SUMMARY OF Ph.D. DISSERTATION

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Title

Design of Adaptive Clutter Suppression Filters in Radar Systems

Abstract

In radar systems that detect the object by measuring the reflection echo from it, it is demanded to suppress unwanted echo called clutter for target detection. Especially, it is very difficult to maintain high clutter suppression performance for moving and bimodal clutters in search radar systems.

In this study, novel AMTI (Adaptive Moving Target Indicator) systems to suppress such clutter adaptively are proposed, and effective results are shown. First of all, adaptive filters are improved by introducing adjustment algorithm of filter coefficients and novel estimation method of the center frequency of clutter utilizing median filters. These improvements make AMTI system to attain higher clutter suppression performance. Next, the methods of variable coefficient filter design and its filter order selection are introduced in staggered PRF (Pulse Repetition Frequency) radar system with variable pulse repetition interval, and its effectiveness is demonstrated.

Chapter 1 outlines previous studies about AMTI systems as a background of this study.

Chapter 2 describes an AMTI system which can reduce remaining clutter caused by adaptation errors of notch filter for clutter rejection. In the proposed AMTI mechanism, the magnitude of the filter coefficient remains constant and its angle is adjusted to the estimated center frequency of the clutter. The alternate AMTI maintaining the clutter suppression performance by introducing median filters is also proposed.

In Chapter 3, an AMTI using burst-averaging technique is described, which extends capability of the AMTI described in Chapter 2. It is shown that the estimation accuracy of the center frequency of the clutter and the clutter suppression performance are improved utilizing the received signals obtained by beam scanning from the same direction.

Chapter 4 describes an AMTI with variable coefficients coping with staggered PRF radar system which is known as the method for improving target detection performance. The clutter suppression filter capable of decreasing computational load while maintaining the clutter suppression performance is proposed and its effectiveness is proved.

In Chapter 5, AMTI system described in Chapter 4 is extended to the clutter suppression system utilizing a small number of received signals effectively. Namely, the clutter suppression filter consists of cascade connection of first-order filters whose total order is automatically controlled by comparing the power ratio of the input and output signal at each first-order filter. As a result, the number of useful signals processed by the filter increases.

Chapter 6 concludes and summarizes the results of this study.