IMPLEMENTATION OF MODEL RADAR TARGET DIRECTION IDENTIFIER

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ABSTRACT

RADARs with fixed carrier frequency profile are vulnerable to jamming. Changing the carrier frequency of the RADAR by sensing the channel condition dynamically. Frequency agility is one of the best techniques used for anti jamming. Self adaptive frequency agility analyze jamming spectrum real time so that to control the radar transmission frequency. Frequency agility refers to the radar's ability to rapidly change its operating frequency in a pseudo-random fashion to maintain a narrow instantaneous bandwidth over a wide operating bandwidth. The total architecture was implemented on LPC2148 ARM7 board with hardware description language and the results are seen in Chip Scope pro analyzer.

Keywords: RADAR, frequency agility, Self adaptive frequency, bandwidth, LPC2148.

1. INTRODUCTION

The term “radar” is generally understood by means of which short electromagnetic waves are used to detect the distant objects and to determine their location and movement of an object. The term RADAR is an acronym from RAdio Detection And Ranging. Jamming is a technique which is usually to make radar non functional. Radar jamming and deception is the intentional emission of radio frequency signals to interfere the operation of a radar by sending to the receiver with noise or false information. There are different type of technology can be applied to modern pulse radar to meet diversified jamming; The echo signal that comes from the target are to weaken interference signals in order to ensure the radar works properly to the maximum extent. There are so many anti-jamming technologies; frequency selection is one of the best technique. The common frequency selection method includes manual frequency modulation, frequency agility, frequency diversity, spread spectrum technology, etc. In this paper the anti –jamming [1, 3] technique used is frequency agility. Frequency agility [8] refers to the radar’s to rapidly change its operating frequency in a pseudo-random fashion to maintain a narrow instantaneous bandwidth over a wide range operating bandwidth. Frequency agility[7] forces the jamming effort to spread its power over the operating bandwidth of the radar (even through the radar is only using a very narrow instantaneous bandwidth at any one point in time). Frequency agility reduces jammer to signal ratio at, therefore, the effectiveness of the jamming effort. Without agility, the jammer concentrates all of its power into the radar bandwidth. A more advanced form of frequency agility is called look-ahead electronic protection (EP). Rather than using a random approach to changing frequency, look-ahead agility selects the next operating frequency and checks to see that it is clear of jamming. If it is clear, that frequency is used. If not, another selection and check is be made. Look-ahead agility further complicates the jammer's task.

2. FREQUENCY AGILE RADAR

2.1 Radar Transmission

Radar is a sensor; its purpose is to provide the estimation of certain characteristics of its surroundings area of interest to a user, most commonly the presence, position, and motion of such target as aircraft, ships, or other vehicles in its vicinity. Radar operates by transmitting electromagnetic wave energy [2,4] into the surroundings and detecting energy reflected by objects (target). If a narrow beam of energy is transmitted by the radar directive antenna, the direction from which reflections comes and hence the distance of the object may be estimated. The distance of the reflecting object is estimated by measuring the period between the transmission of the radar pulse and reception of the echo pulse. In most the radar applications this period will be very short since electromagnetic energy is same as the velocity of light. In this paper by using the DDS core, we are generating the radar transmitting signal as cosine signal. Where ever the pulse radar is present for that particular time period only the cosine wave signal is generated.

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2.2 Jammer Section

Radar jamming refers to radio frequency signals originating from sources outside the radar, transmitting in the radar's frequency and thereby masking targets of interest. Jamming may be intentional, as with an electronic warfare (EW) tactic, or unintentional, as with friendly forces operating equipment that transmits using the same frequency range. Jamming is considered an active interference source, since it is initiated by elements outside the radar and in general unrelated to the radar signals.

Jamming is problematic to radar since the jamming signal only needs to travel one-way (from the jammer to the radar receiver) whereas the radar echoes travel two-ways (radar-target-radar) and are therefore significantly reduced in power by the time they return to the radar receiver [2]. Jammers therefore can be much less powerful than their jammed radars and still effectively mask targets along the line of sight from the jammer to the radar. The jammer section will generate one of the different types of noises and that noise signal will be added with the radar signal. Here we are generating the different noises with different conditions. The two types of noises are the wide band noise and the narrow band noise. Here we take a jamming signal selector with two bit to generate of the four different combinations of noises from the jamming section. To the jammer noise by default we are adding the additive noise to the radar transmitting signal.

Table 1: Jammer selection lines

<table>
<thead>
<tr>
<th>Selection line</th>
<th>output</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>No Jamming</td>
</tr>
<tr>
<td>01</td>
<td>Only Narrow band Jamming</td>
</tr>
<tr>
<td>10</td>
<td>Only wide band Jamming</td>
</tr>
<tr>
<td>11</td>
<td>Both narrow band and wide band jamming</td>
</tr>
</tbody>
</table>

2.3 Target Simulator

In target simulator the radar signal and jamming signal combined signal will detect the target distance and the cross section area of the target. The echo signal will move to the radar receiver. As the noise is more than that of original signal frequency, the noise over comes the echo signal from the target, so the radar did not detect of the Target. The echo signal will move to the radar receiver. In the radar receiver the JATS will be processed. So we have to shift frequency of the radar signal instantaneously according to the jamming frequency. The frequency agility can be done by the JATS. It can shift the frequency of the radar signal.
2.4 Jamming Analysis And Transmission Section (JATS)

The echo signal coming from the target is moves to the radar receiver. In the radar receiver we have the JATS. In JATS the echo signal will processed by the FFT algorithm and find the magnitude spectrum from it will select the minimum frequency value and it shifts the radar signal to that minimum frequency. From this the radar signal can overcomes the jamming signal. Magnitude calculation allows you to view these complex valued signals as either their real and quadrature (also known as imaginary) components separately, or by a magnitude and phase representation. You may switch between these two representations at any point. Mathematically switching between the two representations for a given complex value can be expressed as

\[ |X| = \sqrt{X_r^2 + X_i^2} \quad \text{and} \quad \angle X = \tan^{-1}\left(\frac{X_i}{X_r}\right) \]

or equivalently,

\[ X_r = |X| \cos(\angle X) \quad \text{and} \quad X_i = |X| \sin(\angle X) \]

3. SIMULATION RESULTS

Fig. 3, which contains real data captured on models, in this figure, the radar pulse is the input, whenever the radar pulse is present for that particular time period only the radar_sig is generated. The channel_out is the output signal, the radar_sig is transmitted and hit the target and the echo signal is generated and return to the radar receiver. channel_out is the combination of radar_sig with noise and jammer signal.
4. RESULTS

5. CONCLUSION

Anti-jamming is a major issue that must be resolved on searching radar. In this paper, the radar analysis and transmission selection module is performed using ultrasonic transducers modules under fixed frequency mode and frequency diversity mode, detailed steps is discussed, the key steps are considered, and the function is applied to LPC2148 ARM7 board. The frequency analysis result displays on the monitor and control terminal, which is clear at a glance. During practical application, this module acquires satisfactory real time Radar effects.

REFERENCES