interactIVe
Accident avoidance by active intervention for Intelligent Vehicles

News | 04

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www.interactIVe-ip.eu

Dear reader

In the third year of interactIVe, we concluded the core phase of the project, during which all the partners focused mainly on function development. The applications developed by the SECONDS, INCA and EMIC sub-projects are now ready for evaluation.

With the successful completion of the EC review 2012 in Lommel and Aachen, interactIVe took an important step forward and the project was rated as "excellent". Other highlights included the fruitful discussions with external experts during congresses and project events as well as our thriving Summer School on Corfu and the special sessions at TRA and ITS World Congress 2012.

We are now beginning the final project phase. All applications will be tested and their safety impacts evaluated. Two types of tests are planned for interactIVe: technical tests that are needed for the technical assessment of the functions, and user-related tests which focus on the interaction between the driver and these functions. These tests will show how the functions work and how they are respond and perceived from a user's perspective.

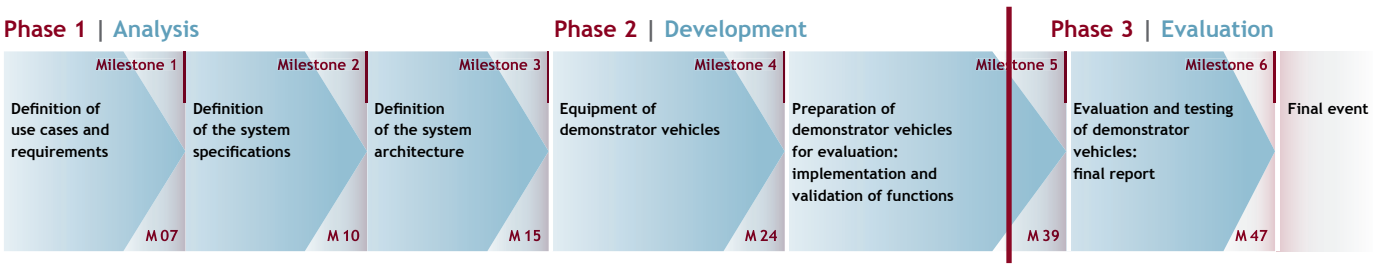
Participants of the interactIVe Summer School on Corfu, July 2012.

All results will be presented on the 20th and 21st of November 2013 at the interactIVe final event. We would like to invite you to join us for the conference days at EUROGRESS Aachen (Germany) and the driving demonstration day in Lommel (Belgium). Please pre-register for the event on our website www.interactIVe-ip.eu. We are looking forward to welcoming all of you personally at the event. The interactIVe partners and I hope you enjoy reading the interactIVe news.

Best wishes

Aria Etemad, Project Coordinator

March 2013



interactIVe's safety detectives
Evaluating function performance

As the project is approaching its final stage, the evaluation of the safety systems that have been developed has increased in importance. The interactIVe applications have been integrated into the demonstrator vehicles and tested in accordance with the test and validation plans developed by the "Evaluation and Legal Aspects" sub-project.

The main objective of the evaluation is to assess how well the different interactIVe functions fulfil their objectives as specified in their target scenarios. Hence, the functions have been evaluated from a development point of view rather than from a consumer point of view. The tests will show how the functions work with regard to the function description and requirements as well as how they are accepted and perceived by users. Additionally, an impact assessment will be carried out to estimate how and to what extent the functions influence traffic safety on a European level.

