PhD THESIS ABSTRACT

"CONTRIBUTIONS TO IMPROVE THE METHODOLOGY FOR DEVELOPMENT AND TESTING OF PROXIMITY SENSORS"

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The paper falls within the area of signal processing aiming to developing methods for processing signals in radio proximity sensors with continuous wave transmission for extracting information of interest, most often target distance and speed.

Triggered by defense related research projects, the exploration is applicable in other security areas as well as industrial, automotive and medical fields. Along with theoretical findings this paper presents some of the practical research results of doctoral student who has been involved in various projects, some of them being directly related to the thesis.

Considering the state of the art and achievements in the field, it is searching for new methods of signal processing for various use cases sensors. These methods can contribute to the design and testing of proximity sensors with continuous wave transmission. For this purpose it is seeking for new modulation waveforms in the transmitted signal and new processing algorithms to exploit the characteristics of the received signal.

Chapter 1 presents some general aspects of proximity sensors by introducing the block diagram and general operation of the radio proximity sensor as short-range radar (SRR).

Chapter 2 examines the detection problem in RDS offering several ways to maximize the probability of detection and probability of false alarm reduction at system level.

Starting with Chapter 3 methods for determining the parameters of targets in continuous wave radar are shown. Particularly the Chapter 3 analyzes the behavior of the continuous wave sensor without modulation in the proximity of surface targets. Here it is provided a new method of estimating the distance based solely on Doppler signal amplitude variation.

Section 4 describes the operation of the continuous wave frequency-modulated sensors and analyzes the signal characteristics for different types of modulation waveforms. It also provides several methods for extracting the target parameters of signal parameters. On this basis, signal processing methods for linear frequency modulated continuous wave sensors are analyzed in Chapter 5.

Chapter 6 explores the possibilities of getting information about the target parameters with better accuracy in a short time without having to extend the transmitted bandwidth. It is achieved a more accurate and unambiguous localization of the target in a single chirp period by using a complex modulation of the transmitted signal, e.g. frequency shift keying combined with linear frequency modulation.

Chapter 7 outlines possibilities for testing proximity sensors and propose a testing method called white-box testing that takes into account the internal operation of the sensor. The method is a generalization of the testing principle for continuous wave Doppler sensors without modulation of transmitted signal, principle introduced in Chapter 3.

Chapter 8 deals with a relatively new use of SRR in the medical field to monitor vital signs such as heartbeat and breathing rate. A separation algorithm is developed based selection of Gabor transform coefficients of interest from the received signal from the Doppler sensor.

The paper concludes with a review of the findings, listing of the original contributions, a list of peer-reviewed publications during the doctoral preparation, and bibliography consulted throughout the process of scientific research.