IN CAR ADVANCED ASSISTANCE SYSTEMS

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Abstract
Department of Applied Human Sciences of the Transport Research Centre Brno, Czech Republic takes part in Europe-wide research project ADVISORS. ADVISORS is a project co-funded by the European commission, in which governmental and other research institutes, a transport company, insurance companies, and industries of ten different European countries participate.
Key words: Advanced Driver Assistance Systems, Transport Research, road accidents, blind spot detection, behavioural changes, and navigation

Abstrakt
Sekce 15 aplikovaných humanitních věd Centra dopravního výzkumu v Brně se účastní evropského projektu ADVISORS. Tento výzkumný projekt je financován Evropskou komisí a účastní se ho vládní a výzkumné instituce, dopravní společnosti, pojišťovny a elektronický a automobilový průmysl deseti různých evropských zemí.

INTRODUCTION

The political economical and social changes in the Czech Republic in the last decade have led to increasing mobility, mostly in the private sector. Some European countries achieved substantial reduction in fatalities in the turn of the century, while others, the Czech Republic is one of them, saw road safety worsen.
Beyond such variations, the overall European downward trend in fatalities demonstrates that targeted car and road safety measures which include Advanced Driver Assistance Systems /ADAS/ can help to avoid road accidents in spite of increasing level of car ownership and motorization. In different ADA systems there are various functions (such as ACC, ISA etc.) that are designed to reduce crash risk and enhance driving comfort. In addition, in individual ADA functions it is very common that different levels of intervention exist, ranging from informative to intervening systems. In other word, some systems are designed to reduce crash risk by providing support to drivers in a number of ways, by even taking over control of the driving task and intervening in situations of increased crash risk to eliminate or et last reduce risk to an acceptable level. Some systems aim at reducing crash risk by informing or warning drivers of imminent hazards, like following the vehicle in front too closely, hazards to be expected ahead on the route or incidents blocking the road or causing some time delays.

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The expectation concerning these informing or warning systems is that road users utilise this information by adapting their behaviour to account for the hazard and thus decrease the crash risk and avoid a collision. To gain the best safety effects of ADA systems, it must be ensured that the drivers understand the technical capability and the level of intervention that the system he or she is using is capable to offer. This is possible only if the functions and level of intervention of different ADA systems are described with terms that are understandable to the user.

According to recent OECD research, if all known road safety measures were adopted by all member countries, the number of deaths on roads in OECD countries could be cut, not just by a few percentage points, but as much as 50%[1]. ADA systems may help to make the entire driving experience safer for consumers. They gear to reduce vehicle collision, to enhance occupant protection and to assist post event (crash etc.) rescue. However, it is common knowledge that the implementation of a lot of ADAS is not based on users expressed wishes but rather on the manufactures considerable technological push. Furthermore misunderstandings between developers technical terms and users´expectations and assumptions are making the conversation between the providers and the users irrelevant and even impossible.

Acceptation of common EU transport law, and in the other hand the negative impact of transport like environmental pollution, congestion and fatalities make it possible, that the introduction of Telematics aids and services in standard cars in the Czech Republic is no longer a distant prospect – it is reality. The introduction of co called Advanced Driver Assistance Systems /ADAS/ into traffic is expected by authorities to enhance safety and comfort of driving to optimise the traffic flow in the Czech Republic and to decrease fuel consumption.

However, will such expectations be fulfilled? For example, is it really safe to attend to warnings about exceeding the speed limit, being to close to the vehicle ahead and drifting slowly off the white line, when you to overtake but only forgot to use your indicator lights? ADVISOR project attempts to resolve the expected problems by undertaking the following actions:

The project focuses on the assessment of driver behaviour changes due to implementation of various types of ADAS. Questionnaires, laboratory tests, driving simulator and on-road tests were used performing in parallel a thorough cost-benefit assessment of each tested scenario, to allow the relevant authorities to select not only reliable, but also affordable evaluation means for ADAS assessment. ADVISORS developed a common framework for the evaluation of ADAS, using an integrated traffic environment approach, considering impact and benefits throughout the traffic chain and not localised only to one type of infrastructure for which the system might be developed.

