New European Approach for Intersection Safety – The EC-Project INTERSAFE

Kay Ch. Fuerstenberg
Director of Research
IBEO Automobile Sensor GmbH,
Fahrenkrön 125, 22179 Hamburg, Germany
Tel.: +49 40 64587-140, Fax: +49 40 64587-109
E-Mail: kf@ibeo-as.de

SUMMARY

Intersection Safety is a challenging subject due to the complexity of the heterogeneous environment. But as well it is one of the most important areas under discussion with respect to the huge number of accidents which occur on intersections. Therefore the European Project INTERSAFE was established within the Integrated Project PReVENT. INTERSAFE focuses on 2 approaches. The first one is a bottom-up approach, using state of the art sensors – Laserscanner and Video – and infrastructure to vehicle communication. An innovative strategy to identify static and dynamic objects based on accurate positioning at the intersection will be presented. The second one is a top-down approach based on a driving simulator. With this different sensor configurations and communication methods can be evaluated. In addition the investigation of dangerous scenarios can be realised as well.

INTRODUCTION

In the 6th Framework Programme of the European Commission, the Integrated Project PReVENT includes Intersection Safety. The INTERSAFE project was created to generate a European Approach to increase the safety at intersections. The project started in February 2004 and will end in January 2007.

The partners in the INTERSAFE project are:

- Vehicle manufacturer: BMW, VW, PSA, RENAULT
- Automotive supplier: TRW, IBEO
- Institute / SME: INRIA / FCS

The main objective of the INTERSAFE project is to

improve safety and to reduce (in the long term, avoid) fatal collisions at Intersections

The objective will be achieved by a combination of sensors for detection of crossing traffic and all other objects on the intersection as well as sensors for localisation of the host vehicle when approaching and transversing the intersection. Furthermore, there will be a communication between the host vehicle and the infrastructure, to exchange additional information, like traffic, weather or road conditions. A basic approach will be realised on a test vehicle with existing on board sensors and off the shelf communication modules. In parallel an advanced approach will develop driver warning strategies using a driving simulator to evaluate and specify the needs for an extended Intersection Safety System.

INTERSAFE CONCEPT & VISION

The INTERSAFE project realises two different approaches in parallel. The first approach is a Bottom-Up Approach, based on two Laserscanners, one video camera and vehicle-to-infrastructure communication. All these state of the art devices will be installed on a VW test vehicle, as shown in Figure 1 and Figure 2. The Laserscanners will be used for object detection and the video camera for road marking detection. Highly accurate vehicle localisation is performed by fusion of the outputs of the video and Laserscanner systems. The Laserscanner system tracks and classifies obstacles and other road users.

Figure 1: Bottom-Up-Approach with state of the art sensors on a VW test vehicle1

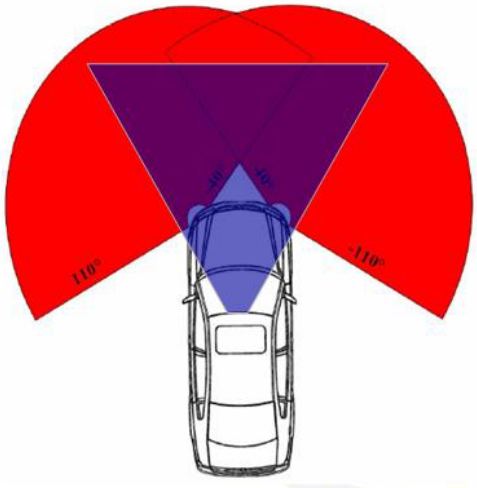

Figure 2: Fields of view of two ALASCA sensors and one Video Camera

Furthermore, some communication modules will be installed at selected intersections in public traffic to realise the communication between the vehicle and the traffic lights. This approach will result in a basic intersection system, which can be evaluated in public traffic on the selected intersections.

