Master Thesis 218/2019

“Driver monitoring camera-based threat awareness for collision avoidance”

Background

Recent advances in machine learning, sensor technology and computational power have led to availability of cheap driver monitoring camera (DMC) systems (DMS). The ability to accurately determine intended driver actions, and awareness of road threats based on driver’s eye- and head data, will be crucial in allowing Active Safety systems to reducing unnecessary interventions and warnings, leading to systems that are both safer and more comfortable.

Project description

This project focuses on development and analysis of DMC-based metrics for representation of drivers’ awareness for enhancements of the underlying threat assessment of today’s collision avoidance systems.

Based on drivers’ gaze directions and on 2D world description of vehicle and road objects around it (such as road markings, pedestrians, cyclists and vehicles), the algorithms should be able to accurately assess if the drivers are aware of the threat such objects pose. Awareness levels can be used, for example, to brake in advance if oncoming objects have not been seen, or to prevent the vehicle from leaving the lane in case of unintended lateral drifts.

A large data set with recorded traffic data is available for fundamental statistical analysis, pattern detection and classification of drivers’ gaze behaviors, evaluations of new concepts for threat awareness, and possibly for validation of complete collision avoidance system behaviors.

Purpose and goals

Based on available recorded data, a camera-equipped development vehicle, tools for visualizing gaze direction on- and off-line, as well as fundamental algorithms for “gaze zone probabilities”, the purpose of the thesis is to develop a proof of concept for “threat awareness” of road objects. This includes the following tasks:

1. Carry out and document, a literature study on the following topics:
   b. Statistical driver gaze behaviors.

2. Carry out a statistical data analysis of Zenuity’s FOT (Field Operational Test) data set and compare with results from similar FOT studies (using results from step 1) to:
   a. Become familiar with methods and tools used for post-process of the FOT data set
   b. Build competence and understanding about typical driver gazing behaviors, and characteristics of the gaze vector as measured by the DMS.
   c. Understand how representative the data set is for validation purposes

   a. Develop and study an awareness model based on time spent looking at different objects (possibly "gaze zone"-based).
   b. Develop and study an awareness model based on "prediction errors" (i.e. trying to consider deviations from driver’s mental traffic situation model and the actual traffic situation as measured by the external sensors)
   c. Validate and compare the two concepts’ capabilities to capture “Road scene awareness” and/or “target awareness”

Qualifications

- Two highly motivated students from any master program with background and interest in system modeling, signal processing, and statistics. Competence in machine learning algorithms is also beneficial.
- The ideal candidates have interest in both theoretical and applied aspects of the problem
- Solid programming skills are required. Previous experience with MATLAB is an asset
- Effective communication skills in English both in oral and especially written are also appreciated
The thesis writers will gain

- Competences on and experience from:
  o Modeling driver's behavior and its influence on driving
  o Threat assessment algorithms with market leading technology
  o Industrial experience from autonomous assistance systems aimed for the automotive market

Further information and contacts

Please send in individual applications with CV, motivational letter and grade transcripts (undergraduate and graduate education) at the following link:


If you wish to partner with someone, simply note that in your application.

For questions regarding the project, please contact:

Henrik Eriksson (henrik.eriksson@zenuity.com, +46(0)731 25 81 65) or
Claes Olsson (claes.olsson@zenuity.com, +46(0)723 71 67 51)