interactIVe

Accident avoidance by active intervention for Intelligent Vehicles.

News | 02

July 2011

www.interactIVe-ip.eu

Dear reader,

During the presentation of our work in interactIVe at the 8th ITS European Congress in Lyon, France the progress of interactIVe was made evident: in the first year we focused on defining and specifying of the assistance, intervention and mitigation functions and how to realise them in the demonstrator vehicles. With the start of 2011 real development activity was launched with equipment of demonstrator vehicles, integration of components and implementation of software modules. The demonstrator vehicles – six passenger cars of different vehicle classes and one commercial truck – are now in the workshops. By the end of this year we will have all of them equipped with hardware components and software modules to start on-road set-up tests to verify the developed functions under real conditions before functional tests are conducted.

As a prerequisite, the major milestone of defining the architecture of the demonstrator vehicles was reached. In March, the General Assembly in Athens gave all participants important impulses for the development phase. Four project wide workshops on perception, evaluation and legal aspects, and information, warning and intervention (IWI) strategies took place.

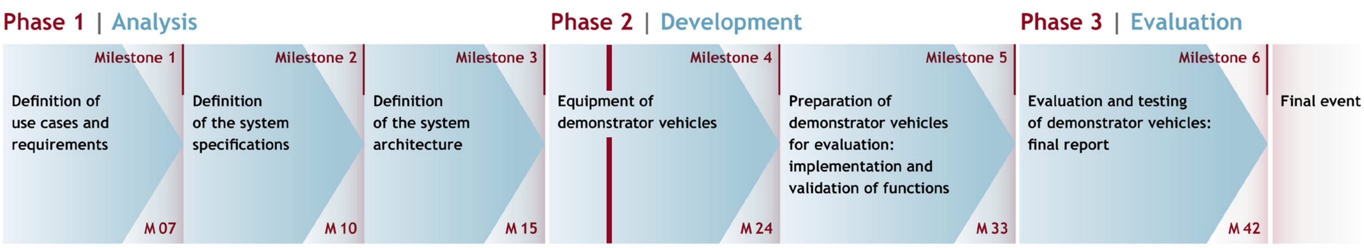
Improvement of decision strategies for active safety and driver-vehicle-interaction is one of the distinctive missions of interactIVe. Human factors specialist Emma Johansson provides an insight into the ongoing research.

Perception of the ego-vehicle remains in the focus of collaborative work. A Fusion Camp by the end of June further triggered the creation of an innovative model and platform to enhance perception of the driving situation.

Next summer, it will be interactIVe inviting you to a larger event: the interactIVe Summer School in 2012.

For now, I wish you a pleasant reading. For more information please also visit the website: **www.interactIVe-ip.eu**

July 2011, Aria Etemad, Coordinator

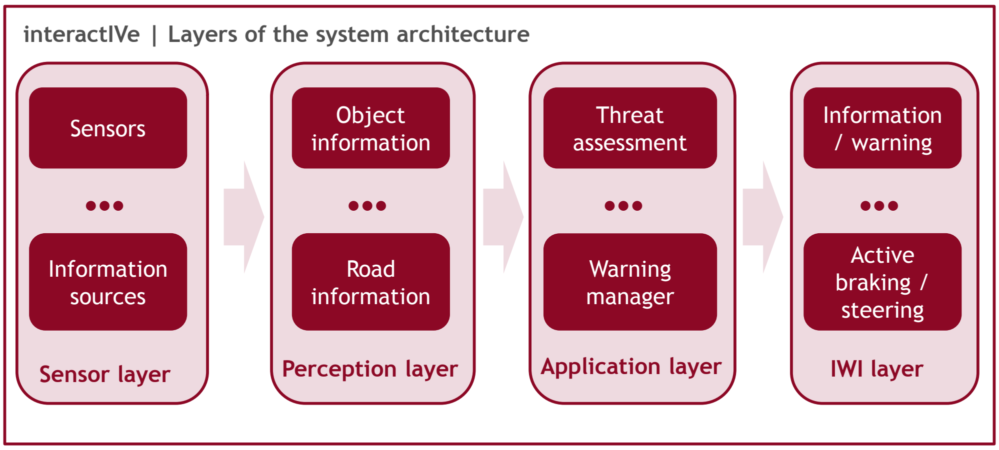


More than 60 delegates from all interactIVe partners gathered at the National Technical University of Athens (Politechnio).