The second approach is a Top-Down Approach, based on a BMW driving simulator (see Figure 3). The driving simulator allows the analysis of dangerous situations, independent of any restricted capa-

[1] In this figure, an existing test vehicle of IBEO is presented. In INTERSAFE, a VW-Phaeton will be build up.

bilities of the sensors for environmental detection. The results of this approach will be used to define an advanced intersection safety system, including requirements for advanced on-board sensors.

Figure 3: Top-Down-Approach in the BMW driving simulator

The concept of INTERSAFE is shown in Figure 4. Based on object detection, road marking detection and localization based on natural landmarks (realised by matched information of the Laserscanners and the video camera in the basic approach) as well as a detailed map of the intersection, a static world model is built. As a result of this model, all objects and the position of the ego vehicle are known precisely.

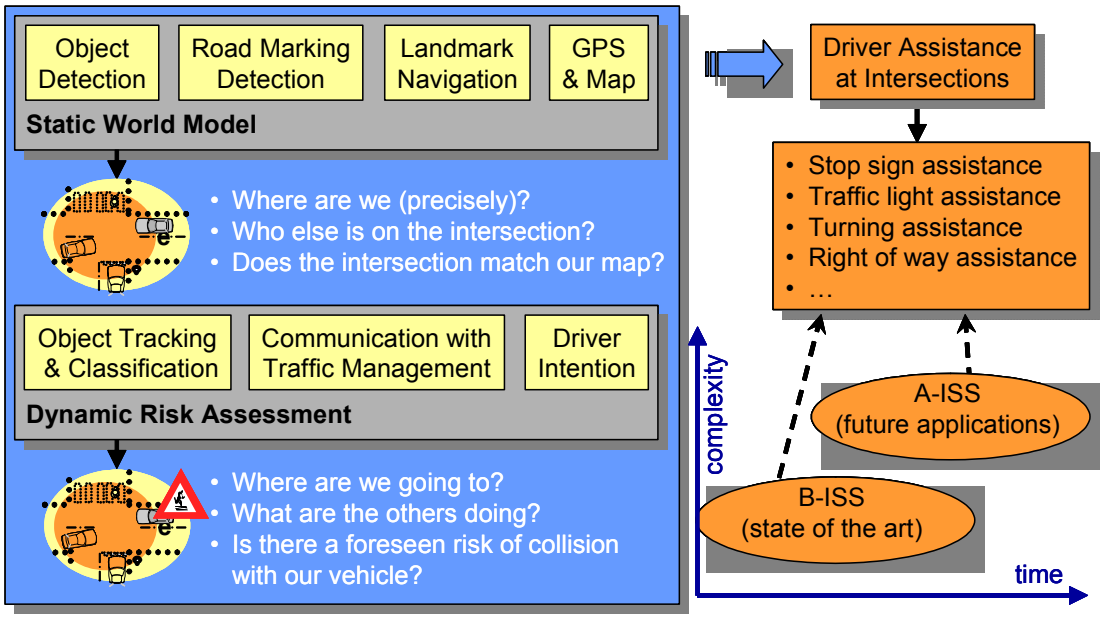

Figure 4: INTERSAFE concept & vision

In a second step, as shown in Figure 5, a dynamic risk assessment is done. This is based on object tracking & classification, communication with the traffic management as well as the intention of the driver. As a result of the dynamic risk assessment, potential conflicts with other road users and the traffic management can be identified.

Consequently, the intersection safety system is able to support the driver at intersections. In the INTERSAFE project, the consortium is mainly focused on stop sign assistance, traffic light assistance, turning assistance and right of way assistance.

The difference of the two approaches (A-ISS = Advanced Intersection Safety System and B-ISS = Basic Intersection Safety System) lies in their time to market and complexity. The architecture and the warning strategies will probably be the same.

