ABSTRACT

Pulse compression methods are used in the pulsed radar to overcome the problems between the parameters of range and resolution. Pulse compression is a technique of transmitting pulses with long durations for large range detection capability and then in the receiver will compress the pulse to short duration for high range resolution capability. The matched filter method is used for pulse compression to achieve high Signal to Noise Ratio (SNR) with the short pulse duration. The filter performs a correlation between the transmitted and the received pulses.

Waveform design of radar is an important part for radar designer. Linear Frequency Modulation (LFM) is a waveform type which is commonly used in current radar systems because of its simplicity and doppler tolerant. However, LFM has a drawback in high sidelobe level, the matched-filtered response of this waveform has a sidelobe level about -13dB to the peak of the main lobe at the receiver. The high Peak Sidelobe Level (PSL) will decrease the parameter of radar detectability, especially on the weak echoes. LFM with windowing function such as Hamming, Kaiser and Chebyshev can suppress the PSL until less than -34dB, but the level of mainlobe decreases about -5dB until -7dB, it will reduce the level of SNR.

Non Linear Frequency Modulation (NLFM) is another method that can suppress the peak sidelobe level without additional of windowing function. NLFM didn't require any weighting function because they have inbuilt one. NLFM has variable frequency deviation function because it has relation between frequency and time of the signals which is not linear so that it is possible to suppress the PSL. This thesis has been analyzed the characteristic of various NLFM waveforms: NLFM TSPW+, NLFM TSPW-, NLFM S+, NLFM S-, NLFM Curve+, NLFM Curve- and NLFM Taylor. Analysis of NLFM waveform consists of three aspects i.e. analysis of pulse compression performance, analysis of background noise and analysis of Doppler effect. And then we have done simulation and comparison for application of surveillance radar using LFM and NLFM.

The result of characteristic of some NLFM waveform is divided into two groups, that is NLFM+ consist of NLFM TSPW+, NLFM S+ and NLFM Taylor while NLFM- consist of NLFM TSPW-, NLFM S- and NLFM Curve+/-. The PSL can be suppressed with NLFM+ where NLFM Taylor has the lowest for PSL. While the Pulse Compression Ratio (PCR) can be enhanced with NLFM- where the NLFM Curve+/- has the highest for PCR. The moving of a target is the cause of Doppler frequency and time dilation. When the speed of a target is increased, the PSL would be increased and then Mainlobe Level (MLL) would be decreased, it occurs in all NLFM waveform. The changing of AWGN noise in the system would be

influence to parameter of PSL. The increasing of AWGN noise would increase the PSL at all NLFM waveform and vice versa. The method of NLFM is better than LFM for detectability and resolution in the radar surveillance applications.

Keywords: Pulse Compression, LFM, NLFM, PSL, PCR, MLL, Doppler Frequency, Time Dilation