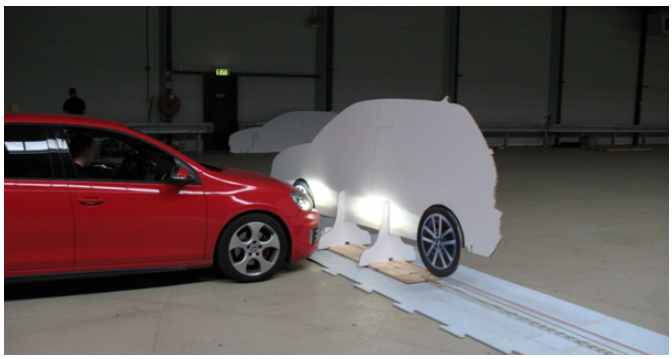
The tests cover the following interactIVe target scenarios:

- Rear-end collisions
- Head-on collisions
- Blind-spot collisions
- Cross-traffic collisions
- Collisions with vulnerable road users
- Unintended lane departure accidents
- Excessive speed accidents and
- Traffic rule violations.

The first tests were conducted in July 2012 on Volkswagen's outdoor test track in Wolfsburg (Germany). These were followed by tests in the TNO's indoor testing facility, "VeHIL", in Helmond (Netherlands) in September 2012.

The test drives on the test track in Wolfsburg were extremely beneficial although the West European weather presented some challenges in the form of heavy rain showers and strong winds. The rear-end collision scenarios and crossing traffic scenarios were tested on both the test track and in VeHIL. In order to test the cross-traffic collision scenarios in VeHIL a special setup was created: The test vehicle drove through the laboratory (i.e. is not on a chassis dynamometer) towards a junction. There, it met an object intersecting its path, which was pulled over a smooth surface. During the test, the position of the vehicle was communicated to the VeHIL controller, and the velocity of the crash object was adjusted to have a repeatable predefined collision scenario. The crash object was disposable and made out of cardboard. It was shaped like a car from the side and proved not to be as unstable as expected; hence, it could be used for several tests instead of only one. If necessary the colours of the object could be adjusted to fit the requirements of the testing system. This may be desirable for systems that are still at a research stage. The tests for the SECONDS and INCA demonstrator vehicles are scheduled for the beginning of 2013 and are already ongoing. The results of the tests will be presented at the final event.

Picture 01: Testing collision mitigation at TNO test site. Intersecting object scenario from the driver's perspective.



Picture 02: Collision mitigation function decelerates the vehicle before crashing into intersecting object.

The successful implementation of the Reference Perception Platform

In 2012, the Perception sub-project's core work was successfully concluded. This includes the development of the Reference Perception Platform and its implementation in the demonstrator vehicles as well as the testing of specific target scenarios in order to provide the first SP2 evaluation results. With the delivery of the Perception Platform's output, namely the Perception Horizon (PH), to the sub-projects, the core application function development has been enabled. The set of PH consists of periodically synchronised information, particularly on:

- road geometry for one segment to the rear and several segments ahead, including road edge detection information for the segment the vehicle is driving on (see pictures 4 and 5)
- ego-vehicle dynamics, short trajectory and its lane assignment in the road
- object dynamics and location in the frontal and side/rear areas of the ego vehicle (objects can be vehicles, motorcycles or pedestrians) relative to the ego vehicle (see picture 3)
- object classification (based on lidar/vision fusion, not available in all demonstrators).

The SP2 highlights for the final period of the project will be the development of modules with advanced features related to:

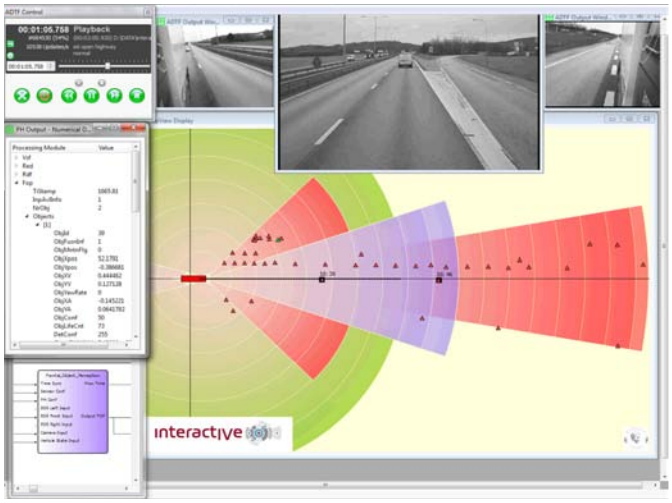
- frontal near-range perception and the recognition of unavoidable crash situations (with application in collision mitigation objective)

Picture 03: Snapshot of the road edge detection module from Volvo Group.

