Multi-Level Sensorfusion and Computer-Vision Algorithms within a Driver Assistance System for Avoiding Overtaking-Accidents

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1 Scope and State of the Art

On two-lane rural roads, there is a large number of overtaking accidents. Those cause many serious casualties and fatalities. In many cases, inaccurate assessment of the traffic situation is identified as the major cause. Hence, the development of a driver assistance concept for those scenarios is desirable.

This paper shows the approach to a surroundings sensor and data fusion system which provides this assistance function.

2 Approach, Methods and Tools

The level of information about the car's environment, which is required for an overtaking assistance, depends on the phase of the overtaking maneuver. In early stages, i.e. when the overtaking vehicle is in the situation just before the initial lane change, it is primarily necessary to get information about oncoming cars far ahead. For late stages in the scenario, i.e. when the overtaking speed is too low, dangerous situations may occur due to the fact that the gap in front of the car to be overtaken cannot be reached any more. In this case, it is necessary to calculate an evasion path, based on the perception of unoccupied space in front of the overtaking car.

A data fusion of different automotive sensors (cf. figure 1) is proposed in order to cover all parts of the overtaking scenario in the system's perception: Information about independently moving objects in front of the car is gained from a radar-device. In the short and medium range a CMOS-camera sensor is used. Two different algorithms are run on the camera's video stream: an texture-based free space detector as well as an object detection algorithm. Details of those algorithms are shown in further sections of the paper. The proposed approach fuses object information from raw rader object data and the output of the video based object detection algorithm. As a result of this mid-level fusion, there is a list of moving objects in the whole range of the targeted field of view. For the free space part, a typically appliance occupancy grid representation of the front car environment is used for shorter distances in the field of view, the area relevant for evasion maneuvers. This grid is target of the camera free-space detection and is corrected with the known objects from the object-list. Thus, a high-level grid fusion is obtained.

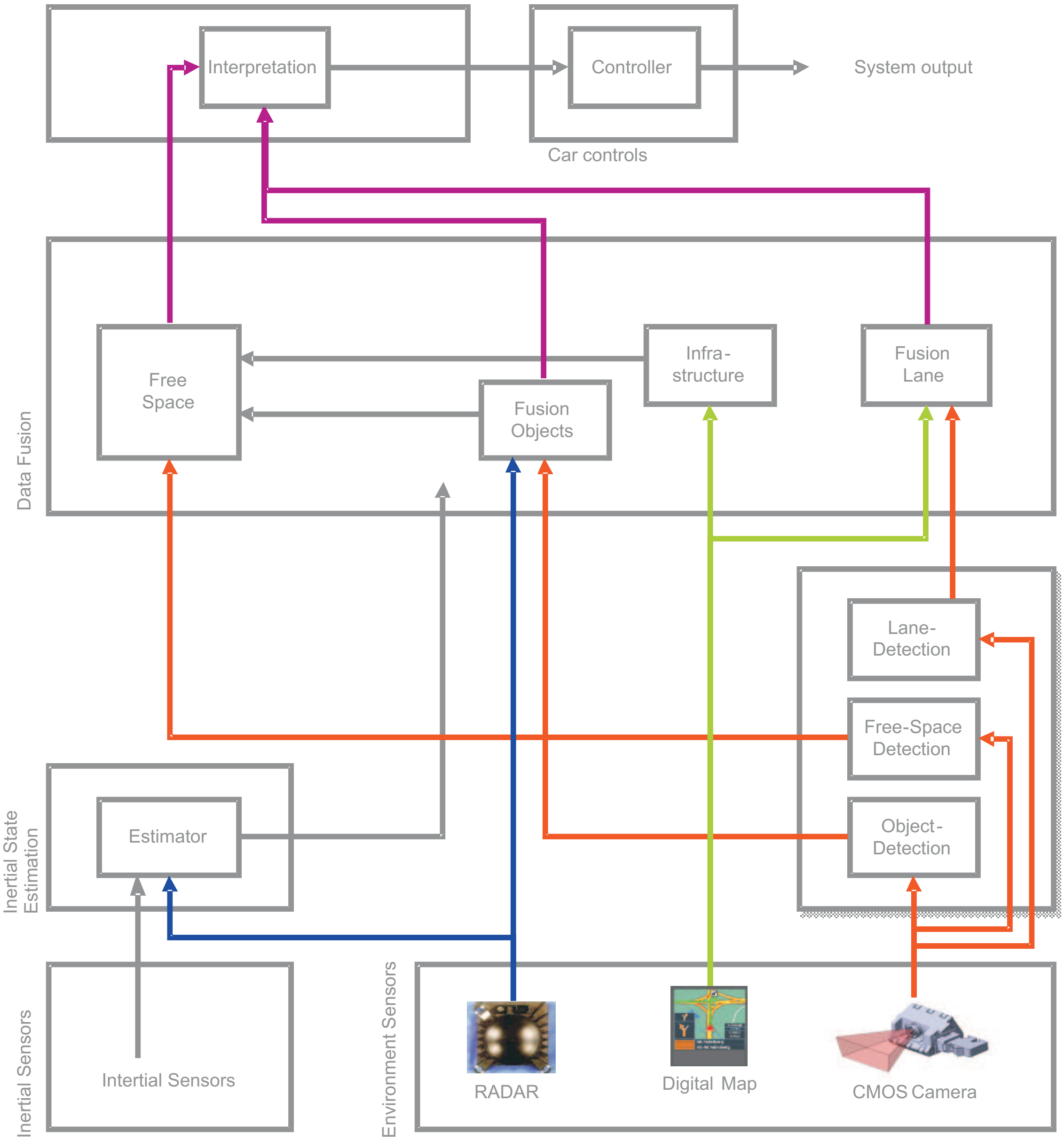

Figure 1: A flow chart showing the available sensors and their interplay

3 Results, Conclusions and their Significance

In particular, it is shown that the fusion of both sensor inputs is appropriate to fulfil the requirements. On the one hand it is possible to detect oncoming vehicles at a relativly high range with the radar device. On the other hand object detection on video frames becomes increasingly difficult for more distant cars. In close range both sensors benefit from the fusion of multiple cues. False positive detections can be filtered and video object detections allow for an improved estimation of other vehicles' widths. Experimental results on real world data which has been recorded with a typical onboard system will be given in the results section.