▸ Generating ideas: First General Assembly in Athens, Greece

More than 60 delegates from all partners gathered for the first General Assembly at the National Technical University of Athens (Politechnio), to which the host Institute for Communication and Computer Systems (ICCS) had invited the consortium. These days were packed with workshops and meetings. **During a joint workshop between the sub-project "Perception"** and the sub-projects who develop the demonstrators the different system development teams - for sensors, modules, perception platform and applications - coordinated their next steps towards the first data loggings and testings inside the demonstrator vehicles.

The discussions ranged from the proposed functional architecture of the perception platform to the synchronisation strategy. Other topics were the expected update rate and bandwidth of the information of the perception horizon. Regarding road data representation the participants also decided on the Road Data Fusion module implementation plan and the exploiting of ADASIS horizon data.



▸ Outlining the system: Architecture defined

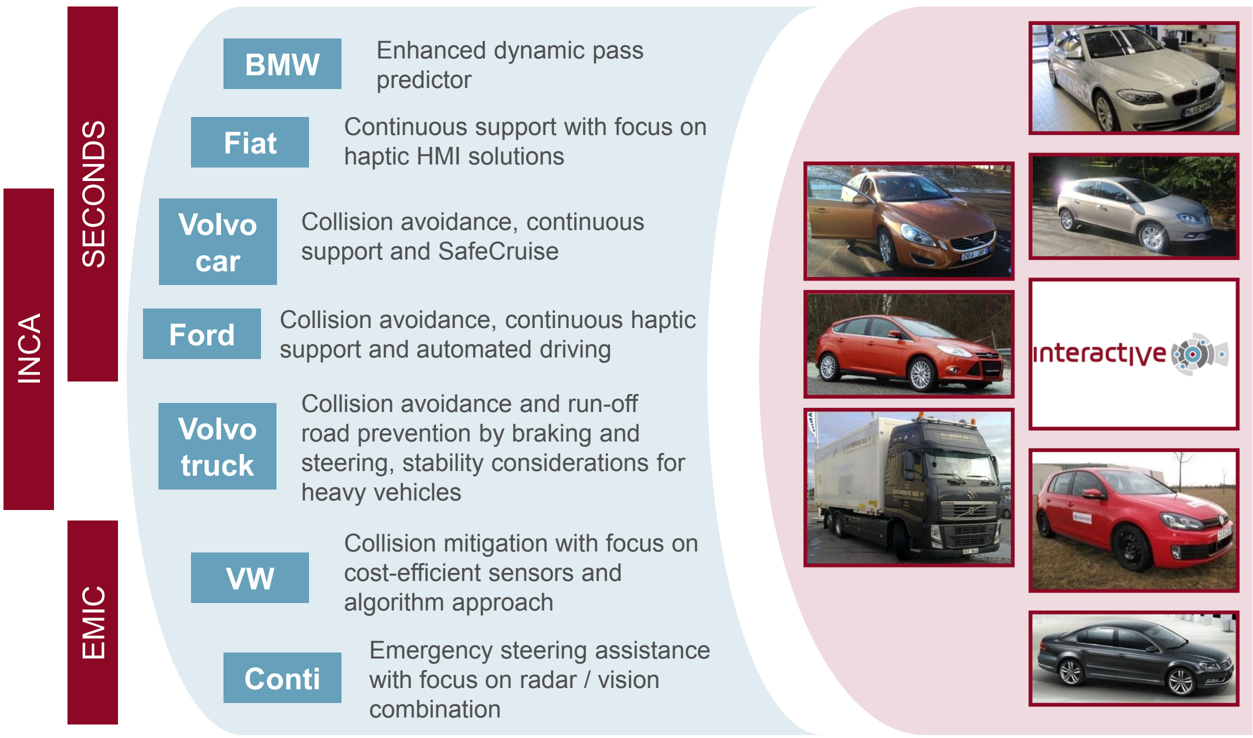
As an important milestone for the project, the overall system architecture has now been defined. The system is built of four layers addressing sensors, perception, applications, and IWI strategies.

