traffic Accident Reporting System