

Integrated Design and Prototyping of a 77 GHz Medium Range Radar Into a Car Rear Lamp

Mattia Caffa

Supervisor: Prof. Riccardo Maggiore

Thesis Summary

The continuing trend towards an increase in the frequency used for automotive radar applications has allowed an overall increase in performance and a reduction of the dimensions of this type of device. This last feature could permit new ways of installation with respect to the standards adopted today by car manufacturers (behind bumpers or in car bodies). Instead of considering the radar as an external device to be installed on the car it could be part of the initial project and included into the design process of a plug-in part.

In this thesis, the integrated design and prototyping of 77 GHz automotive radar into a modern car rear lamp is presented.

The radar Printed Circuit Board (PCB) was designed to fit into the lamp without affecting the external look; the optimization of the material thickness of the radar cover and temperature tests have been performed on the system.

The embedded radar processing was implemented on a monolithic chip to perform target tracking and the main processing steps are reported.

The results obtained from tests in controlled environments and on the road in traffic scenarios show that including the radar into the design of a lamp from the beginning is a feasible solution. This approach brings some advantages such as improved placing and connections, an undisturbed view, better protection from disturbances and accidents, etc., and provides more customized solutions for car makers.

In Chapter 1 an overview of Advanced Driver-Assistance System (ADAS), automotive radar fundamentals, state of the art, and motivations for the project are presented.

In Chapter 2 the radar housing and the hardware design choices for the implementation of the integrated radar prototype into the rear lamp are discussed.

In Chapter 3 the description of the fully developed radar firmware and the algorithm solutions for different critical points of the applications is presented.

In Chapter 4 some of the results obtained in the laboratory, during the tests carried out in the open field, and during the tests carried out on the road in traffic scenario are shown. The results obtained during the test campaign carried out with the radar installed on the host car are also presented.

In Chapter 5 a proposal for more effective modulations for automotive radar waveforms and relative experimental results are presented.