The sensor types to be used are abstracted as a *sensor layer* with a defined set of generic sensors. Regarding the perception platform, time synchronisation of input and output data is essential to achieve the necessary accuracy for the subsequent sensor fusion processing. The *perception layer* is a major component of the system architecture. It is the interface between the perception platform and the *application layer*. The standard CAN (Controller Area Network) bus is being used for data transport. The interactIVe application development will be implemented into the application layer that is abstracted into modules, to be implemented separately for each demonstrator, although sharing a common basic structure.

An important aspect of the architecture is the inclusion of the *IWI layer*. The IWI layer contains the IWI strategies and thus connects the development process with relevant standards, and research and legal requirements.

Having agreed upon the system architecture, the partners can start the development phase.

interactIVe | Seven demonstrator vehicles



▸ In the workshops: Equipment of demonstrator vehicles started

SECONDS - safety enhancement through continuous driver support

INCA - integrated collision avoidance and vehicle path control for passenger cars and commercial vehicles

EMIC - cost-efficient emergency intervention for collision mitigation

These three sub-projects are currently building up the demonstrator vehicles; BMW 535i, Ford Focus, Lancia Delta, VW Golf VI GTI und Passat (B7), Volvo S60 and Volvo FH13 Truck.

Each demonstrator is equipped with a different set of sensors and output devices.

The functions tested are: enhanced dynamic pass predictor, continuous support with focus on haptic HMI solutions, collision avoidance and SafeCruise, run-off road prevention by braking and steering, stability considerations for heavy vehicles, collision mitigation with focus on cost-efficient sensors and algorithm approach, emergency steering assistance with focus on radar / vision combination.

▸ Interview with human factors specialist Emma Johansson, Volvo Technology

Emma Johansson

[Volvo Technology, Sweden, leader of sub-project Information, warning and intervention (IWI) strategies]

What is your specific task in interactIVe and what is your research approach?

Emma Johansson, Volvo Technology: It is our task to investigate IWI strategies for Advanced Driver Assistance Systems (ADAS). This task is performed in close cooperation with the application-oriented sub-projects. The partners involved are Volvo Technology, Centro Ricerche Fiat, Allround Team and the German National Research Centre for Aeronautics and Space (DLR).

Our research question is: How do we create a support system with well-integrated functions which is affordable and accepted by the driver? In short, IWI strategies should cover an array of interaction modes, i.e. visual, auditory and haptic output/input. We aim at assisting the driver with steering, braking and acceleration interventions in emergency cases, but also at providing him with relevant unobtrusive information.

How is research conducted?

Emma Johansson: We work with available standards, guidelines, recent literature findings, and experimental studies. Testing is needed when we are looking for new IWI strategies for specific functions or when we have to validate existing strategies. The first set of experimental studies is currently in the preparation phase. We aim at executing nine experimental studies with approximately 200 test persons. We will use several testing facilities:

Two fixed-based driving simulators from the partners Allround Team and DLR for passenger cars and one truck driving simulator at Volvo Technology, all with dynamical traffic and environment simulation. In all three simulators we are able to adjust traffic dynamically and create any environmental condition like snow. Also, we will use two moving-based driving simulators from Fiat and DLR, and one test vehicle from DLR with full drive by wire capability.

We also have to implement new software and hardware into the simulators. We expect our first results in fall 2011.

What is the particular challenge of your work on IWI strategies in interactIVe?

Emma Johansson: If warnings are unsuitable and the intervention is not according to the driver's expectations of how a situation will evolve, this might lead to that the driver simply shuts the system off or performs counteractions possibly resulting in an even worse situation.

Functions should easily be understood and operated intuitively by the driver. They should give the optimal benefit and support in order for the driver to drive safely and they should not counteract against the driver‘s intentions. All functions should

The fixed base truck driving simulator of Volvo Technology will be used for tests in interactIVe.

be controllable by the driver at any time, be well integrated into the overall vehicle interface with as few modes and abilities as possible and with consistent semantics for warnings and interventions.

▸ interactIVe IWI strategies

A first set of preliminary IWI strategies was constructed. The IWI strategies were grouped into strategy categories, namely *design aspects*. Each demonstrator and its functions were described according to them, e.g.:

- Level of assistance and automation: How much assistance and automation is offered to the driver? The illustration below shows the spectrum of assistance as it was developed by the DLR during precedent projects such as the EC-funded project HAVEit. Researchers use this continuum for active discussions with the application-oriented sub-projects. The interactIVe research concept allows for the integration of a possible warning and reaction towards a potential threat at any point of assistance level.
- Communicate system status: What information about current status is communicated to the driver and how are they presented?

