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Radar Based Automotive Obstacle Detection System

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Daimler Benz AG

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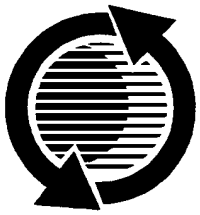

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Radar Based Automotive Obstacle Detection System

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Abstract

This paper highlights the obstacle detection system developed by the Daimler Benz group to assist the driver, particularly in dangerous traffic situations and in case of bad weather.

The area in front of the vehicle is scanned by a radar beam, and the actual traffic is analysed by signal processing software. Safety distance is calculated and displayed, and a warning is given to the driver whenever necessary. With this information, driving safety and comfort is increased while all actions to be taken still remain under driver control. Cruise control applications can be regarded as a natural system extension.

A special chapter is dedicated to vehicle test data evaluation based on a mobile video system operating in the traffic environment and data post-processing in the lab.

Effective synergy and a close co-operation of various companies resources made it possible to push this challenging project rapidly through different development stages to reach the volume pre-production phase in the near future.

1. Introduction

1.1 General motivation

In consideration of the growing demand for increased driving safety, systems for environmental surveillance have been focused with particular interest in the recent years (/1/-/13/). Despite severe initial technological and commercial restrictions the automotive industry has been supporting these activities with growing interest and medium size volume applications can now be expected in the near future.

These applications are motivated to a great extent by traffic accident statistics (Figure 1). Taking into account that frontal crash scenarios are greatly influenced by drivers reaction times it is a promising perspective to engage some sort of forward looking electronic aid.

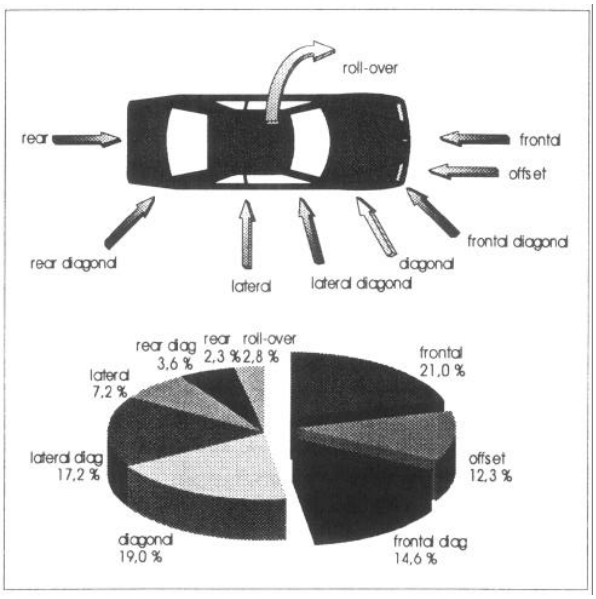

Fig. 1 Collision statistics

This would allow faster response in critical situations which often emerge from driver distraction, fatigue or inattention. Figure 2 shows that about 60 % of the rear-end collisions can be avoided when driver reaction is advanced by a lead time of about half a second.

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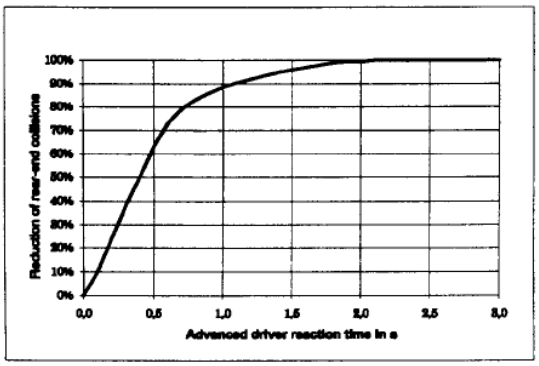

Fig. 2 Crash reduction by advanced driver reaction /14/

The ongoing discussion whether the driver should then be alarmed by visible, audible or tactile means or should perhaps be fully bypassed by automatic interaction is beyond the scope of this paper, but nevertheless deserves specific attention.

1.2 Systems for environmental surveillance and driver assistance

Table 1 gives an overview of systems which combines environmental surveillance tasks with some sort of driver assistance. They all belong to the category of autonomous systems thus not having any data connection to other traffic members, however this is a likely future scenario.

The present situation does not allow a final judgement whether one particular system will be dominant in the long run or if a combination of functions will eventually be grouped together in a common approach, joining near and short distance operation with obstacle detection and AICC. A similar uncertainty exists in the philosophy of driver alerting and data visualisation, and in the question of enhancing the driver's corrective measures in case of danger by automatic interactions to brakes and engine control is also not settled. Moreover the latter is an interesting issue with regard to product liability, especially in North America.

From a system point of view, however, development work on these subjects has already started decades ago and is characterised to date by three competing principles for physical detection: millimetre wave (radar), infrared laser and image processing (video).