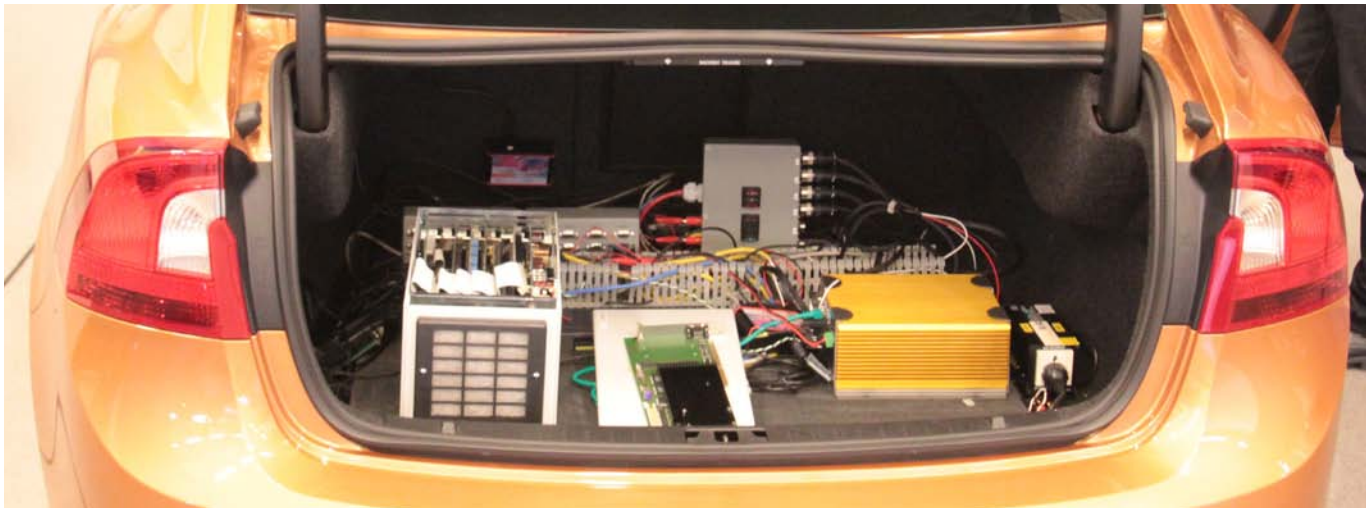
Picture 04: Snapshot of Road Data Fusion Module including digital map data from Adasis v2 Horizon Reconstructor.

- track ID maintenance for surrounding object perception and object classification.

Additionally, more recorded test data and ground-truth data will be made available in 2013 to conclude the SP2 evaluation work.



Picture 05: Output of the Frontal Object Perception Module from Volvo Group demonstrator.



Picture 06: Perception platform physical components' snapshot in the Volvo demonstrator car.

▸ Interview with Agneta Sjögren [Volvo Group], development engineer

Agneta Sjögren

[Volvo Group], development engineer

What is your specific task in interactIVe?

I am one of the participants within the technical expert group. Together with the other members of this group, I am ensuring the quality of the technical research. This includes performing peer reviews of deliverables, support links between sub-projects by assisting in identifying potential synergies and initiating collaborative efforts. The technical expert group is also responsible for compiling the IP-level deliverables and I have had the main responsibility for the demonstrator deliverable. The technical experts also act as a contact point to the SP leaders and steering committee, especially if SPs have some technical issue they need advice on.

How is research conducted?