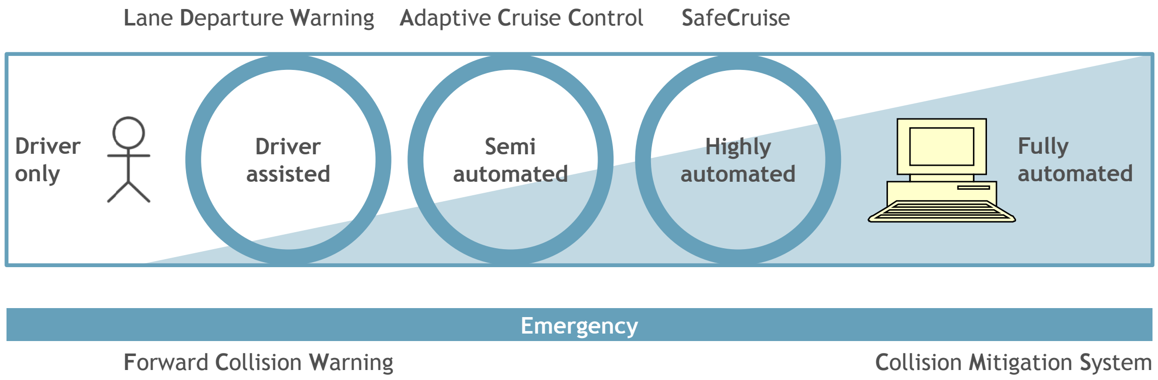
Examples for the specific *IWI strategies* are:

- Driver can always override the system.
- Arbitrate primarily via haptic devices that have direct influence on vehicle movement; use steering wheel for negotiations of direction, pedals for negotiation of velocity.

The IWI strategies team: Martin Brockmann (Allround Team GmbH), Martin Baumann (DLR), Emma Johansson (Volvo Technolgy), Tobias Hesse (DLR), Frank Flemisch (DLR), Amon Rambaldini (CRF)

- Define degrees of machine authority according to situation, for example:
  - driver initiates, machine supports driver action,
  - machine suggests action, driver executes,
  - machine executes, but driver can override or
  - machine executes, no overriding possible.
- Group automation functions into modes of increasing degree of automation. Take care that:
  - not too many levels are used,
  - that the levels are clearly distinguishable for the driver and
  - the current automation level is clearly indicated.

interactIVe | IWI strategy: levels of assistance and automation*



* One-dimensional automation scale, examples of ADAS functions and emergency warning and intervention (adapted from [Flemisch, Kelsch, Löper, Schieben, Schindler & Heesen (2008)])

▸ News from the perception team: Improving vehicle's vision

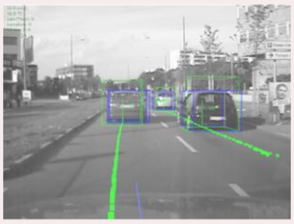
Work on vehicle perception has entered the creative phase, where sensor data fusion research is realised and its outcomes are transformed into the perception platform development and engineering. The set of output signals from the perception platform, the "perception horizon", has been delivered, while the first version of the perception reference platform is being developed.

This first iteration implements the generic interfaces for different sensor types along with sensor configuration files. Implementation of the reference platform includes testing with first logged data from the demonstrator vehicles and acquaintance with the ADTF (automotive data and time-triggered framework) software environment.

The perception platform can serve multiple safety applications and has been built to work on different sets of sensors, thus being close to a "plug and play" approach. The interoperability will be demonstrated by fitting the platform on the demonstrator vehicles.