ADVISORS conclude with recommendations for methods of type approval and standardisation of actions for ADAS marketing, as well as legislative, organisational and institutional recommendations for their applications. This will bring the relevant technology one step further, to the service and benefit of the Czech and European citizens.

Project innovations include the development of a new common, user friendly ADAS terminology, enhancement of user acceptance, public awareness and avoidance of the creation of false assumptions and expectations to the end users. In addition, the project will provide

[1] Provisional estimates of road fatalities in 19 OECD countries show an average overall reduction of 3% during the first half of 2000, continuing the downward trend of the past few years. However, this modest improvement mask the facts that even greater improvements could be within all countries reach. A total of 25 930 people were killed on roads between January and June 2000 in 19 OECD countries for which figures are now available, down from 26870 in the same period in 1999. For the Czech Republic is important, that there were wide disparities in the performance of different countries.

definitions of ADAS priority application scenarios, which will have the census of all bodies involved (industry, national and European authorities and Czech society as a whole).

Traffic safety

The accident reduction of ADAS, estimated to be up to 20% of all accidents, will be distributed between different systems.

Economic gains

ADVISORS PROJECT aims to speed up the implementation of ADAS by recognising and overcoming their implementation barriers as well as to reduce unnecessary costs by avoiding duplication efforts and errors in their evaluation, by devising a unique ADAS evaluation scheme.

Standardisation

ADVISORS PROJECT provides type approval and draft standardisation schemes for selected ADAS, thus promoting their standardisation. Furthermore, by recognising the necessary legislative, organisational and institutional actions in each country for their implementation, the proposed implementation schemes will be applicable to every European country. Indeed, ADVISORS PROJECT results are expected to provide the necessary scientific basis for an ADAS implementation at European level.

Environmental impact

ADAS improved implementation, through ADVISORS PROJECT results, will promote environmental protection both through less road accidents and road network efficiency improvements. The new tools for such impact evaluation will allow amore objective and reliable environmental impact assessment and thus promotion of future ADAS implementation schemes.

Working conditions and quality of life

Embattling ADAS implementation barriers and speeding-up ADAS diffusion, the creation of new jobs and better working conditions in the transportation sector is also supported. Furthermore, less traffic bottlenecks through ADAS implementation would mean better quality of life and better working conditions for the Czech population.

Results

In the Czech Republic the data was collected by personal interviews (CDV psychological laboratory in Prague and S15 section CDV in Brno) with very limited assistance from personnel. The professional drivers were questioned when they did their routine professional evaluation for their employers.

Price was expected to be especially important in the Czech republic, as the Czech motor vehicle fleet is older and cheaper as compared to this study's other countries. In addition, in SARTRE2 a trend of Finnish, Greek and Italian drivers indicating the new technology as more useful than the Czech, German and Dutch drivers was noticeable. Therefore, one might presume that the drivers in the first-mentioned countries would be more technology-oriented, and that price on the other hand might play a bigger role in the Czech, German and Dutch drivers' acceptance of the systems in this survey.

In the Czech Republic both private and professional car drivers indicated the navigation function as being the most important function in all three environments. Only the speed limiting level of the ISA function on motorways was considered more important by professional car drivers. Price was unexpectedly mostly considered only the third most important attribute.

Negative side effects – Assessment of driver behaviour changes

It is predicted that changes in behaviour will occur with the introduction of new systems (behavioural adaptation, risk compensation etc.). The use of blind spot detection and navigation system, in place of a map, may lead to reduction in workload, which in turn may lead to drivers increasing vehicle speed. The introduction of blind spot and navigation systems may lead to changes in driver behaviour. Reduced workload and stress have often undesirable effects such as increased speed. It has been suggested that the introduction of blind spot detection and navigation systems may lead compensatory behaviour that may reduce the benefits of the measures being implemented.

