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A REVIEW ON SYNTHETIC APERTURE RADAR

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***Abstract:** In the modern age, High-resolution radar images can be achieved by employing SAR technique. It is well known that SAR can provide several times better image resolution than conventional radars. The exploration for efficient image denoising methods still remains a valid challenge for researchers. Despite the difficulty of the recently proposed methods, mostly of the algorithms have not yet attained a pleasing level of applicability; each algorithm has its assumptions, advantages, and limitations. This paper presents a review of synthetic aperture radar. Behind a brief introduction in our work we are especially targeting the noise called backscattered noise in SAR terminology which causes the appearance of speckle Potential future work in the area of air flight navigation, mapping Weather Monitoring & during natural disaster like earth quake. The SAR having the capability, to make human visibility beyond optical vision, is also discussed.*

***Keywords:** Speckle noise, Synthetic Aperture Radar (SAR,) Matched Filter.*

I. INTRODUCTION

This part basic principle of Synthetic Aperture Radar (SAR). Matched filter approaches for processing the received data and pulse compression technique are presented. Radar has long been used for military and non-military purposes in a wide variety of applications such as imaging, guidance, remote sensing and global positioning [1].In 1922, the first continuous wave radar system was developed by Taylor. The first pulse radar system was developed in 1934 with operating frequency 60MHz by Naval Research Laboratory, US. At the same time, radar systems for tracking and detection of aircraft were developed both in Great Britain and Germany during the early 1930s. In airborne application particularly the antennas size and weights are restricted. Another way of getting better resolution from radar is signal processing. Synthetic Aperture Radar (SAR) is a technique which uses signal processing to improve the resolution beyond the limitation of physical antenna aperture [2]. SAR has been shown to be very useful over a wide range of applications, including sea and ice monitoring [4], mining [5], oil pollution monitoring [6], oceanography [7], snow monitoring [8], classification of earth terrain [9] etc. A polarimetric airborne SAR system was developed by NASA Jet Propulsion Laboratory (JPL) and loaded on CV-990 aircraft system [10].

This paper is organized as follows. In section II Speckle noise for Synthetic aperture radar is defined. Section III gives the brief idea about the evolution of Synthetic Aperture Radar (SAR) technique. Section IV gives the types of Synthetic Aperture Radar. Finally, section V gives the conclusions of the work.

II. SPECKLE NOISE

Speckle is a granular "noise" that inherently exists in and degrades the quality of the active radar, synthetic aperture radar (SAR), medical ultrasound and optical coherence tomography pictures. The vast majority of surfaces, synthetic or natural, are extremely rough on the scale of the wavelength. Images obtained from these surfaces by coherent imaging systems like as a laser, SAR, and ultrasound suffer from a common phenomenon called speckle. It, in both cases, is primarily due to the interference of the returning wave at the transducer aperture. The origin of this noise is seen if we model our reflectivity function as an array of scatterers. Because of the finite resolution, at any time-period we are receiving from a distribution of scatterers within the resolution cell. These scattered signals add coherently, that is, they add constructively and destructively depending on the relative phases of each scattered waveform. It noise results from these patterns of constructive and destructive interference shown as bright and dark dots in the image, Speckle noise in conventional radar results from random fluctuations in the return signal from an object that is no bigger than a single image-processing element. It increases the mean grey level of a local area.Speckle noise in SAR is generally serious, causing difficulties for image interpretation. It is caused by coherent processing of backscattered signals from multiple distributed targets. In SAR oceanography, for example, speckle noise is caused by signals from elementary scatterers the gravity-capillary ripples, and manifests as a pedestal image, beneath the image of the sea waves.

III. EVOLUTION OF SYNTHETIC APERTURE RADAR (SAR) TECHNIQUE

There are several organizations and individuals who are doing work to improve the performance of SAR some of them related to our topic which we studied and can be improved by our research are explained. In this paper, an effective technique for synthetic aperture radar antenna mask design is presented for optimizing the system performance of an active phased array SAR.The SAR antenna radiation pattern has an important effect on the system performance. the system performance measures such as the range-to-ambiguity ratio (RAR), the noise-equivalent sigma zero (NESZ), and the radiometric accuracy.The antenna mask template should be designed to minimize the ambiguous signals reflected from the antenna side lobes and maximize the system sensitivity,that is,the NESZ,determined by the antenna main lobe[11,12].