My role in interactIVe is actually not to conduct research. I am responsible for monitoring the research performed by other partners and for contributing with know-how in certain areas. To keep up to date with what is going on in the SPs, I try to participate in the sub-project leader teleconferences. I also have more informal contacts with my Volvo Group colleagues who are actively working in SP3, 5 and 7. Sometimes I also get the opportunity to participate both in test drives and in technical discussions.

What is the particular challenge of your work in the project?

The main challenge is perhaps to keep up to date with what is happening in this large project. There are many different activities going on and many partners involved. I need to see both the complete picture and understand at least some of the details. As a technical expert, I am not that active in the actual technical execution and thus it is not always easy to detect arising problems or identify possible areas of improvement at an early stage.

What difference will the developments from interactIVe make compared to existing technological solutions?

The interactIVe perception system is taking the environment into consideration, going one step further than what is state of the art. By combining different sources of information, the perception platform not only detects the surrounding objects but also interprets the situation. interactIVe is addressing the tasks of accident mitigation and avoidance in different ways. These different ways, ranging from early advice to extremely late autonomous interventions, have in common that they focus on giving the driver the correct assistance at the correct time depending on the situation.

Picture 07-08: Fully equipped demonstration vehicles on the test tracks.

Developing IWI
Joint strategies, concepts and designs

The final interactIVe information, warning and intervention (IWI) strategies have been developed and documented in Deliverable D3.2.

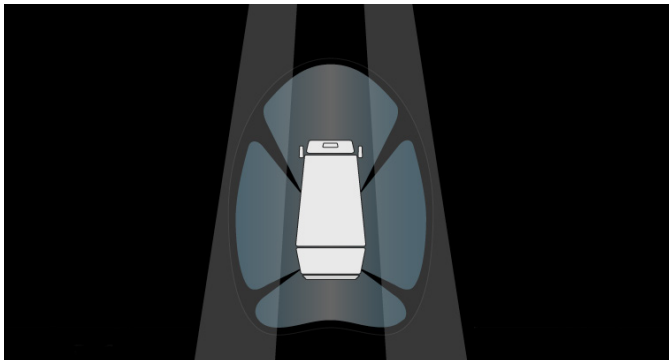
The strategies refer to how, when and where driver information, warnings, and interventions should be activated. They represent a set of guidelines and recommendations for the targeted interactIVe demonstrator vehicles. The goal is to achieve compatibility between driver and automation as well as a coherent, integrated and efficient driver-vehicle interaction design. The IWI strategies focus not only on the graphical user interface but also very much on the intervention aspects of the functions developed in the project, for example steering and braking avoidance and how these manoeuvres can be designed so that they are aligned with the driver's expectations and actions. IWI strategies were developed in an iterative development testing cycle by all partners in sub-project 3 and in close cooperation with the demonstrator owners. The IWI strategies are structured according to the following strategy aspects:

- Layer of driving task
- Level of assistance and automation
- Situation awareness, mental model, mental workload, trust
- Range of operation and availability
- Communication channel
- Sequence of interaction
- States, modes and mode transitions
- Communicate system status
- Arbitration
- Prioritisation and scheduling
- Adaptivity and adaptability.

Apart from developing strategies, different concepts and tools were introduced and discussed. An arbitration-overriding matrix was introduced as a tool to take and document structured design decisions for arbitration, especially in highly critical situations. A further approach was the use of sequence diagrams to discuss and document the temporal and causal flow of interactions, especially the escalation process in critical situations.

Additionally, a comprehensive framework for a idealgraphic layout of the vehicle cockpit visual HMI including detailed design drafts for the various visual and acoustic elements was developed. The main purpose of the graphic elements is to present the support currently available to the driver, while the main visual information is presented in the front field of view, e.g. in a head-up display.