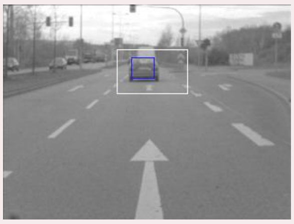
Work on the data fusion modules of the perception platform has started. They process heterogeneous data from different sources like radar, camera, lidars, vehicle sensors and digital maps. Cutting edge multi-sensor online data fusion approaches as grid-based fusion, attention-focused fusion, object classification and road edge detection are part of the future work. In this direction, active intervention envisioned within interactIVe applications, poses hard real-time requirements for perception data processing and fusion modules.

interactIVe | Snapshots depicting functionality of perception fusion modules



Lane recognition and object lane assignment

Road data fusion module (digital map-matched road attributes extracted from vision sensors)



Frontal object detection

▸ Enhancing perception: Fusion Camp in Passau, Germany

The interactIVe sub-project Perception invited all interactIVe project members to a Fusion Camp at the University of Passau end of June. The camp was planned as an exchange event for data fusion and object tracking researchers involved in interactIVe. It aimed especially at PhD students of institutes and companies involved in respective research fields. Interactions between developers enabled the comparison of different approaches and permitted every team to learn from each other and to find a common understanding for object perception research and engineering. During the Fusion Camp ideas on advanced fusion techniques for interactIVe applications were exchanged. The event provided a friendly interaction environment for the perception layer development teams.

▸ Discussing findings: The 8th ITS European Congress

interactIVe presented project results during the 8th ITS European Congress June 6th to 9th 2011 in Lyon, France during **Special Session 42 - Avoiding accidents by enhanced perception and active interventions: a look into the future of intelligent vehicles.**

The session was hosted by interactIVe and merged with a presentation of the project MINIFAROS.

Perception systems that make use of sensor data fusion are more accurate, reliable and comprehensive than single-sensor systems. Apart from established sensor technologies like radar and vision, new information sources such as digital map databases and v2x communication will definitely enhance the capabilities of environment perception systems. Significant effort should be devoted to the enhancement and integration of the perception layer in the future.

In this session approaches to enhancing the perception layer were discussed in detail, together with novel techniques in terms of optics, solutions for replacing the scanning mirror, electronics and possible automotive applications, where such sensors can be used. Well designed human-vehicle interfaces of ADAS determine the level of user acceptance and actual deployment. Initial information, warning and intervention strategies for automotive applications were presented as well as relevant applications from industrial partners and their future applicability.

30 participants joined the interactIVe Special Session during the 8th ITS European Congress in Lyon

Emilio Dávila González from the European Commission moderated the session.

The speakers were

- Aria Etemad, Senior Research Coordinator, Ford Research and Advanced Engineering Europe, Germany
- Angelos Amditis, Researcher Director, Institute of Communications and Computer Systems / Uri Iurgel, Algorithm Engineer, Delphi, Germany
- Emma Johansson, Human Factors Specialist, Volvo Technology, Sweden
- Lars Bjelkeflo, Research Project Manager, Volvo Technology, Sweden
- Florian Ahlers, Research Project Manager, SICK AG, Germany [MINIFAROS]

▸ Close ties with the automotive community: Liaison with HAVEit

interactIVe research and development links the results of other large scale projects. With its focus on long-range vision of highly automated driving HAVEit is one of these projects. interactIVe partners build upon strong liaison relations. Close contacts have been established between both projects: the coordinator Aria Etemad presented the research concept of interactIVe during the HAVEit General Assembly. The management team and leaders of the sub-projects attended the HAVEit final event for active exchange of experience and knowledge. Finally, interactIVe gained insight into deliverables from HAVEit.

The research exchange between these two projects ensures that research progresses beyond state-of-the-art. Additionally, the latest results will be incorporated by interactIVe research.

▸ Save the date: the interactIVe Summer School 2012

interactIVe is inviting you to a 2012 summer event: the "interactIVe Summer School 2012", an academic event combining latest project results on ADAS for safer and more efficient driving with expertise and excellence from other acknowledged researches and specialists within the field.

Prominent speakers from academia and the industry, both from Europe and abroad, will discuss on a varied range of topics, starting from sensor interfaces and fusion modules, and expanding to driver support, emergency intervention and vehicle path control. During afternoon sessions PhD students will have the chance to present their current work and participate in open discussion panels. These activities will be paired with a programme of cultural and social events to enhance networking. Exact date and place will be confirmed in due course.

To indicate initial interest or to retrieve any information please contact Angelos Amditis: **a.amditis@iccs.gr**

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In interactIVe the **next generation of Advanced Driver Assistance Systems** (ADAS) for **driver support** and **emergency intervention** is developed. **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.