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Master's Thesis

Object Classification based on Micro-Doppler Signatures

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Munich, 26-10-2017

Faculty:	Electro- und Informationstechnik
Matriculation Number:	03640751
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Beginning of the Thesis:	01-10-2017
End of the Thesis:	26-10-2017

Sperrvermerk

Declaration of Authorship

Dedicated to..

Contents

1. Introduction

2. Radar Fundamentals

Due two its wide spectrum of applications, radars systems have become important measurement instruments since the last century.

This introductory chapter is organized as follows. Section 2.1 explains the basic terminology used in the scientific community of radars. Section 2.2 presents a simple signal model used to explain the signal processing steps that take place to estimate the range (2.4) and doppler-range (2.5) of targets

2.1. Radar Definitions

Range

$$R = \frac{c_0 \Delta t}{2} \tag{2.1}$$

Pulse repetition interval (PRI)

$$f_r = \frac{1}{T} \tag{2.2}$$

Unambiguous range R_u

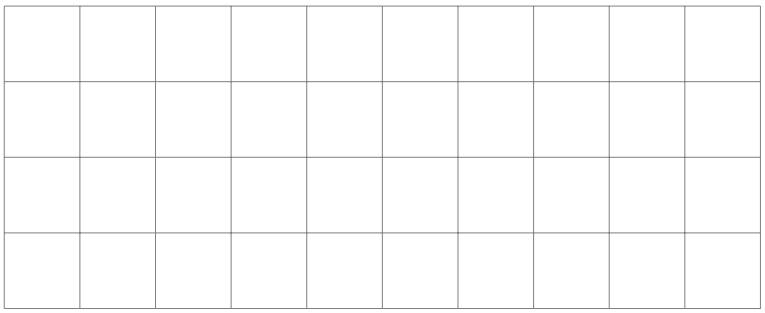

Figure 2.1.: Illustrating the unambiguous range

2.2. Signal Model

2.3. Detection Theory

2.4. Ranging

2.5. Doppler Ranging

2.6. MIMO Radars

2.6.1. The Virtual Array Concept

2.6.2. Space-Time Processing

2.6.3. Azimuth-Range Detection

3. Multi-Target Tracking

3.1. The Kalman Filter

3.2. Gating Techniques

3.3. The Assignment Problem

3.3.1. NN-approach

3.3.2. PDA-approach

3.3.3. JPDA-approach

3.4. Track Life Stages

3.5. Maneuver Detection and Adaptive Filtering

4. Micro-Doppler Signatures

5. Classification

6. Results

7. Summary and Outlook

A. Symbols and Constants

General

$\oint$	Integration over a closed curve

Latin alphabet

R	Range
R_u	Unambiguous Range

Greek alphabet

ΔT	Delay

Constants

c_0	=	299729458 m/s

B. Mathematical Formulas

Bibliography