It has been also suggested that behavioural adaptation might occur in response to ADAS through imitation and isolation effects. There is a danger of non equipped vehicles imitating the behaviour of equipped ones.

Navigation Description of the system functionality

The navigation systems are greatly booming in road communication. The first navigation system appeared in the 1980s, and nowadays, there are many sophisticated systems in the markets that exploit the GIS (i.e. Geographic Information Systems), for example the GPS (i.e. Global Positioning System), RDS-TMC (i.e. Radio Data System-Traffic Message Channel), the electronic maps and network applications for the static navigation and in future for the dynamic navigation. In addition to their utilisation in passenger transport, the navigation systems are also very useful in both bus traffic and goods transport, regardless of their use in the other transport kinds from air traffic to pedestrians.

The development of the navigation systems is directly tied to a development of map digitisation, software and network application development, satellite systems (e.g. GALILEO), and the enhancement of demands for such navigation systems. This ADAS system will give to the driver intelligent information, advice and warning. Navigation systems aim to improve driving safety and should be used in passenger and heavy vehicles. Navigation by providing location and route guidance to the drivers and supports the various collisions avoidance capabilities with road geometry and location data at every moment of the day and during all traffic and weather conditions. It will also provide the necessary capability RDS-TMC Radio Data System/Traffic Message Channel to filter traffic information to select those messages that are applicable to the vehicle location and route of travel. It will also offer the capability to recommend optimal routing based on driver preferences. More advanced versions of this service may integrate real-time traffic conditions into the calculations of optimal routes. An extra module will enable the receipt of information via GSM. The navigation display can also be used helping the driver when parking, using a camera viewing backwards.

Driver's behaviour is not expected to significantly reduce the system benefits or may even further enhance them. Some behavioural adaptations could occasionally occur. It is probable that behavioural adaptation will be detected (but depends on the situation). System customisation may compensate for driver‘s behavioural adaptation.

The techniques are developed, available and already marketed. Price depends on sophistication, approx. 2000 Euro. It is expected that this system will be installed at the factory more a more in new cars.

Demand development: Of course, the development of the most advanced and sophisticated navigation systems will also depend upon the demands for such systems. The great markets with both high demands and technological pressure provide a perspective of dynamic development and the utilisation of navigation systems. It is obvious that the new technology splits up the world. Purchasing power and willingness to pay for such comfort is incomparably higher in the advanced countries compared to the developing countries. Moreover, the advanced countries can benefit by the production and selling of the systems,

while the developing countries can only purchase such systems because of their outdated technology. The cost for the sophisticated car navigation systems in the Czech Republic ranges from 60 up to 130 thousands CZK, which would purchase few of the drivers. The standard installation of the navigation systems in new cars will also increase their price, and hence the existing tendency of importing the used cars from abroad still prevails in the Czech Republic.

Mitigation strategy and possibility

There is valid risk of exploiting some of the ADA systems by drivers to more risk behavioural (escalating of speed, belittling of attention due driving).

To prevent doing that would be useful set these problematic ADA systems in order to be active only when driver respect legal speed. When driver exceeded sufferable speed limit there would be deactivating ADA systems, thereby would be prevent trade on them risky behaviour and to undesirable transmittal of responsibility for driving vehicle from driver to autonomous systems.

Essential condition to in place such as restriction would be prior in place of navigation systems (for example GPS system of localisation and electronic maps), which would be eligible assess what road is topically using by vehicle. Navigation systems in this case should prior to control maximum speed limit in actually leg and compare that limit with real speed of vehicle.

We do not expect that using of electronic systems of navigation should have great negative impact to safety by means of undesirable behaviour adapting of drivers.

