

MECHATRONICS

BOOK SERIES

SYSTEM DESIGN AND SIGNAL PROCESSING

VOLUME 2

Editors

Md. Raisuddin Khan

Md. Mozasser Rahman

Muhammad Mahbubur Rashid

Shahrul Na'im Sidek



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CHAPTER 13

PRINCIPLES OF FMCW RADAR SIGNAL PROCESSING

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13.1 Introduction

Frequency Modulated Continuous Wave (FMCW) radar is a short range measuring radar system. During a normal operation this radar system transmits a known stable frequency continuous wave radio energy that is modulated by a triangular modulation signal so that the transmitted signal varies gradually along a certain time period. Variations of modulation such as sine, sawtooth, etc. are possible. The triangle modulation is used in FMCW radars when both range and velocity are to obtain. It is known that the received waveform is a delayed replica of the transmitted waveform, and the time delay is a measure of the range.

When operating the radar in FMCW mode the transmitted modulation waveforms are mixed with the delayed replicas (coming from various targets) via the mixer to produce a beat signal, and then analyzed by an FFT algorithm. The beat signals are passed through an analog to digital converter (ADC) and digital processing is performed on the result. In this work the principle of FMCW radar signal processing will be demonstrated on the example of INDERA (the first maritime radar made in Indonesia).

INDERA is a FMCW maritime radar that is designed to be installed and operated in a ship [1]. During its normal operation INDERA is continuously transmitting modulated electromagnetic waves to detect targets in the surrounding area. Since the transmitted signal is a continuous wave, it needs only a very small power to transmit it. Consequently, the power level of signals arrived on the Rx-antenna is also very low. Therefore, a reliable signal processing plays a significant role in distinguishing between reflected signals coming from real targets and from other (mostly) unwanted sources.

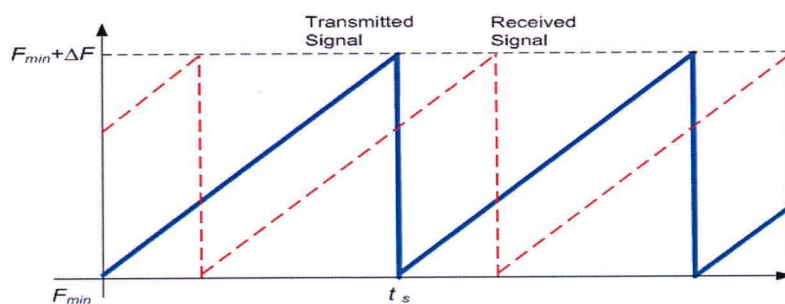


Fig. 13.1: Sawtooth shaped FMCW radar signal.