1) Range Gated Doppler Filters

The delay line canceler has been widely used in

MTI radar as the means for separating moving targets from stationary clutter. Frequency domain bandpass filters of conventional design are also used for this purpose, but the smearing caused by narrowband filters destroy the range resolution. The loss of the range information and the collapsing loss may be eliminated by first quantizing the range (time) into small intervals.

This process is called range gating. A block diagram of the MTI radar with multiple range gates followed by clutter-rejection filters is shown. The output of the phase detector is sampled sequentially by the range gates. The output of the range gates is stretched in a circuit called boxcar generator, or sample and hold circuit, whose purpose is to aid in the filtering and detection process by emphasizing the fundamental of the modulation frequency and eliminating harmonics of the pulse repetition frequency. The clutter rejection filter is a bandpass filter whose bandwidth depends upon the extent of the expected clutter spectrum. Following the doppler filter is a full-wave linear detector and an integrator (a low pass filter). The purpose of the detector is to convert the bipolar video to unipolar video. Only those signals which cross the threshold are reported as targets. Following

the threshold detector, the outputs from each of the range elements must be properly combined for display on the PPI or A-scope or for any other appropriate indicating or data-processing device.

2) Matched filter with non-white noise

In the derivation of the matched filter characteristic, the spectrum of the noise accompanying the signal was assumed to be white, that is, it was independent of frequency. If this assumption were not true, the filter which maximises the output signal to noise ratio would not be the same as the matched filter with white noise. It has been shown that if the input power spectrum of the interfering noise is given by $[N_i(f)]^2$, the frequency response function of the filter which maximizes the output signal to noise ratio is

$$H(f) = \frac{G_a S^*(f) \exp(-j2\pi f t_1)}{[N_i(f)]^2} \quad \text{---} (1)$$

When the noise is non white, the filter which maximizes the output signal to noise ratio is called the NWN (non white noise) matched filter. For white noise [$N_i(f)^2$ = constant] and the NWN matched filter frequency response function reduces to $H(f) = G_a S^*(f) \exp(-j2\pi f t_1)$. —②

Equation ① can be written as,

$$H(f) = \frac{1}{N_i(f)} \times G_a \left(\frac{S(f)}{N_i(f)} \right)^* \exp(-j2\pi f t_1)$$

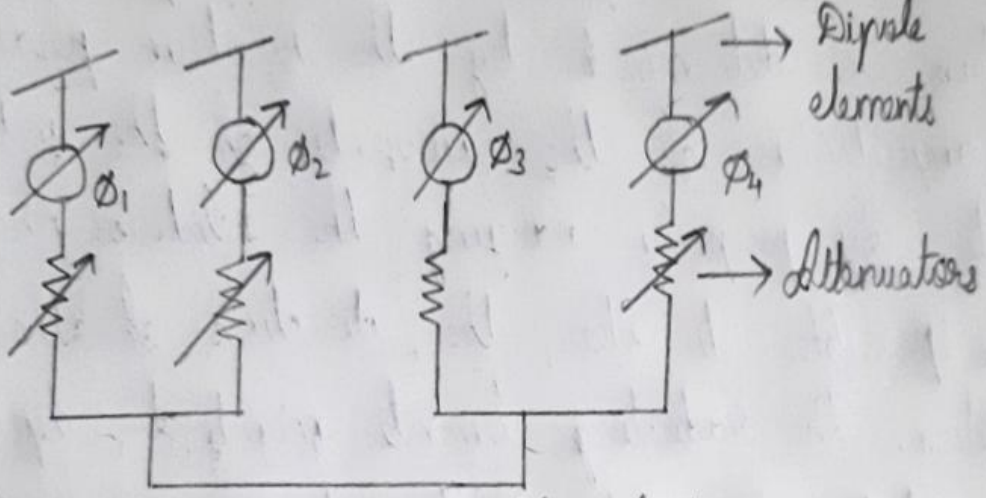
This indicates that the NWN matched filter can be considered as the cascade of two filters. The first filter, with frequency response function $1/N_i(f)$, acts to make the noise spectrum uniform or white. It is sometimes called the whitening filter. The second is the matched filter described by equation ②, when the input is white noise and a signal whose spectrum is $S(f)/N_i(f)$.

3) Phased Array Antennas

A phased array is a directive antenna made up

of individual radiating elements or antennas, which generate radiation pattern whose shape and direction is determined by the relative phases and amplitudes of the currents of the individual elements. By properly varying the relative phases it is possible to steer the direction of the radiation. The radiating elements might be dipoles, open-ended waveguides, slots cut in waveguide, or any other type of antenna. The inherent flexibility offered by the phased array antenna in steering the beam by means of electronic control is what has made it of interest for RADAR. It has been considered in these RADAR applications where it is necessary to shift the beam rapidly from one position in space to another. The full potential of a phased array antenna requires the use of a computer that can determine in real time, on the basis of the actual operational situation, how best to

use the capability offered by the RADAR.



Phase array with parallel feed

The above figure is the schematic of a phased array with phase shifter and attenuator at each element.