

Testbed and Analysis of Highway Cut-In Scenarios for Evaluating the AEB and FCW Functions

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Received: 26 April 2024 / Revised: 17 June 2024 / Accepted: 5 August 2024 / Published online: 19 September 2024
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Abstract

This study aims to provide a detailed evaluation and comparison of the performance of forward collision warning (FCW) and automatic emergency braking (AEB) systems in lane-changing scenarios, focusing on their detection range and detection angles. Real-world tests were conducted with a Tesla Model 3 and a KIA K8 to assess their detection capabilities. The experiments simulated common highway lane-changing scenarios, referencing Euro NCAP standards. Testing environments included a full-size target robot and a guided vehicle target to ensure accuracy. Preliminary tests established the test speed range and relative distances, while main tests focused on three key variables: time-to-collision (TTC) for FCW activation, TTC for AEB activation, and relative lateral positions of the target and test vehicles. The study also analyzed collisions despite FCW and AEB activation, identifying system limitations by examining deviations in TTC values and their correlation with collisions. These findings provide insights into the effectiveness and reliability of FCW and AEB systems under various conditions, aiding the advancement of ADAS technologies.

Keywords Autonomous vehicles · Vehicle safety · Automatic testing · Intelligent vehicles · Highways

Abbreviations

ADAS	Advanced driver assistance systems
FCW	Forward collision warning
AEB	Autonomous emergency braking
FCA	Forward collision avoidance assist
Euro NCAP	The European New Car Assessment Program
ACC	Adaptive cruise control
TTC	Time-to-collision
TLC	Time to line change
SCC	Smart cruise control
LKAS	Lane keeping assist system
FOV	Field of view
GPS	Global positioning system
GVT	Guided vehicle target

List of Symbols

d	Definition of lateral distance, m
h	Definition of longitudinal distance, m
θ	Definition of angle between vehicles, degree
TTC	Time to collision, sec
RV	Relative velocity, kph
TLC	Time to lane change, sec
F-TTC	Time to collision when FCW is activated, sec
A-TTC	Time to collision when AEB is activated, sec

Subscripts

$P_0, P_1, P_2, P_3, P_4, P_5$	Control points
μ	Mean
σ	Standard Deviation

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1 Introduction

Considering the growing interest in advanced driver assistance systems (ADAS) in both domestic and international automotive markets, there have been significant