FFI

AstaZeroSim

Project within Vehicle and Traffic Safety

Authors: Martin Skoglund, SP, Anne Bolling, VTI, Jonas Åsberg, VGR, Frida Reichenberg, VTI

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Content

FFI in short

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. FFI has R&D activities worth approx. €100 million per year, of which half is governmental funding. The background to the investment is that development within road transportation and Swedish automotive industry has big impact for growth. FFI will contribute to the following main goals: Reducing the environmental impact of transport, reducing the number killed and injured in traffic and Strengthening international competitiveness. Currently there are five collaboration programs: **Vehicle Development, Transport Efficiency, Vehicle and Traffic Safety, Energy & Environment and Sustainable Production Technology.**

1. Executive summary

Active safety in road vehicles is an important part of the efforts to achieve Vision Zero which is an overall safety goal which aims to achieve a highway system with no fatalities or serious injuries in road traffic. Through research linked to AstaZero project will contribute to reducing deaths and serious injuries on the roads.

The project seeks to demonstrate the benefits of using driving simulation tools, to facilitate the development of new ways to test active safety systems, which may be difficult and costly to reproduce in a physical environment. And also explore the possibilities to enable safe reproduction of dangerous situations in a driving simulator environment, to be used as a safe, ethical acceptable, training platform.

In the project a virtual AstaZero will be developed, to be utilized for test planning, concept evaluation and driver training. By the means of the virtual version of AstaZero, implemented in a scaled-down simulator, and in the advanced driving simulator SimIV, simulator-based training will be evaluated compared to real environment training, paving the way for ethically accepted (safe) training of blue light drivers.

An underlying project goal is to give Swedish industry and research community a unique platform for testing active safety features in a realistic environment in a cost effective manner.

2. Background

Emergency response driving, driving with blue lights and sirens on emergency missions, is a risky element in the ambulance personnel work assignment. The ambulance service at Skaraborgs Hospital aspires to educate their emergency driver in a manner where risk awareness and safety awareness permeates the outcome, you want an insight based training. Traditionally, driver training has been more skill based, i.e. oriented to train and operate the vehicle in pre-created incidents. The insight-based training is more aimed at training the driver in anticipating and thus avoiding dangerous situations and incidents. Actually, there are no apparent contradictions between the two approaches, but they need to be combined in a functional way to produce results. A driver with high risk awareness

needs, for example, also needs to train on radical situations to become familiar with the vehicle active safety systems such as ABS, ESP, etc.

Pontus Albertsson and Per-Olov Bylund have in a retrospective analysis1, Ambulance Crashes in Sweden, clearly demonstrated the risks of emergency driving. This analysis is currently the basis for driver training at Ambulanssjukvården Skaraborgs Hospital. It also provides the evidence base of education in the simulator program that has developed. Ultimately the education rests on Vision Zero.
A major problem in traditional driver education is that one cannot practice the emergency driving in traffic without being forced to use reserved lanes and traffic practice sites. The idea of using simulators was born out of this dilemma. They took inspiration from flight simulators and realized that a pilot exercise several hours in a simulator before the pilot comes up in the air. A survey was done, that recognized today there is no ready simulation software for emergency training to download. In the process of probing market contact had been made with the simulation company Stage IT in Gothenburg. Stage-IT has a program that primarily focuses on teaching eco-driving. Experience shows that eco-driving has a lot in common with risk awareness is training. Driving economically requires scanning, planning and foresight. These components are also the way to a soft safe driving. The program is called ECO2-trainer and is based on so-called serious gaming. Another added benefit is more climate-friendly driving.
Ambulanssjukvården Skaraborgs hospital purchased five laptop simulators and these are used in the training of new drivers, but also the staff taken part in the training. The experience of this has inspired and motivated a further development of virtual training methods. It was realized almost immediately that the programs needed to be developed and more focused on emergency driving. Along with Stage-IT, Ambulanssjukvården Skaraborgs Hospitals started work on a new program with scenarios and risk situations identified by Albertsson and Bylund. The program is available today as crude product in the ambulance for testing and evaluation. The ambition is that the program will provide the opportunity for wide training in ways that were previously impossible to do. Both the training of new drivers and competence assurance for established drivers.