IV. TYPES OF SYNTHETIC APERTURE RADAR (SAR)

(1.) Typical Radar System & Synthetic Aperture
(2.) Young Synthetic Aperture Radar (YSAR)
(3.) CV-990 Polarimetric SAR System

(1.) TYPICAL RADAR SYSTEM & SYNTHETIC APERTURE:-

RADAR is the short form of **RA**dio **D**etection **A**nd **R**anging.It works like a flash camera but at radio frequency. Typical radar system gets of transmitter, switch, antenna, receiver and data recorder. The transmitter produces a high power of electromagnetic wave at radio wavelengths. The switch directed the pulse to antenna and come back echo to receiver. The antenna transmitted the EM pulse towards the region to be imaged and collects returned echoes. The returned signal is converted to digital number by the receiver and the function of the data recorder is to store data values for later processing and display,Fig. 4.1 displays the simply block diagram of a radar system.

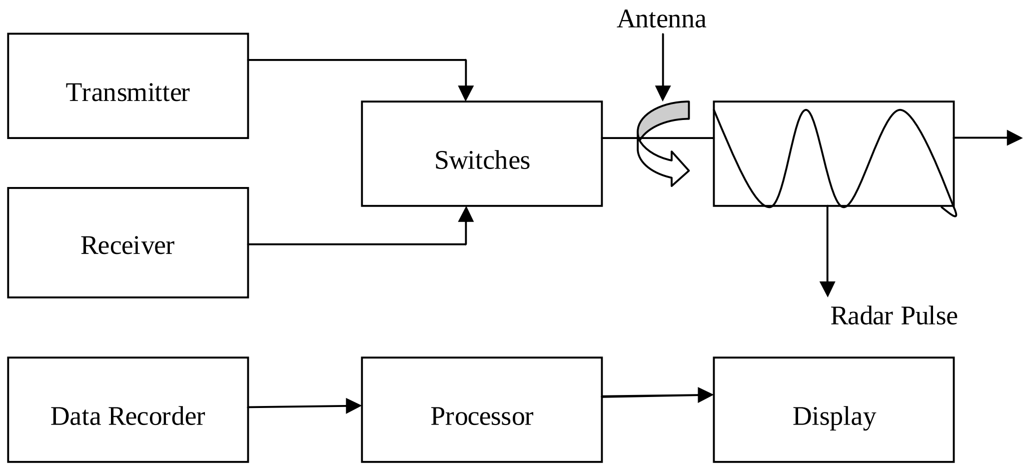

***Figure 4.1** Basic block diagram of typical radar system*

In SAR, forward motion of real antenna is used to 'synthesize' a very long antenna. At each position a pulse is transmitted, the return echoes pass through the receiver and recorded in an "echo store".