All the IWI strategies, design concepts and tools, and the visual and acoustic elements are applied to the various interactIVe demonstrator vehicles. As a result, the demonstrator vehicles feature individual manufacturer-specific design details while sharing the same underlying strategies, concepts and basic elements of the interaction design. As an example, two preliminary display variants from two different demonstrator vehicles are shown below. Among other elements, they feature the grouping of functions into an automation spectrum and a safety shield.



Picture 09: Safety shield of a truck.

Picture 10: Safety shield of a pasenger car.

Project stories

interactIVe video trailer

Making of scenes from the video shooting

A video will show the work and research within interactIVe. Scenes for the interactIVe video were shot in Aachen at the Ford Garage, in Lommel at the EC-Review and in Gothenburg at the Volvo test track. The trailer is available on YouTube and on the project website.

EC review

The interactIVe team and the reviewers

Each year the interactIVe consortium prepares for the EC-Review. During the presentation in Lommel in May 2012 the project received an "excellent" rating: a great and rare achievement, which shows the success of interactIVe's team work.

General Assembly

The General Assembly is the central meeting of each EU-project; 50 participants attended interactiVe's General Assembly. Delegates from each partner came to Corfu in July 2012. During a conference the coordinator and the sub-project leaders presented the project's progress and achievements. Within the integrated workshop "The Future of Intelligent Vehicles and Transportation Systems" two presentations were discussed.

Presentation 1 (internal): Collaborative Control between Human and Artificial Co-Driver by Mauro da Lio

Presentation 2 (external): Extended Control Model Architectures and Results of DIPLECS Project by David Windridge

Cooperation stories

Summer School

Listening to Summer School presentations

More than 70 participants attended interactIVe's Summer School in July 2012 on Corfu. They had the opportunity to learn about state-of-the-art Perception Systems, advanced driver assistance systems (ADAS), human machine interfaces (HMI) and interactIVe's latest developments.

EUCAR

Cooperation and liaison with EUCAR

Ford represented interactIVe at the European Council for Automotive R&D (EUCAR) assembly in November 2012. In the picture, the coordinator, Aria Etemad, explains the project to the EU Commissioner for Climate Action, Connie Hedegaard.

Start-up cooperations

Sub-project leader meeting with start-up inspiration (picture: the Resonic measurement system)

In keeping with the concept of initiating new cooperations within the consortium, EICT initiated a "get-together" of the project partners and young companies at the sub-project leader meeting in Berlin in September 2012. Two Berlin based start-ups (Resonic for mass properties measurement and Mapegy for technology mapping) were invited to present their innovations for the automotive sector and began further discussions on prospective common activities.

Technical papers

IEEE Intelligent Vehicles Symposium, Alcalá de Henares 2012

In 2012, the interactIVe partners submitted and presented several technical papers at the ITS World Congress, AHFE etc. The papers for the "2012 IEEE Intelligent Vehicles Symposium" are particularly noteworthy:

1 Will intelligent vehicles evolve into human-peer robots?

2 A novel multi-lane detection and tracking system

3 Frontal Object Perception using radar and mono-vision

4 Path and speed control of a heavy vehicle for a collision avoidance manoeuvre.

Virtual co-driver on board
Continuous driver support functions

As part of the "Continuous Driver Support" sub-project, an artificial driver assistant has been developed. The so-called "co-driver" is built-in and works parallel to the real driver. While the artificial driver will function as a permanent, sentient companion, the human driver continues to be the decision-maker, the "real motorist".

interactIVe's innovative co-driver function for "Continuous Support" refers to the integration at the functional level of driving. Against the backdrop of advanced driver assistance systems, the continuous connection between the virtual co-driver and the human driver is the function's purpose[1].

While driving, the artificial co-driver:

- develops sensory-motor strategies for all possible decisions concerning individual situations on the road, then identifies the one strategy that matches the human driver best and
- interacts with the driver while drawing on the appropriate strategy as well as on safer or more efficient options.

