A DVB-T Based Passive Radar Using USRP Board

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Abstract

In this work, a single channel passive radar based on DVB-T illumination is discussed. A Universal Software Radio Peripheral (USRP) platform is used to realize the data acquisition stage. The reference signal is reconstructed using channel estimation methods. Clean algorithm, Wiener and adaptive filtering are then applied for static clutter rejection.

Introduction

Passive radar systems exploit illuminators of opportunity radiation for target detection. Generally, the architecture of a passive radar includes two channels, one to receive the direct path signal and the other to receive target echo [1]. The present paper presents a passive radar system using only one channel receiving the target echo. The reference signal reconstruction is made possible thanks to the DVB-T modulation which permits the recovery of the original transmitted signal using channel estimation methods. Figure 1 shows the different stages of the proposed system.

Receiver architecture

The receiver consists in a USRP board that allows acquisition of DVB-T signals with carrier frequency equal to 482 MHz (proximate transmitter), with a sampling frequency of 16 MHz. The USRP board is USB-connected to a computer, where I/Q data recording takes place.

Reference signal reconstruction

The DVB-T standard is based on the orthogonal frequency-division multiplexing (OFDM) which uses orthogonal subcarriers, i.e., data and pilot subcarriers [2]. A DVB-T receiving chain is implemented to perform the received signal demodulation. Channel estimation process, which is based on pilot subcarriers, is then used to estimate the transmitted symbols [3]. The resulting symbols are modulated to regenerate the transmitted signal and the channel effects are inserted to obtain the reference signal.

Clutter rejection and target echo extraction

In the present work, the performances of three static clutter rejection methods are compared: Wiener filter, adaptive filtering [4] and the CLEAN algorithm which is applied directly on the range-Doppler diagram, where the static clutter is eliminated sequentially [5]. Their performances are compared in terms of static clutter rejection efficiency, i.e., zero-Doppler echoes removal and low velocity targets detection possibility.

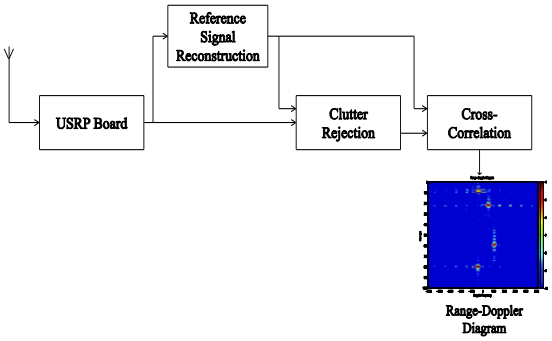

Figure 1: Single channel DVB-T based passive radar

Future work

In the future, data obtained via ADS-B, including exact position and velocity of the airplanes overflying the surveillance area, will be used for validating the detection results.

References

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