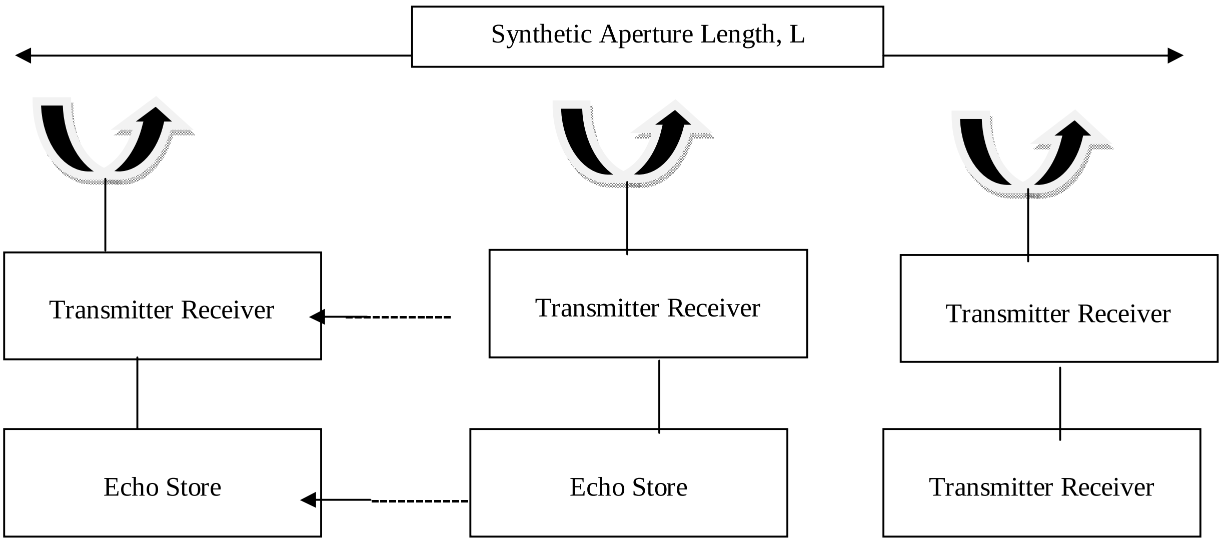

***Figure 4.2** Synthetic aperture*

(2.) YOUNG SYNTHETIC APERTURE (YSAR):-

One of the cheap SAR systems is the Brigham Young University SAR (YSAR) [13].Typical SAR system is complex, more expensive and difficult to transport but the YSAR is relatively cheap and lightweight. This system is to be flown in 4 or 6 passenger aircraft at altitudes up to 2000 feet.

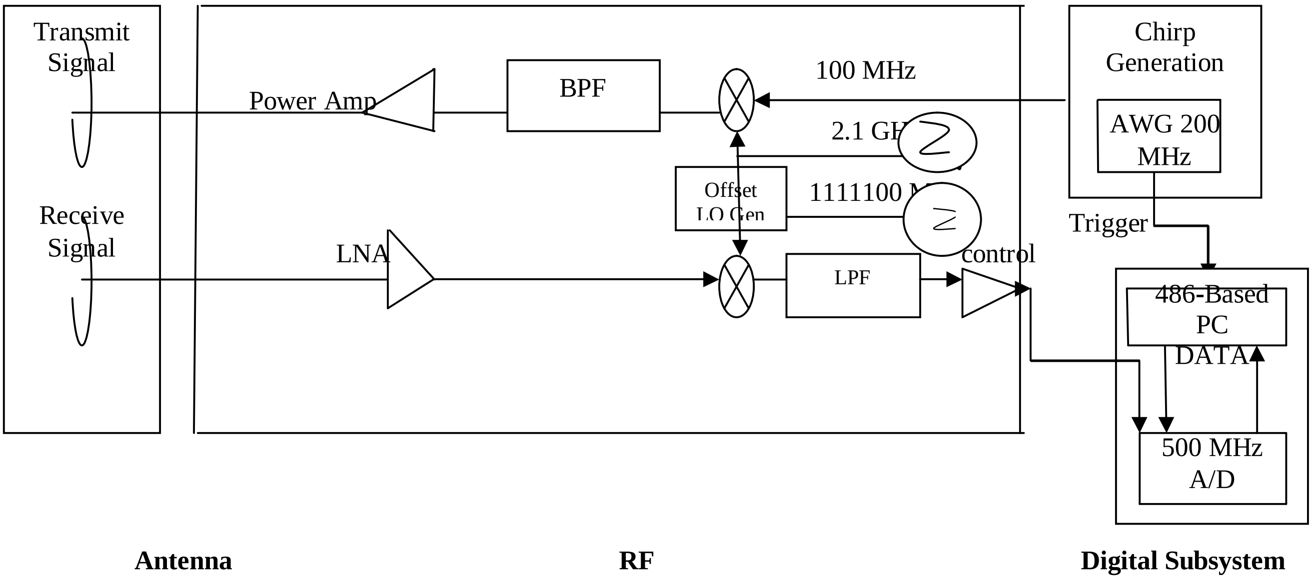

Figure 4.3 YSAR block diagram

(3.) CV-990 POLARIMETRIC SAR SYSTEM:-

A polarimetric airborne SAR system was launched by NASA Jet Propulsion Laboratory and loaded on CV-990 aircraft system [10]. The radar was operated at a wavelength of 24.5 cm (L-band) and had a four-lookre solution of about 10m by 10m. In July1985,CV- 990 together with the SAR instrumentation was destroyed by fire during an aborted takeoff from March Air Force Base in Southern California. After that the disaster, a new imaging radar (AIRSAR) was developed at JPL and this system incorporates all the characteristics of the last CV-990 L-band SAR.