Blind spot detection

Driver's behaviour is not expected to significantly reduce the system benefits or may even further enhance them. There is a slight probability that some behavioural adaptation will occur. The behavioural adaptation is detected only in particular cases. System is inflexible to driver's behavioural adaptation. 7. Mitigation strategy and possibility

To resolve blind spot problem when driving forward would be good use mechanistic resolving whereby addicting rear-view mirror integrated into doors mirrors of automobile.

To resolve blind spot by means of visual sensors located on stern of vehicle would be appropriate put to use in the first place when reversing. To realise potential of camera when reversing enhances broadly safety mainly for heavy vehicles. Stern camera should compensate also missing rear-view mirror in interior.

We do not expect that using of electronic systems eliminated blind spot should have great negative impact to safety by means of undesirable behaviour adapting of drivers.

Both of these systems (navigation, blind spot detection) are information only. Such systems provide information to the driver by audible or visual means. Information only systems have no connections to any vehicle operational controls.

CONCLUSION

From the point of view of long-term perspective, today's condition of road communication is untenable. For its effective and sustainable development and practice, it is necessary to strengthen the co-operative traffic components at the expense of individual traffic ones. In the near future, traffic will be less dependent upon the decision of individuals and will be more and more controlled. And providing current information on traffic situations in the real time will more and more support this part that will remain dependent upon the individual decisions (that is, the drivers). In the world, great attention is devoted to this trend, and new research and development projects are supported that concentrated on the development of a wide collection of the systems and the methods supporting different transportation types. In the USA, the collection of the methods is commonly called the Intelligent Traffic Systems, in

Europe the Traffic Telematics. Both in the USA and also in the European Union, great attention has been devoted to the problems.
The applications should be divided into two parts. On one hand, the drivers should be provided with the information as most as effective (and cheap) to be needed for using the road network effectively and safely, and on the other hand they can be provided with the other information for which the drivers are willing to pay.
ADAS system capabilities and conditions for driving the cars on roads: The ADAS and TICS systems are the typical technological products that facilitate human activities. However, this may be a great source of temptation how to fill the released mental capacity and the time. Hence without the specification of a strict feedback and knowledge of a real mental capacity, driver's behaviour, the stipulation of the rules among human being, vehicle, road and legislation, and the relation of traffic security versus the facilitation of the basic driver's activities, this perfect idea to replace the sensory and mental human capacity by technology would be able to be counter-productive or even dangerous.
Topics and condition stipulation
In addition to the technical parameters of the devices and the systems themselves, there is a number of the aspects that can affect the operational quality of technology used and its full and effective exploitation.
Great attention is devoted to the standardisation process, its technical arrangement, possible abuse or unauthorised use within the framework of the creation of the European standards in Telematics. However, the standardisation of "human parameters" is only marginal, or nearly fully omitted. This problem is solved by legislation as the driver's legal responsibility, this means that the driver is liable for his activities even though some supporting facility is used. From the commercial point of view, the elimination of possible customers is not acceptable, however, it is necessary to emphasise and define the legal responsibility of the producers of such systems, for example, the responsibility for training courses of such systems, their verification, proper use, etc.
The safe use of technological facility/systems when driving the vehicle must be taken into account not only for its construction, but also in designing its control elements, communication modules and all display tools.
The specification (i.e. the priority) of information to be transmitted and the right to react in a critical event. The priority of the driver's decision before the calculated response, the priority of information related to safe drive before the additional information (e.g. leisure, music, other news, etc.), the elimination of overloading the mental human capacity (e.g. unclear information, misinformation, implied sense, unclear instructions for use, etc.).
The compatibility of the system functionality with the basic driver's activities, goals and tasks and the unacceptability of using the system for the other purposes have to eliminate the danger of the loss of control over technology or its use for the other purposes than specified (e.g. calling, sending e-mails, playing games, etc.).
Only the trained persons should handle and operate these technical tools, both under normal operation and in emergency events (i.e. in case of system failure, incorrect operation, in case of delayed responses, etc.)
Any failure of the system must be immediately and clearly indicated to the user. The user should be ready and able to fully control the vehicle manually.