Strong direct-path interference removal for DVB-T based passive radars

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Abstract

In this work, the direct-path interference (DPI) and the static clutter (SC) in DVB-T based passive radars is discussed and more specifically the case of strong DPI. The classical approach of using the received reference signal or even the technique of decoding and recoding the reference signal exhibit low performances for DPI removal from the surveillance signal with a channel that differs of that of the reference signal. A DPI suppression scheme employing the decoding-recoding of the DVB-T signal and modifying the reference signal is proposed and applied on real measurements.

Introduction

Passive radar systems exploit the radiation of illuminators of opportunity (GSM, FM, DVB-T …) for target detection. The architecture of passive radars includes two channels, one to receive the direct path signal (reference signal) and the other to receive target echo (surveillance signal) [1]. Usually, the received surveillance signal comprises strong DPI many orders of magnitude higher than the target echo, thus a process for DPI and static clutter removal is required. This work deals with a real-world case where the surveillance signal is characterized by a strong DPI with propagation channel different from the reference signal channel creating a mismatch between the signals.

Proposed scheme

The mismatch between reference and surveillance signals reduces the efficiency of the DPI-SC suppression process. To overcome the mismatch issue, we propose to adapt the reference signal to the surveillance signal. The exact transmitted QAM symbols are estimated by decoding the reference signal and an estimate of the surveillance signal channel is obtained by calculating the pilot subcarriers response [2]. The adapted reference signal is obtained by recoding the estimated QAM symbols after application of the estimated channel. The resulting reference signal is then used for the DPI and static clutter removal using an LMS adaptive filter [3].

Processing results

Two B100 Universal Software Radio Peripheral (USRP) boards are used for signals acquisition. A nearby DVB-T transmitter with central carrier frequency of 482 MHz is selected and sampled with a frequency of 8 MHz. Figure 1 shows the zero-range section of the cross-ambiguity function calculated before and after the DPI-SC removal. Three reference signal varieties are used: received signal, reconstructed signal and the one generated by the proposed method (channel matching). The comparison is based on the efficiency of the DPI suppression, thus the reduction of the principal lobe in the zero-range section is used as a criterion. Results show that principal lobe reduction for the proposed method is the highest (25 dB) comparing to the use of the reconstructed signal (15 dB) and the received signal (10 dB).

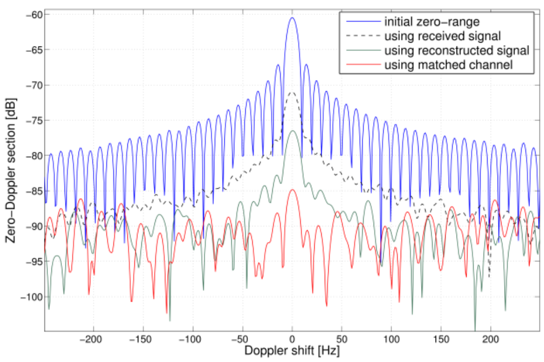

Figure 1: Processing Results.

Future work

In the future, the DPI-SC surveillance signal will be used altogether with the matched reference signal to perform passive detections.

References

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