System Task	Sensor technology
Obstacle warning with driver in the loop	Radar/IR-Laser/Video
Automatic collision avoidance	Radar/IR-Laser/Video
Intelligent Cruise Control (AICC) / Stop-Go	Radar/IR-Laser/Video
Blind spot and rear lane surveillance	Radar/IR-Laser/Video
Near distance warning systems (parking aids)	Ultrasonic/Radar/IR/Video

Tab. 1 Systems for environmental surveillance

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All of these rely to a high extent on sophisticated electronic sensor components in conjunction with fast digital processing capabilities. These technologies have been developed in the past with high effort, but without giving priority to the cost issues mandatory for automotive applications. It was the clear objective to introduce these technologies in defence and airborne products (including space) first. The automotive business was not of primary concern. The drastic changes in the global political climate have set free world-wide powerful capacities in high-tech companies striving now to reorientation on new markets. As automotive systems generally rely more on cost effectiveness and maximum simplicity than on absolute technological perfection, these high-tech incentives run the risk of being observed sceptically, at least when cost issues and consumer acceptance are concerned.

Therefore it must be considered a strategic advantage when all required resources are combined and co-ordinated under the common roof of a large automotive player who attaches great importance to both driving safety issues and customer satisfaction.

1.3 Daimler Benz Group synergetic co-operation programme

With the background of this scenario, the concerted actions within the Daimler-Benz group are very promising because all required resources for system development, testing and production are in-house. Combined efforts are controlled by the automotive manufacturer himself (Mercedes Benz) with a clear perspective for volume introduction and customer relevance. This relationship is shown in Figure 3.

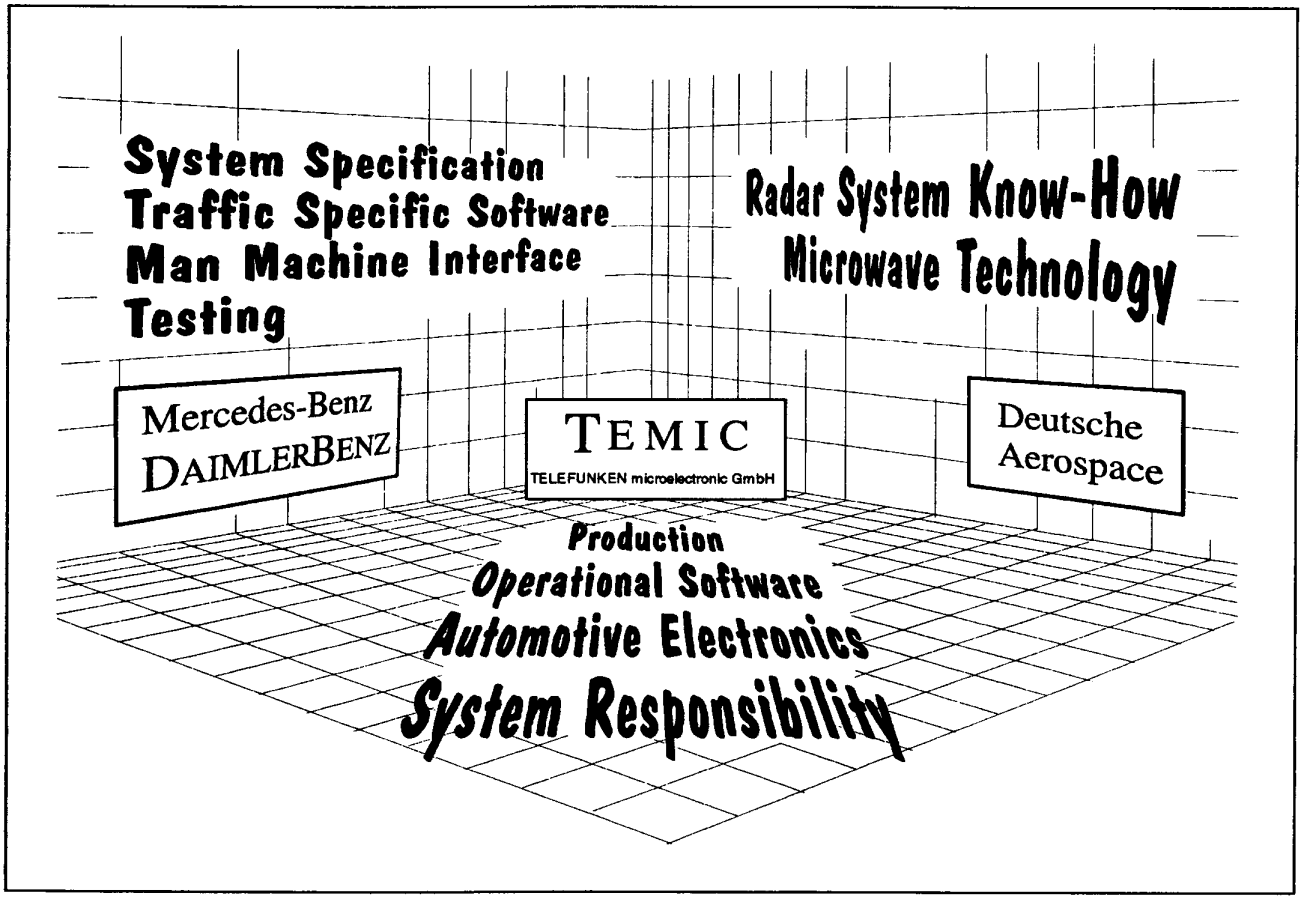

Fig. 3 Synergy of resources in the Daimler Benz group

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