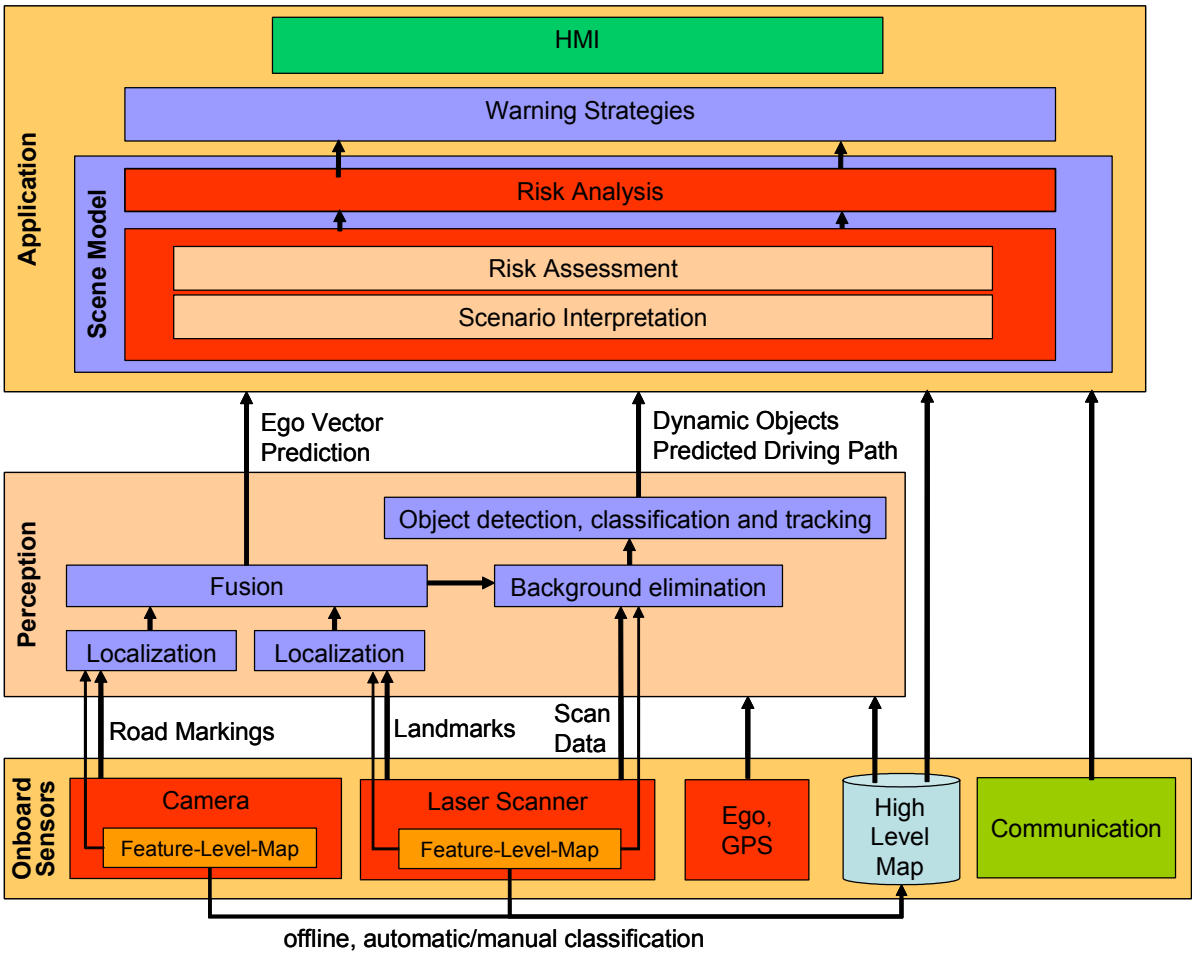

Figure 5: Architecture

ACCIDENTOLOGY - RELEVANT SCENARIOS

Based on a detailed accident analysis for intersections of selected European countries the relevant scenarios which have to be addressed by an intersection safety system are determined. The three most important scenarios including more than 60% of the accidents on intersections are identified. The strategy of the applications in INTERSAFE is focussed on warning the driver if a dangerous situation is predicted. Thus only a few seconds before a potential crash a warning has to be generated.

