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NEW ANTI-ARM TECHNIQUE BY USING RANDOM PHASE AND AMPLITUDE ACTIVE DECOYS

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Abstract—This paper presents a new method to counter Anti Radiation Missile (ARM) threats, which is effective against advanced ARM. By using random phase and amplitude active decoys in the specified optimum positions and network implementation we show that ARM threats will be removed profoundly. Also, iterative methods are presented to cancel the internal interference effects in the proposed structure.

1. INTRODUCTION

Radar and its related researches have gone through a history for more than a century. In recent years, new techniques are applied in various radar systems [1–10]. The threat of electronic jamming to military radar is well known. But in the event of future wars, there are two serious threats to radar: stealth and antiradar missiles (ARM). Stealth is similar to electronic jamming, that is a "soft" opposing technique which makes radar vulnerable but ARM is a "hard" opposing technique which destroys radar.

Since the emergence of this threat in Vietnam battlefield in 1965, Anti Radar Missiles have been rapidly developed, especially after the seventies with the advent of SHRIKE and other types of new generation of ARM such as AGM-88E and ALARM which are fatal threats to the radar. Hence, countermeasure techniques against ARM become an urgent matter at present and lots of the methods are presented in literature [11–13]. Active decoys are the only reasonable option for the radar to counter ARM threats [14–17]. These decoys are, in general, designed to radiate synchronously pulse-by-pulse with the radar, covering both leading and trailing edges of the radar pulses. In this paper, we propose a new decoy structure which introduces better performance while reducing production cost by transmitting random phase and amplitude signals. The problem is that if the number of decoys increases or they are used in a network system the interference caused by these transmitters (radar and decoy) reduces the detection ability of the main radars.

In section two, we review some aspects and parameters of ARM homing. According to these parameters, in section three we find the optimum distance between decoys. The proposed method is introduced in section four and iterative methods for reducing the interference is discussed in section five. Finally, we summarize our results in section six.

2. ARM GUIDANCE HEAD: TRACKING OF THE DECOYS OR RADAR NETWORK

Before tracking the target, ARM locks on frequency, direction of arrival and sometimes repetition frequency of target signal through gate circuits. Then the guidance head tracks the source of the power until hitting it. Angle tracking for the desired target is a common radar problem. Statistics of the measured angle can vary significantly for the guidance head of the ARM. A commonly used expression for the apparent angle of two point-sources in the same resolution cell (Figure 1) is given in the following equation [18]:

$$\theta = \left(a^2 + a\cos\vartheta\right) / \left(1 + a^2 + 2a\cos\vartheta\right) \tag{1}$$

where the measured angle θ is a function of the amplitude ratio "a" and the relative phase ϑ between the two radars. Here the angle separation of the two radars is normalized to unity in this equation. Typically this equation is used to illustrate the nature of target glint and how the apparent measured angle from this glint can appear outside of the physical extent of the two sources. It was shown by Dunn and Howard [20] that this equation represents the phase front distortion of the returning signal for the dual source, and is independent of the radar system parameters.

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