# Evaluation and Improvement of State-of-the-art RADAR Object Detection Networks

Deniz Braun[1], Niclas Zeller[2]

[1] Karlsruhe University of Applied Sciences
**Brde1020@h-ka.de**
[2] Karlsruhe University of Applied Sciences
**Niclas.Zeller@h-ka.de**

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## 1 Introduction

Autonomous driving has seen rapid development in recent years and is considered one of the most promising technologies that could revolutionize the way we get around. However, for a vehicle to act autonomously, it must be able to accurately perceive and interpret its surroundings [1]. This is where camera-radar fusion (CRF) systems come into play, playing a crucial role in providing accurate information about the vehicle's environment.

In the past, cameras and radar sensors were mainly used as stand-alone systems to gather information. Cameras provide high-resolution visual data and enable detailed detection of objects and their features. On the other hand, radar sensors provide information about the distance, speed, and direction of objects by emitting electromagnetic waves at near the speed of light and measuring their reflections [2].

The combination of cameras and radar sensors makes it possible to use the strengths of both technologies and balance their weaknesses. By fusing the data, accurate and comprehensive information about the vehicle environment can be generated. This is crucial for autonomous driving, as it allows the vehicle to make precise decisions and interact safely with its environment.

The importance of camera-radar fusion systems in the context of autonomous driving lies in their ability to ensure reliable perception of the environment in the optimum case. By combining the advantages of cameras and radar sensors, the system can accurately detect and track obstacles, pedestrians, traffic signs and other vehicles. It enables improved object detection, classification, and localization, even under suboptimal weather conditions or in situations with limited visibility [3].

In addition, camera-radar fusion systems help to increase safety in autonomous driving. They minimize the risk of misinterpretation and provide a robust basis for autonomous vehicle decision making. By providing a comprehensive perception of the vehicle's environment, they help detect potentially dangerous situations at an early stage and react accordingly.

Overall, camera-radar fusion systems play a crucial role in the further development of autonomous driving. They help to improve the performance of vehicle perception, enhance safety, or ultimately promote the acceptance of autonomous vehicles in society. Continuous further development and optimization of these fusion systems are therefore of great importance in making the vision of a fully autonomous vehicle fleet a reality.

## 2 Contents.

In this comprehensive scientific paper, we present a detailed investigation and comprehensive analysis of several radar object detection networks that represent the current state of the art. [4][5][6]

In doing so, radar data will be analyzed using a CNN to obtain precise and reliable information about detected objects.

This approach needs to be further explored in the following to make a qualitative statement about its advantage over radar detection through conventional and well researched signal processing.

In the course of our work, we will thoroughly analyze and evaluate the strengths and weaknesses of these networks. We will pay particular attention to a specific framework, which we will study intensively and make several modifications to optimize the existing pipeline in order to achieve significantly increased object detection accuracy.

Our overall goal is to define a unified data format for the neural network, which will serve as a fundamental basis for future research.

Furthermore, we would like to create the possibility to create and use our own camera radar data sets at the Karlsruhe University of Applied Sciences.

Through this approach, we aim to comprehensively improve the integration of camera-radar-fusion systems, thereby significantly increasing the overall performance of radar object detection.

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