3. Objective

The project will highlight a number of important research questions that can be categorized into one of two groups. Where one group of questions will address the problem of quantifying the usefulness of virtual methods and environments aimed at being used as a training platform. And the other category of questions will tackle the problems of objectively evaluating driving education, or any educational activity.
To answer the first category of questions, which is the main focus of the project, there is a need to recreate and evaluate the stressful situations that emergency drivers experience when answering an emergency call. We had to create a test that makes it possible to evaluate the training capabilities of three different scenarios in the three different

[1] Ambulance Crashes in Sweden - A retrospective analysis of data from Strada

environments to be studied. In order to make this comparison feasible we had to recreate similar/identical driving experience in all three environments. Therefore the scenarios created were representative of a real traffic environment, but had to be simple enough so that recreating the scenario, both on the test track AstaZero and be readily converted into a virtual format. The test set that was created is scientifically unique with regard to the size of the test groups, and the stringency of the recreation of the preconditions of the comparison. The test subjects have the same occupation and same education, but can otherwise be seen as a demographic cross-section of the working population with regards to age and gender. The background of the test subjects with the respects to driving experience and how much the test subject drove privately. The test subjects were also asked to evaluate personal traits like, stress sensitivity, planning proclivity, carefulness of their nature. This background information and the personal information can be correlated with the results at the later stage.
There was a small batch (eight test subjects) of tests done in November 2014 that can be considered as a rehearsal, that verified all developed methods, and identified what was needed to be tweaked, before the big test batch (32 test subjects) in the end of March 2015. This makes a total of 40 test subjects that constitutes the source for the gathered data to be evaluated with the purpose of answer the research question posed in the project.

4. Project realization

The general outline of the project progression was that the main part of preparation, development and planning was done during 2014. Then we had a small batch (eight test subjects) of tests done in November 2014 that can be considered as a rehearsal, where we verified all developed methods, and identified what needed to be tweaked, before the big test batch (32 test subjects) in the end of March 2015. This makes a total of 40 test subjects that constitutes the source for the gathered data to be evaluated with the purpose of answer the research question posed in the project.
The preparation phases started with defining the traffic situations that the drivers should be exposed to. These traffic situations will constitute a set of typical high-risk scenarios that is commonly encountered by blue light drivers in their ordinary work capacity. The scenarios must be sufficiently challenging, in order to stress the risk awareness of the drivers, to make it possible to make an evaluation relevant for real the traffic environment, this while the remaining safe, both for participants in the trials, and for the staff that is handling the track. The set of defined scenarios must be reproducible, both on the simulators and on the track.

FIGURE 1 AS A EXAMPLE THE PEDESTRIAN SCENARIO IMPLEMENTED IN THE REAL ENVIRONMENT (TOP) AND IN THE SIMULATOR (BOTTOM)

The project then proceeded to develop the virtual representation of the AstaZero track, vital as a platform to make valid comparison between the test environments. There was also a need to create and modify the VIP simulation platform2 in order to handle a three screen solution and other expectations of the project on the desktop simulator, as well on the advanced driving simulator SimIV. There was also a need to have a vehicle that corresponds to the real ambulance driven at the AstaZero track; work aimed at developing a vehicle dynamics model that acts and feels like a real ambulance was initiated.

[2] http://www.vipsimulation.se/

We then had three sets of environments to test our blue light driver, the desktop simulator, SimIV and the AstaZero track. Where a lot of effort had been placed on to make the environments compare. The environments are the scaled-down simulator, the full-scale simulator SimIV for and the AstaZero track, where the track is deemed to be the most comparable to real-life traffic and often used as a baseline in statistical analysis of the result.
Lead traffic educators from VGR rode along in the ambulance on the test track and observed the blue light drivers negotiating the scenarios, testing the ability of the drivers to make informed traffic decisions, and evaluating the risk awareness according to a predefined set of rules. These evaluations will be stored and a statistical analysis will be made later. Other measurements are also logged, full set of videos recordings are kept so the evaluation situation can be revisited at any stage. In addition to video, information about speed and position were logged. For a more objective analysis of environment scanning patterns of the blue light drivers, there was an eye tracking system installed in all three environments. A cognitive test was taken by all test subjects both before the tests and after, with the purpose of evaluating if the effort has had an impact on the cognitive performance of the drivers.

5. Results and deliverables

There was a massive amount of data collected during the tests, only a fraction of the information were evaluated due to the fact that the tests was carried out very close to the end of the project. This was as a result of the need to have a final test plan for the test subjects completed at least six months in advance, due to the lead time in assigning slots and scheduling of emergency drivers. We also needed to be somewhat sure that the track was ice and snow free, at the time for the final tests on the track, which were in March 2015, which left only a couple of weeks for an analysis of the results before the project ended in the end of March.
The data that we were able to analyze were the individual drivers are evaluations of each environment, the evaluation done by the traffic leaders of each drivers risk awareness level, and the results of cognitive tests that each driver took before and after each test session in every environment. This leaves the bulk of the objective data like vehicle speed and position i.e. all data the driver inputs to the simulator and their eye tracking information, left be evaluated at a later stage.

FIGURE 2 VGR'S VERSION OF THE DESKTOP SIMULATOR (LEFT), SP'S VERSION OF THE DESKTOP SIMULATOR (RIGHT)

An underlying project goal is to give Swedish industry and research community a unique platform for testing active safety features in a realistic environment in a cost effective manner.