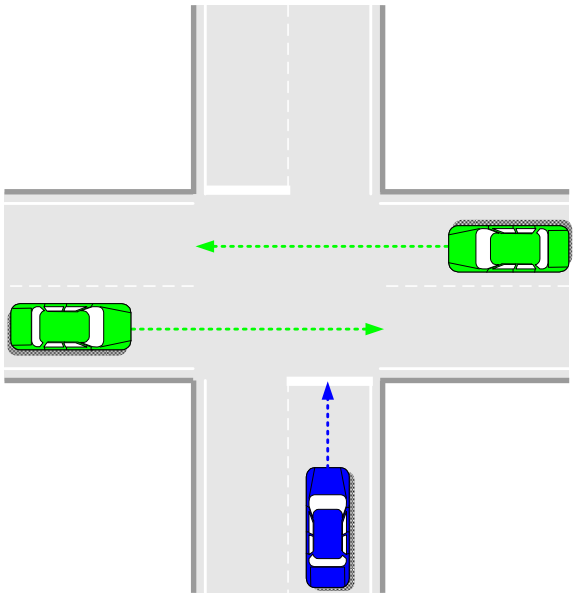

Figure 6: CASE VEHICLE (A) is driving with an initial speed of 0 to 60 kph. The final speed is 0 kph and the final position is the stop line at the road sign. The DRIVER INTENTION (A) is to stop and cross the road, stop and turn left or right or don't stop. The ROAD SIGNS could be a stop sign (mainly), traffic light or give-way sign. The OPPONENT VEHICLE (B) drives with a constant speed of up to 40 kph from right to left or vice versa.

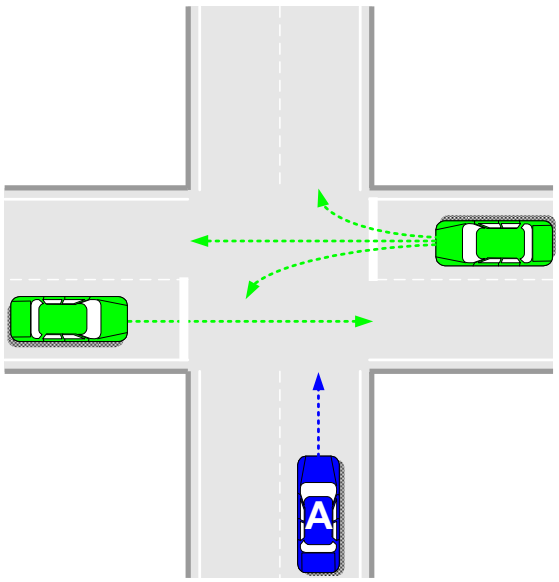

Figure 7: CASE VEHICLE (A) is driving with an initial speed of 0 to 60 kph. The ROAD SIGNS could be a stop sign (mainly), traffic light or give-way sign. The OPPONENT VEHICLE (B) drives with a constant speed of up to 60 kph from right to left or vice versa or right to left/right turn. The DRIVER INTENTION (B) is to stop and cross or don't stop.