As shown in the co-driver figure below, the function operates on several hierarchical levels referring to behavioural loops, based on Brooks' layered control approach[2]. In addition, mirroring and forward emulator mechanisms based on the emulation theory of cognition[3,4] complete the analysis process. The outcomes emerging from the lower levels are taken on by the more complex levels. Thus, at the "goals/motivations level" the appropriate decision is identified and its corresponding sensory-motor loop activated.

The progress made during the development of interactIVe's artificial driver assistant is described in two papers:

Saroldi, A., F. Tango, M. Da Lio, F. Biral, M. Galvani. (2012). Implementation of a Co-Driver for Continuous Support, in proc. 19th ITS World Congress, Vienna, Austria, paper EU-00748.

Da Lio, M., F. Biral, M. Galvani, A. Saroldi. (2012). Will Intelligent Vehicles Evolve into Human-peer Robots? in proc. 2012 IEEE Intell. Veh. Symposium. Alcalà de Henares, Spain, pp. 304-309.

In this way, the co-driver system not only suggests how the human drivers could, but also how they should, drive. It takes into account the given situation, i.e. position of the vehicle, traffic flow and potential obstacles, and analyses the possible reaction schemes for further interaction with the driver via multiple channels with extensive use of haptic feedback and interaction on driver commands. Thus, the co-driver and the human driver form a "symbiotic system"[5].

References:

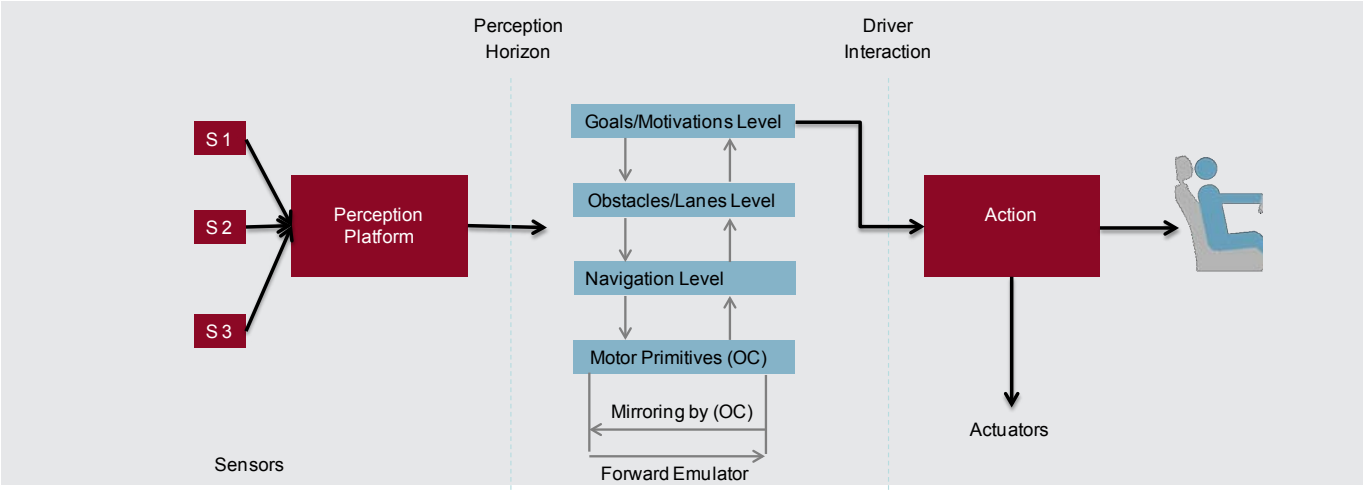
[1] *Saroldi, A., F. Tango, M. Da Lio, F. Biral, M. Galvani. (2012). Implementation of a Co-Driver for Continuous Support, in proc. 19th ITS World Congress, Vienna, Austria, paper EU-00748.*

[2] *Brooks R. A. (1986). A robust layered control system for a mobile robot. IEEE J. Robotics Automation, vol. 14 (23).*