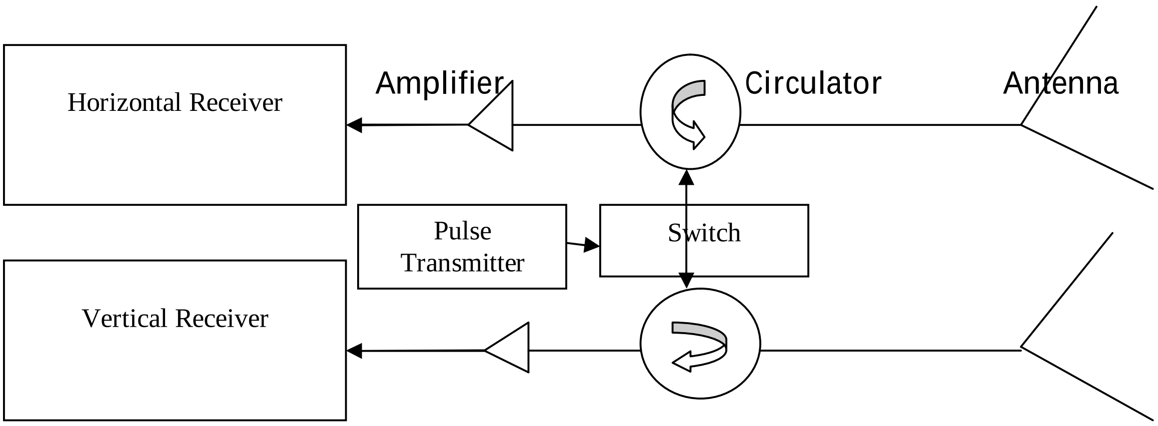

***Figure 4.4** CV-990 polarimetric SAR system*

4.1 MATCHED FILTER:-

The matched filter and its pulse compression concepts are the basic of SAR processing algorithms [2]. It is a filter whose impulse response, or transfer function is explained by a certain signal, in a way that will result in the maximum attainable signal to noise ratio. Pulse compression involves using a matched filter to compress the energy in a signal into a relative narrow pulse.

4.1.1 PROPERTIES OF MATCHED FILTER:-

It is developed to maximise the response of a linear system to particular known signal. Fig. 4.1.1 shows block diagram of a matched filter radar system. The transmitted waveform is produced by a signal generator designated as $s(t)$. The signal output from $s(t)$ is amplified, fed to antenna, radiated, reflected from a target and return to receiver side. The output of receiver is fed into the matched filter after suitable amplification.

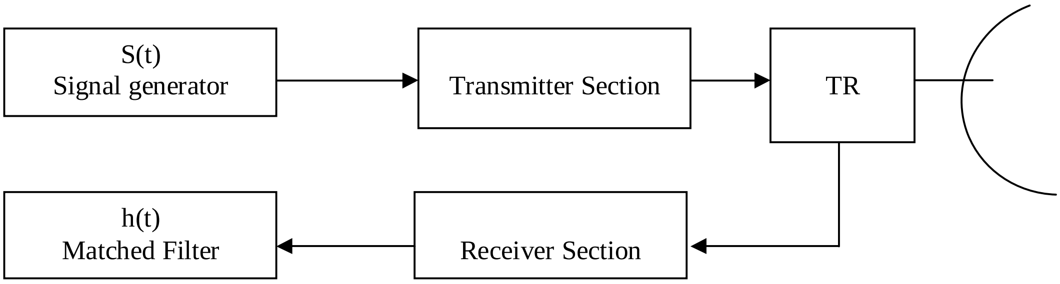

Figure 4.1.1 *Matched FilterRadar System*

It response, *h*(*t*), is simply a scaled, time reversed and delayed form of the input signal,and shape of the impulse response is associated to the signal and hence matched to the input.It has the property of being able to detect the signal even in the presence of noise. It creats a higher output peak signal to mean noise power ratio for the input than for any different signal shape with the samilar energy content.

4.1.2 PULSE COMPRESSION:-

Range resolution for a given radar can be significantly improved by using small pulse. Unfortunately utilising small pulse decreases the average power,which degrades radar signal detectability and measurement precision. Since the average transmitted power is directly linked to the receiver Signal to Noise Ratio (SNR), it is desired to increase the pulse width while simultaneously maintaining adequate range resolution.It can be completed with using pulse compression technique. Pulse compression permits getting the average transmitted power of a relatively long pulse,while obtaining the range resolution corresponding to a small pulse [14].

V. CONCLUSION

In this paper, a simple and effective technique for SAR antenna mask design in an active phased array has been presented. The quantitative equations for SAR antenna main lobe and side lobe mask design have been derived to batterely the system performance like RAR and NESZ.total of 11 antennas masks based on RMHC have been successfully developed and synthesized soSynthetic aperture radar is so much usefull in various field.

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