5.1 Delivery to FFI-goals

The goal to drive innovations and development activities that contribute to reducing the number of serious injuries and traffic deaths can be closely linked to an efficient and well educated emergency service. Both in the capacity of a capable ambulance service that arrives fast to incidence scenes and treats injuries with competence that otherwise could have resulted in fatalities, and the capability to navigate the traffic without contributing to risks while breaking the traffic rules. Since Sweden lacks a national coordinated emergency driver training, which means that the quality and content differ in an alarming way, seen to geography and organizations. The results and lessons learned in the project is small step toward a scientifically bases consensus on how a national coordinated education for emergency drivers can be design, that produces the best capability drive towards the Zero Vision.

The produced results within the project, like advances in driver evaluation, extensions of the physical environment AstaZero into the virtual world and simulator platform that can be used as an education tool within academia in active safety system development as well as being used a driving education platform, can bring about significant changes relevant to the traffic safety.

6. Dissemination and publications

6.1 Knowledge and results dissemination

- In order to disseminate the ideas and also get more independent feedback Ambulanssjukvården Södra Älvsborgs, Rescue service RÖS and Falköping-Tidaholm were invited to participate with test persons and instructors
- Already the driver risk evaluation science can draw on a number results derived by the project.
- The virtual representation of AstaZero is modelled in the OpenDRIVE® format3 which is an open file format for describing road networks. It is maintained and developed by simulation professionals with support from the simulation industry. This project result has already been requested by at least five other research project/activities paving the way to integrate advanced virtual methods into the research capabilities of AstaZero.
- The project and the results have been presented at five seminars/conferences/workshops and the interest has been high. The feedback has been overwhelmingly positive.
- The Desktop simulator has given research community a unique platform for testing active safety features in a realistic environment in a cost effective manner, and the emergency services an environment to be used as a safe, ethical acceptable, training platform.
- The simulator has been disseminated to: VGR, Chalmers, KTH, SP/AstaZero as a research platform for future project.

6.2 Publications

- Development of a Parameterized Passenger Vehicle Model for Longitudinal Dynamics for a Desktop Driving Simulator. Master's Thesis - Matteo Santoro. Supervisor Jonas Sjöberg, Professor Mechatronics, Signals and Systems at Chalmers University of Technology.
- Desktop Driving Simulator with Modular Vehicle Model and Scenario Specification. Master's Thesis. -Arpit Karsolia, Supervisor Jan Jacobson, Professor in Vehicle Dynamics and leader of Vehicle Dynamics group at Chalmers University of Technology.
- Master thesis in vehicle dynamics was ongoing at the end of the project with Lars Drugge as supervisor, at the KTH School of Engineering Sciences.
- Lessons learned report – Jonas Åsberg, Leg. Nurse, Education Leader and responsible for traffic education Skaraborg Hospital.

[3] Version 1.3. http://opendrive.org/

7. Conclusions and future research

AstaZeroSim project has meant that the ideas of simulated traffic education have been tested under controlled forms. In order to disseminate the ideas and also get more independent feedback Ambulanssjukvården Södra Älvsborgs, Rescue service RÖS and Falköping-Tidaholm were invited to participate with test persons and instructors. The project has also enabled the organizations to get acquainted with VTI and AstaZero and their respective technologies and facilities. Participating organizations have also been able to develop the skills of their traffic instructor by letting them participate as evaluators. The use of technological tools for assessment and logging, DART and the SAAB AKKA, has also contributed to the development towards a more quality-focused assessment.

In the training of emergency drivers, a part of the program that was used in AstaZeroSim project is used in the education right now. It is expected that after some additional years of development it will be integrated further and with higher quality. Having been involved in AstaZeroSim project has been inspiring for both test subjects and trainers. It is seen as extremely stimulating to participate in the AstaZeroSim project and very interesting to see how ideas carry in the long term and in any future studies.

The results and lessons learned in the project is small step toward a scientifically based consensus on how a national coordinated education for emergency drivers can be designed that produces the best capability to meet the Zero Vision.

Almost all produced results within the project, like advances in driver evaluation, extensions of the physical environment AstaZero into the virtual world and the simulator platform has been coupled with the rise of new research questions and avenues of inquiry that will if investigated significantly contribute to the improvement of overall the traffic safety.

8. Participating parties and contact person

Partners: SP, VTI, Räddningstjänsten, Autoliv, Chalmers, KTH, AstaZero

Contact person: Martin Skoglund, martin.skoglund@sp.se tel. 010-5165949

Adress: FFI/VINNOVA, 101 58 STOCKHOLM
Besöksadress: VINNOVA, Mäster Samuelsgatan 56, 101 58 STOCKHOLM
Telefon: 08 - 473 30 00