[3] *Grush, R. (2004). The Emulation Theory of Representation: Motor Control, Imagery, and Perception. Behav. Brain Sci. vol. 27 (3). pp. 377-396.*

[4] *Hurley, S.L. (2008). The shared circuits model (SCM): how control, mirroring, and simulation can enable imitation, deliberation, and mindreading. Behav. Brain Sci. vol. 31. pp. 1-58.*

[5] *Da Lio, M., F. Biral, M. Galvani, A. Saroldi. (2012). Will Intelligent Vehicles Evolve into Human-peer Robots? in proc. 2012 IEEE Intell. Veh. Symposium. Alcalà de Henares, Spain, pp. 304-309.*



Picture 11: Diagram of the continuous driver support function according to the co-driver concept.

▸ interactIVe: final event

On the 20th and 21st of November 2013 interactIVe is inviting the expert community and interested members of the public to its final event. After four years of research, the project results will finally be presented during a two-day event, including a conference and live demonstrations.

It will be hosted together with the project eCoMove, which concludes its activities at the same time. eCoMove has identified the main sources of vehicles' energy waste using eco-driving support and eco-traffic management. The audience will benefit from the presentation of both projects – interactIVe and eCoMove – since both of them have developed solutions for cooperative systems and platforms, HMI and driver support.

On two conference days the results will be presented in parallel technical presentations and a common exhibition at the EUROGRESS facility in Aachen, Germany. On the second day (21st of November) all the functions will be shown during driving demonstrations with the interactIVe demonstrator vehicles. Transfer shuttles will be available for participants from Aachen to the Ford test track in Lommel, Belgium.

Registration for the final event is open on the interactIVe website. For any further questions regarding the final event please contact Anja Winzer (anja.winzer@eict.de) and Evi Brousta (p.brousta@iccs.gr).

▸ Congress activities

In the upcoming congress season, interactIVe partners will represent the project at international congresses and conferences. The next activities will be special sessions at the FUSION 2013 Congress in Istanbul and at the 20th ITS World Congress in Tokyo.

In 2012, interactIVe participated in seven international congresses, contributing several papers and presentations. The documents can be downloaded from the interactIVe website: http://www.interactive-ip.eu/publications/presentations. The following table summarises the highlights.

Event	interactIVe input
Transport Research Arena 2012	Special session "Enhanced Environment Perception and Results of Field Operational Tests of Active Safety Systems" together with euroFOT; one technical paper presentation
Workshop on the Future of Road Vehicle Automation	Presentation "KONVOI and interactIVe - Truck Platooning and Crash Avoidance"
AHFE 2012; First International Conference on Human Factors in Transportation	Presentation "Implementation and Evaluation of Lane Departure Warning and Assistance Systems"
19th ITS World Congress	Special session "Advanced integrated safety applications based on enhanced perception, active intervention and new advanced sensors" together with MiniFaros and 2WIDES-SENSE; two paper presentations

Picture 12: Selected congress activities 2012.

interactIVe is a common project of European leading official equipment manufacturers (OEMs), suppliers, research institutions and small companies. interactIVe is co-funded by the European Union under the Framework Programme 7 conducted by DG Connect and is supported by EUCAR, the Council for European Automotive R&D.

In interactIVe, we are developing the **next generation of advanced driver assistance systems** (ADAS) for **driver support** and **emergency intervention**. **interactIVe systems** will:

increase the perception horizon: environment information is recognised through a new integrated and comprehensive sensor platform.

improve decision strategies for ADAS: the systems are using new prediction techniques and integrating advanced human-machine interface (HMI) concepts, balancing human and system interventions.

suit the ordinary driver: several tests enhance the knowledge about driving behaviour and impact of the systems.

be affordable: system cost is reduced by the implementation of low cost sensors and the integration of previously independent functions.

apply to all vehicle classes: six passenger cars of different vehicle classes and one truck are being built.

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