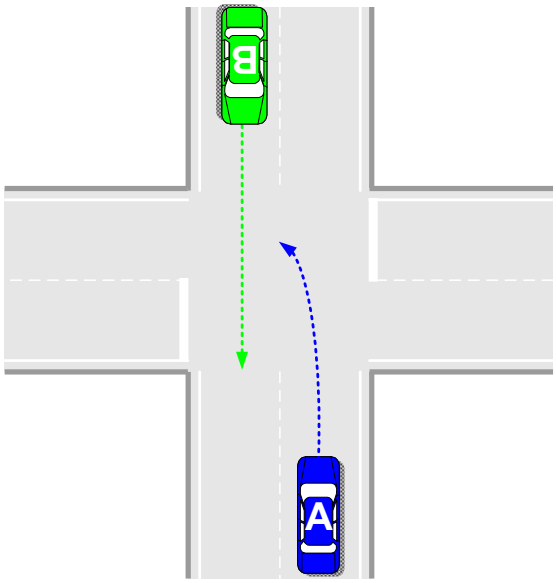

Figure 8: CASE VEHICLE (A) is driving with an initial speed of 0 to 60 kph. The final speed is 0 kph and the final position is the stop in the centre of the intersection. The DRIVER INTENTION (A) is to turn left. There are no ROAD SIGNS for the case/opponent vehicle. The OPPONENT VEHICLE (B) drives with a constant speed of up to 40 kph from the opposite direction.

The 3 most important scenarios including more than 60% of the accidents on intersections are taken as reference for the requirements.

REQUIREMENTS

As a result of the relevant scenarios from the previous chapter and the warning strategy, requirements for the sensor system are formulated. INTERSAFE is focussing on stop sign assistance, traffic light assistance, turning assistance or right of way assistance. Sensor systems should have a medium range up to 80 m, with a very broad field of view of about ±125 degree around the front of the vehicle. They should have the ability to localise the vehicle accurately in position and orientation. Of course, automotive requirements like weather robustness or lighting conditions are under consideration, as well.

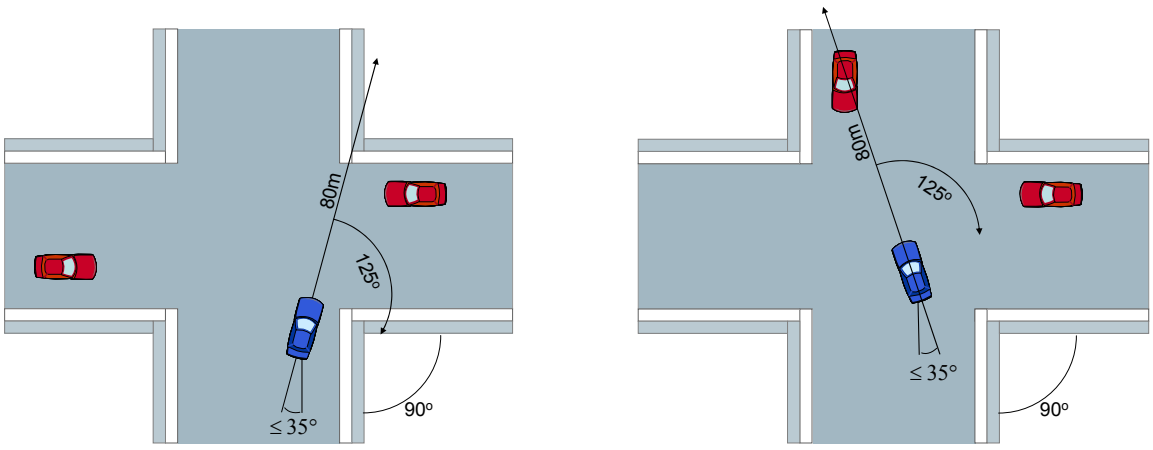

Figure 9: Field of view for turning into a road with priority (left) and for turning off a road with priority scenario (right) (not in true scale).

The sensor systems of the bottom-up approach, which will be built up by spring 2005, will be applied to the three relevant scenarios.

CONCLUSION

The proposed solution to realise the INTERSAFE System is based on challenging technical objectives. The consortium is convinced it will be able to fulfil the requirements to support the driver on intersections. The basic system with on-board sensors will provide a solution, which can be tested on selected intersections. The advanced system will provide knowledge about future needs of sensors and new opportunities to support the driver in more critical driving situations as well.

ACKNOWLEDGEMENTS

INTERSAFE is a subproject of the IP PReVENT. PReVENT is part of the 6th Framework Programme, funded by the European Commission. The partners of INTERSAFE thank the European Commission for supporting the work of this project.

The INTERSAFE consortium thanks INVENT for providing first data about accident analysis related to intersections.

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