

## Doppler-Filter

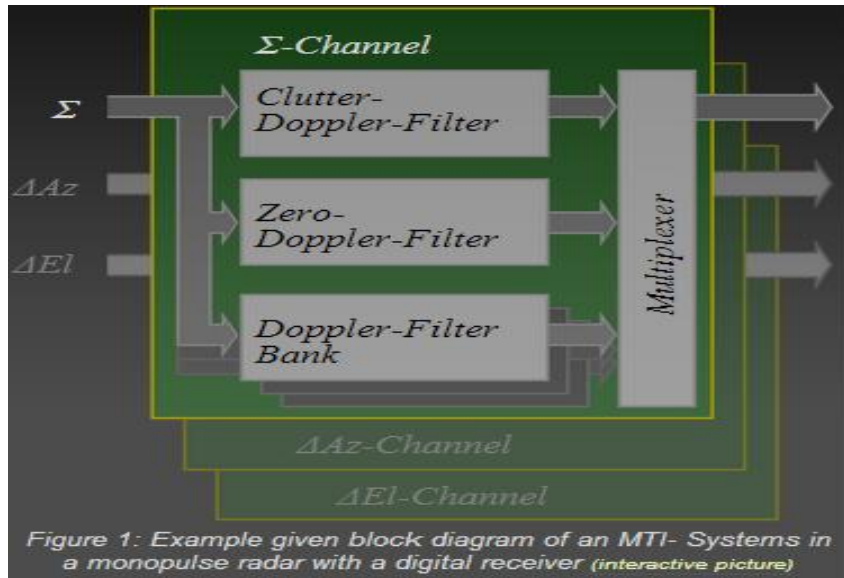


Figure 1: Example given block diagram of an MTI- Systems in a monopulse radar with a digital receiver (interactive picture)

Practical moving target detectors on a fully-coherent radar equipped with monopulse processing involve a Doppler filter bank. The I and Q output from the phase-sensitive analogue/digital converter (ADC) are fed to a filter bank which can either be implemented in a Fast Fourier Transformation or in a bank of transversal filters. The output of the filters is followed by frequency-domain weighting to reduce filter sidelobe levels, and the magnitude of the output in each spectral band is computed. The whole MTI-wiring is carried out for three identically channels ( $\Sigma$ ,  $\Delta Az$  and  $\Delta El$ )

The familiar pseudo-coherent triggering of the COHO is not necessarily here. The stage called „COHO“ in a fully-coherent radar is now a phase constant frequency counter only.

The Zero Doppler-Filter works similar to the Puls-Pair-Method: a fixed target suppression happens by the phase comparison of the echoes received by at least two pulse periods. All targets with a considerable Doppler-frequency can pass this filter. The Zero-Doppler-Filter is a low-pass filter. The cutoff-frequency is justable mostly. All Doppler filters shown in the figure 1 are similar and work to as a band-pass filter. The high expenditure of Doppler Filters is due to reduce the influence of the blind speeds too.

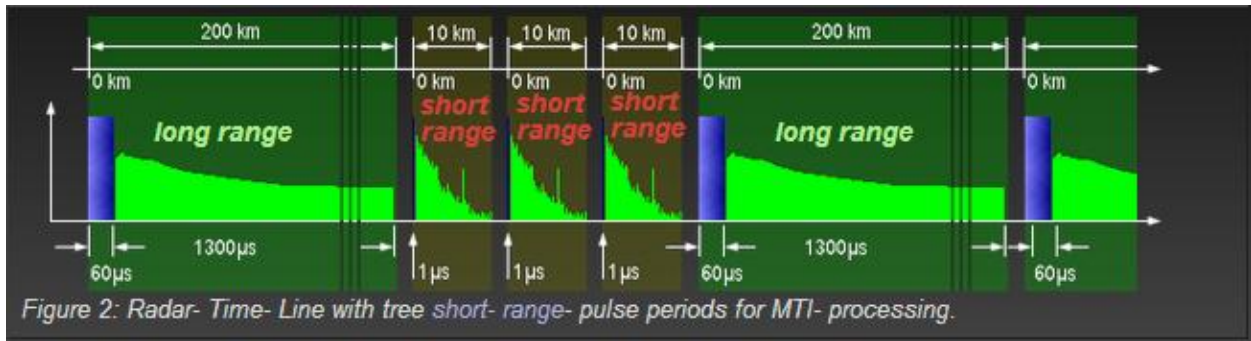


Figure 2: Radar- Time- Line with tree short- range- pulse periods for MTI-processing.

Division of the Doppler frequency domain into a number of N separate bands offers a very flexible approach towards discriminating against fixed and moving clutter. If moving clutter (such as that from weather or birds) appears with a non-zero mean Doppler shift, the thresholds at the outputs of the various Doppler filters may be raised accordingly.

$$f_D < f_{cut} \Rightarrow v \leq 20 \text{ kn}, 40 \text{ kn}$$

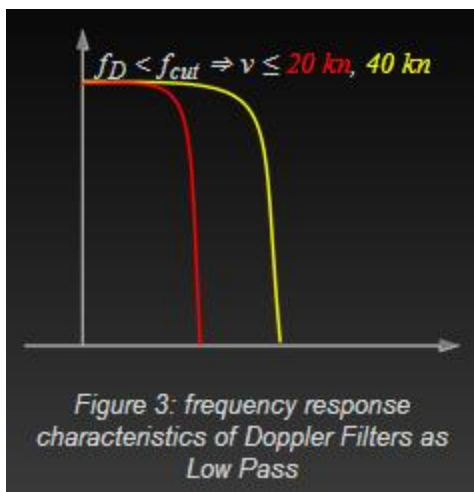


Figure 3: frequency response characteristics of Doppler Filters as Low Pass

### Doppler Filter as Low Pass

The basic principle incorporated in all MTD systems is that of a Doppler filter bank, which enables targets and clutter to be separated in the frequency domain. The output of these filters have separate thresholds which optimise detection for the relevant part of the frequency band concerned. It will also

be appreciated that the Doppler filters are inherently performing the process of coherent integration.

Ground clutter is shown mainly in the Zero Doppler filter. The Zero Doppler Filter may be carry out as a digital low pass filter. It detects targets with a Doppler frequency corresponding with a radial speed of less than 20 knots. The next filter detects targets with a Doppler frequency corresponding with a radial speed of less than 40 knots, like rain clutter or chaff.

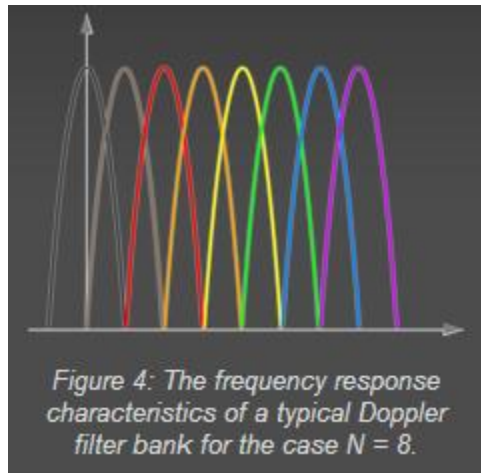


Figure 4: The frequency response characteristics of a typical Doppler filter bank for the case  $N = 8$ .

### **Doppler Filter bank**

Division of the Doppler frequency domain into  $N$  separate bands offers a very flexible approach towards discriminating against fixed and moving clutter. If moving clutter (such as that from weather or birds) appears with a non-zero mean Doppler shift, the thresholds at the outputs of the various Doppler filters may be raised accordingly.

**Source:** <http://www.radartutorial.eu/11.coherent/co08.en.html>