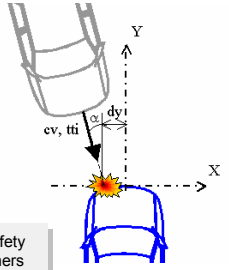
Reducing Uncertainties in Precrash-Sensing with Range Sensor Measurements

BOSCH

1. What is Precrash-Sensing?

Sensors integrated in the vehicle periphery collect information about the surroundings which is then used to enhance road safety.

In the event of an impending crash, the time to impact (tti), closing velocity (cv), location (dy) and angle (α) at impact point are included in the Crash Object Interface.



PReVENT

BOSCH contributes to the enhancement of vehicle safety and is a member of the European IP- PReVENT partners

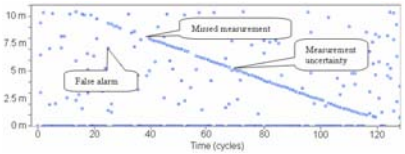
2. From the Vehicle Environment to Passive Safety

Development Issues

Vehicle environment information is included in the Measurement List which consists of distances to real objects and the following disturbances:

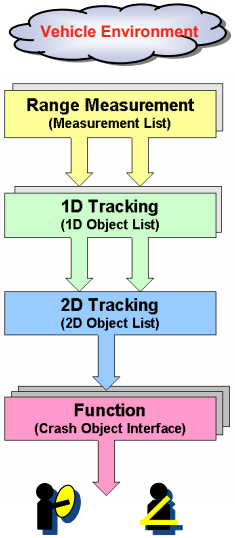
- clutter (false alarms)
- missed observations
- range uncertainty

The Measurement List



Our *object tracking* algorithms filter out these disturbances, while considering:

- relevant automotive scenarios
- timing and accuracy constraints
- available computational resources

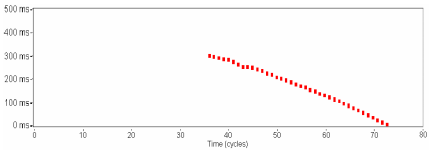


System Implementation

Recursive processing techniques such as Kalman-Filtering are of great interest because its effectiveness in terms of performance and use of resources.

Estimations of the *motion* between vehicle and objects are used to assess the level of threat. Time-to-Impact is continuously computed.

Time-to-Impact estimate



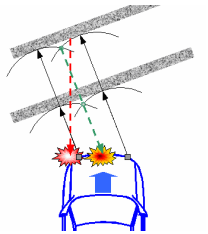
In an impending crash, information estimated about the situation at impact is provided to safety systems such as a reversible belt tensioner or an airbag.

3. The Challenge by using Range Sensors

In comparison with other technologies, range-only sensors are of great interest because of the lower cost for the system.

In addition to the sensor accuracy, system performance depends on the ability of the processing algorithms to reduce uncertainties to a minimum.

Systematic estimation error in multilateration



Algorithm design for Precrash has to deal with:

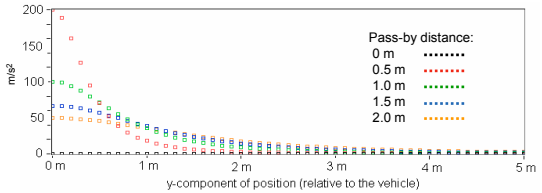
- widely varying speeds and rates of acceleration
- geometry-induced pseudoacceleration in pass-by situation
- different classes of objects (e.g. Wall, Pole)

and furthermore:

- short time available for decision-making

Not only the motion but also the shape of the object is unknown. At close distances in particular, our interpretation of object behaviour depends on our knowledge of the shape.

Geometry-induced pseudoacceleration in passing-by situations



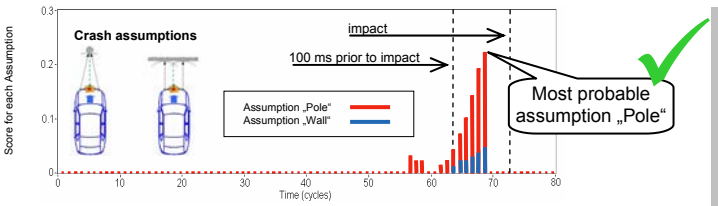
4. Advanced Situation Assessment

Multiple assumptions concerning the situation in the vehicle surroundings are sequentially tested over successive cycles, with the *most probable assumption* being accepted. Several situations are distinguished:

- elongated objects (e.g. wall, car)
- thin objects (e.g. pole, tree)

Afterwards, the situation at contact point is predicted.

Sequential test of multiple assumptions (crash against a pole)



Main Results

Initial approaches for advanced situation assessment using range-only sensors were tested. These methods provide additional shape information about the approaching object, which is relevant in order to accurately predict the impact trajectory in impending crashes.

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Authors: Jorge Sans Sangorrín, Thorsten Sohnke, Jürgen Hötzel (dept. CR/AEA)

Contact: Jorge.sanssangorrin@de.bosch.com
Thorsten.sohnke@de.bosch.com
Juergen.hoetzel@de.bosch.com

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