

**Active Lane Keep Assist System**

**Submitted by**

Anshuman Singh

Davide Occello

Raymond Wouters

Sharad Bhadgaonkar

January 13, 2017

-Eindhoven

**Active Lane Keeping Assist System (ALKA)**

**Module I: Technical Report**

Eindhoven University of Technology

Stan Ackermans Institute / Automotive Systems Design

The design that is described in this report has been carried out in accordance with the TU/e code of scientific conduct

**Partners**

 

**Steering Group** Gijs Dubbelman

Rameez Ismail

Peter Heuberger

**Authors**  Anshuman Singh

Davide Occello

Raymond Wouters

Sharad Bhadgaonkar

**Date** Friday 13th January, 2017

**Contact Address** Eindhoven University of Technology

Department of Mathematics and Computer Science

MF 5.074, P.O. Box 513, NL-5600 MB, Eindhoven,

The Netherlands +31 402743908

**Abstract** The technical report presents the functional safety concept of Active Lane Keep Assist Systems (ALKA). The project mainly focused on studying the Euro NCAP requirements, performing Hazard Analysis and Risk Assessment (HARA) and delivering functional and safety requirements along with system architecture. Having set a timeline of one and half months, ALKA was initially analyzed to attain a good understanding of the major constituents of such a system and the issues such a system come across. A project plan was then proposed to complete the project

in the given period, by clearly defining the scope and limitations of the project. Milestones are prepared such as extracting Euro NCAP and associated functional requirements, deciding the use cases and scenarios, performing HARA Analysis and finding safety goals, evaluating functional safety requirements and functional safety concept in compliant to ISO 26262. Major deliverable of the project is to submit the safety requirement document containing functional safety requirements and technical safety requirements and enhanced architecture to meet the necessary ASIL levels. Appendix I, II, III are also added containing below information.

Appendix I: Scenarios

Appendix II: Euro NCAP requirements

Appendix III: HARA

Appendix IV: FSR

**Keywords** Lane keeping, Active lane keeping, CAFCR, Lateral control, Hazard Analysis and Risk Assessment, Functional safety requirements, Functional safety concept, Automotive Safety Integrity Level, Supervisory control, Vision sensor processing, Vehicle dynamics

**Disclaimer Liability** While every effort will be made to ensure that the information contained within this report is accurate and up to date, Eindhoven University of Technology makes no warranty, representation or undertaking whether expressed or implied, nor does it assume any legal liability, whether direct or indirect, or responsibility for the accuracy, completeness, or usefulness of any information.

Contents

[List of Figures 3](#_Toc471400550)

[1. Introduction 5](#_Toc471400551)

[1. Item definition 5](#_Toc471400552)

[2. Project Objective 5](#_Toc471400553)

[~~3.~~ ~~Project Planning~~ 6](#_Toc471400554)

[~~4.~~ ~~CAFCR frame of work~~ 6](#_Toc471400555)

[2. Functional Requirements and Architecture 7](#_Toc471400556)

[1. Fundamentals of ALKA 7](#_Toc471400557)

[2. Euro NCAP requirements 7](#_Toc471400558)

[3. Basic architecture of system 7](#_Toc471400559)

[3. Functional Safety Concept 8](#_Toc471400560)

[1. Scenario generation 8](#_Toc471400561)

[2. HARA 8](#_Toc471400562)

[3. Formulation of Safety goals 8](#_Toc471400563)

[4. Formulation of FSR’s 8](#_Toc471400564)

[5. Decomposition of FSR’s 8](#_Toc471400565)

[4. Enhanced architecture 9](#_Toc471400566)

[5. Conclusion and way forward 10](#_Toc471400567)

[References 11](#_Toc471400568)

# List of Figures

1. XX
2. Xx
3. Xx

# Introduction

Advanced driver assistance systems are one of the fastest-growing segments in automotive electronics [1]. These are systems developed to automate/adapt/enhance vehicle systems for safety and better driving. Safety features are designed to avoid collisions and accidents by offering technologies that alert the driver to potential problems, or to avoid collisions by implementing safeguards and taking over control of the vehicle. Active Lane Keep Assists System (ALKA) is such a system designed to avoid collisions or accidents by actively maintaining the vehicle in the lane if unwanted drift away from lane detected.

## Item definition

One of the causes of lane road accidents is unintended lane departure during driving. The main system function of an ‘Active Lane Keeping Assistance System (ALKA)’ is to detect the unintentional drift outside the lane on which it is travelling and to support the driver in keeping the vehicle within the current lane. The system primarily uses camera sensor(s) to detect lane markings or makes use of available software like MobilEye to get the lane markings. It also acquires the data and estimates the lateral position of the subject vehicle and when required, sends command(s) to the actuator(s) to influence the lateral movement of the vehicle. The intention of driver to leave a lane is detected by the toggling of the indicator/turn signal switch or by even measuring the torque applied on the steering wheel of the vehicle. The status information of ALKA can be provided to the driver by means of audio, visual or even haptic elements. ALKA is an assist feature and not an autonomous driving feature. The responsibility for the safe operation of the vehicle always remains with the driver. ALKA is intended here to be operated only on highways with forward driving speed more than 50 Kph. Temperatures outside -20 to 40 deg Celsius band are considered out of scope for ALKA [2]. Roads and lane markings outside Europe are considered out of scope here.

## Project Objective

The project mainly focused on establishing a functional and technical safety concept for ALKA. Literature study must be conducted in order to extract functional requirements from Euro NCAP requirement document [3]. CAFCR framework must be used to finalize the basic architecture by establishing requirements from customer perspective. Hazard Analysis and Risk Assessment must be performed to derive the necessary ASIL levels and safety goals. Functional safety requirements must be established and if needed further decomposition must be done in order to meet necessary ASIL criteria. Enhanced software and hardware architecture must be delivered meeting necessary safety criteria. The major project objectives are summarized as follows:

1. Functional requirements definition for the ALKA

2. Application of CAFCR framework for system architecting

3. Extract the Euro NCAP requirements (and any other like ISO) for ALKA

4. Basic functional architecture

4. Perform the HARA and find the functional safety goals with respective ASIL levels

5. Establish functional safety requirements (FSR) associated with safety goals

6. Decomposition of FSR’s to achieve necessary safety integrity level.

7. Enhanced architecture in compliant to technical safety concept

## ~~Project Planning~~

## ~~CAFCR frame of work~~

# Functional Requirements and Architecture

## Fundamentals of ALKA

## Euro NCAP requirements

## Basic architecture of system

# Functional Safety Concept

## Scenario generation

## HARA

## Formulation of Safety goals

## Formulation of FSR’s

## Decomposition of FSR’s

# Enhanced architecture

# Conclusion and way forward

# References

1. Ian Riches (2014-10-24)

"Strategy Analytics: Automotive Ethernet: Market Growth Outlook | Keynote Speech 2014 IEEE SA: Ethernet & IP @ Automotive Technology Day"

1. ISO 11270:2014(en)

‘’Intelligent transport systems — Lane keeping assistance systems (LKAS) — Performance requirements and test procedures.’’

1. Euro NCAP:

"EUROPEAN NEW CAR ASSESSMENT PROGRAMME’’

TEST PROTOCOL – Lane Support Systems (Version 1.0 November 2015)