A NEW CFAR DETECTOR WITH GREATEST OPTION

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Abstract This paper presents a new CFAR detector based on Ordered Statistics (OS) and Cell-Averaging (CA) forming local estimates, and using Greatest-Of selection (GO) to form clutter power level estimate $Z$ in test cell(OSCAGO). Under the Swerling II assumption, the analytic expressions of $P_{fa}$, $P_d$ and ADT of this detector are derived, its detection performance in homogeneous background and in strong interfering targets environment are analyzed and compared it with OS, GOSGO detectors. The results show that the detection performance of OSCAGO in homogeneous background and in multiple-target situations are obviously better than those of OS and GOSGO. When the number of interfering targets is equal to certain value, the CFAR loss of OSCAGO is about 3dB less than that of GOSGO.

Key words Radar; Detection; CFAR; Signal processing

I. Introduction

Radar signal detection is always done in clutter background. In automatic radar detection system, for a fixed detection threshold, if the clutter power level increases several dB, false alarm rate will sharply increase. So it requires that the detector possesses Constant False Alarm Rate (CFAR) performance. The technique is called CFAR technique. In the literature a number of CFAR methods are described. Where, Cell-Average(CA)\cite{1}, Greatest-Of selection(GO)\cite{2}, Smallest Option(SO)\cite{3} are more representative, and are thought to be classic CFAR methods. However, they can not properly be adaptive to the variety in space and time of the strength of clutter in background. The reason lies in that these methods can not effectively distinguish different clutter regions. Therefore, the ascent of $P_{fa}$ (false alarm probability) and the covering phenomenon\cite{4,5} could happen in clutter edge and multiple target situations. In order to solve this problem, Rohling\cite{6} proposed the Ordered Statistics (OS-CFAR) method. It has better detection performance in both homogeneous background and multiple target situations. The weakness of OS is the long time of sorting process. In order to overcome it, in Ref.\cite{7} two modified OS detectors were proposed. They are OSGO and OSSO. In Ref.\cite{8,9} we proposed Generalized OSGO(GOSGO) CFAR detector and a new automatic censoring technique. In multiple target situations, when the number of interfering targets attains the greatest number allowed, the GOSGO get better detec-
tion performance than OS. This paper presents a new CFAR detector based on Ordered Statistics (OS) and Cell-Averaging (CA) forming local estimates, and using Greatest-Of selection (GO) to form clutter power level estimate $Z$ in test cell (OSCAGO). The detector also applies the automatic censoring technique in Refs. [8,9]. Under the Swerling II assumption, we derive the analytic expressions of $P_{fa}$, $P_d$ (detection probability) and the measure ADT (Average Decision Threshold), analyze the detection performance of OSCAGO-CFAR in homogeneous background and strong interfering target situations, and compare it with OS, GOSGO CFARs.

II. Detection Principle and Basic Mathematical Model

The block diagram of OSCAGO detector is shown in Fig.1. The length of reference window is $R = M + N$, where $M$ and $N$ are the lengths of leading and lagging reference windows, respectively. $X$ and $W$ are respectively the local estimates from the leading and lagging reference windows. The adaptive decision rule is

$$H_1 \quad \quad V > T Z$$
$$H_0 \quad \quad V < T Z$$

(1)

where, $H_1$ represents the target presence, $H_0$ stands for no target. $Z$ is the clutter power level estimate. $T$ is a scale factor, $V$ is the signal under detection procedure. The stop shift controller and shift register of the reference cells in Fig.1 constitute the automatic censoring function [8,9].

We assume that the receiver noise is Gauss distributed, the detection envelope is Raleigh distributed. And we only consider the single pulse square-law detection in this paper. So