Journal of Safety Research 49 (2014) 1

Contents lists available at ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

Editorial

Letter from the Editors

The *Journal of Safety Research* is pleased to publish in this special issue the proceedings of several papers presented at the 4th International Conference on Road Safety and Simulation convened at Roma Tre University in Rome, Italy, October 2013. This conference serves as an interdisciplinary forum for the exchange of ideas, methodologies, research, and applications aimed at improving road safety globally.

Conference proceedings provide the opportunity for research in its formative stages to be shared, allowing our readers to gain early insights in the type of work currently being conducted and for the researchers to receive valuable feedback to help inform ongoing activities. This conference in particular offers an array of research topics not often covered by this journal from researchers practicing in over 11 countries. As is common with publishing conference proceedings, the papers published in this issue did not go through the normal *JSR* review process. Each paper included in this issue did meet the Road Safety and Simulation conference review requirements. They reflect varying degrees of scientific rigor, methodological design, and groundbreaking application.

The proceedings published in this special issue of *JSR* draw from the following road safety research sectors represented at the conference: driving simulation, crash causality, naturalistic driving, and new research methods.

It is our hope that the publication of these important proceedings will stimulate vigorous dialogue, rigorous research, and continuing innovative initiatives and applications, leading, ultimately, to fewer traffic fatalities, injuries, and crashes.

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18 February 2014

http://dx.doi.org/10.1016/j.jsr.2014.02.001

Journal of Safety Research 49 (2014) 85–90

Contents lists available at ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

A mathematical model for predicting lane changes using the steering wheel angle

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ARTICLE INFO

Article history:
Received 26 November 2013
Accepted 27 February 2014
Available online 24 April 2014

Keywords:
Lane change
Prediction
Mathematical model
Driving simulator
Steering wheel angle

ABSTRACT

Introduction: Positive safety effects of advanced driver assistance systems can only become effective if drivers accept and use these systems. Early detection of driver's intention would allow for selective system activation and therefore reduce false alarms. *Method:* This driving simulator study aims at exploring early predictors of lane changes. In total, 3111 lane changes of 51 participants on a simulated highway track were analyzed. *Results:* Results show that drivers stopped their engagement in a secondary task about 7 s before crossing the lane, which indicates a first planning phase of the maneuver. Subsequently, drivers start moving toward the lane, marking a mean steering wheel angle of 2.5°. Steering wheel angle as a directly measurable vehicle parameter appears as a promising early predictor of a lane change. A mathematical model of the steering wheel angle is presented, which is supposed to contribute for predicting lane change maneuvers. *Practical applications:* The mathematical model will be part of a further predictor of lane changes. This predictor can be a new advanced driver assistance system able to recognize a driver's intention. With this knowledge, other systems can be activated or deactivated so drivers get no annoying and exhausting alarm signals. This is one way how we can increase the acceptance of assistance systems.

1. Introduction

Advanced driver assistance systems (ADAS) are becoming increasingly present in modern vehicles. Next to comfort and information purposes, driving safety improvement is one of the major aims of these systems. Recent estimates on potential ADAS safety benefits in terms of avoidable accidents with personal injury range from 2% to 45% for cars, 2% to 12% for trucks, and 1% to 15% for buses (Hummel, 2011), depending on systems and maneuver types. Lane change is one of the maneuvers associated with high workload (Schiessl, 2008) and substantial accident risk. In Germany in 2011, 13% of accidents with personal injury on motorways were associated with lane change maneuver, 5% on roads within built-up areas (Statistisches Bundesamt, 2012). The Lane Change Decision Aid Systems (ISO 17387, 2008) aim at providing assistance for this type of maneuvers. Estimations of the safety potential for lane change assistance/blind spot warning ranges up to 24% of addressable lane change-crashes (Jermakian, 2011) and 25% of crash severity reduction (Bayly, Fildes, Regan, & Young, 2007). However, to fully exploit this potential, it is necessary that drivers accept these systems and use them on a regular basis. An important precondition for acceptance is the ability of ADAS to provide reliable assistance specifically when required. False alarms in situations where the driver has no intention of performing a lane change could annoy, distract, and irritate drivers. As a consequence, ADAS are disregarded or disabled and the potential safety benefit gets lost. Driver intent information is supposed to reduce the mismatch between driver expectations and system reactions. Knowing whether a driver would like to change the lane provides the opportunity to specifically activate lane change assistance for this situation, suppresses distracting events such as incoming calls or navigation system messages and adjusts parameters of other ADAS (e.g., lane departure warning or adaptive cruise control (ACC)).

One important issue for intent recognition is to capture the earliest moment when drivers plan to change the lane. The time period of 3 to 4 s prior to a lane change is considered as the critical phase of visual search to determine the feasibility of the maneuver (Doshi & Trivedi, 2008; Liebner, Klanner, & Stiller, 2012; Morris, Doshi, & Trivedi, 2011). The approaching behavior toward a lead vehicle is considered as an even earlier predictor, already 7 s before changing the lane (Liebner et al., 2012). However, the formation of intentions in terms of a

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http://dx.doi.org/10.1016/j.jsr.2014.02.014
0022-4375/