Q22. Discuss about blind speeds.

Ans:

The delay line canceller is a time domain filter used to overcome the difficulties caused by clutter. It eliminates the D.C component from the clutter. When the moving target's Doppler frequency is same as the pulse-repetition frequency or a multiple of it, in such case the moving target also gets eliminated. The corresponding target velocities, those resulting in zero MTI (Moving Target Indicator) response are termed as blind speeds.

These blind speeds do not occur with CW (Continuous Wave) radar but considered as a major limitation with pulse MTI radar.

The relative velocities of the target at which the response of single delay line canceller is zero are called as blind speeds and are obtained by equating the sine term of equation below to zero as,

$$V = 2k \sin \pi f_d T \cos \left[2\pi f_d \left(t - \frac{T}{2}\right) - \phi\right]$$

$$\sin \pi f_d T = 0$$

$$\Rightarrow \quad \pi f_d T = n\pi$$

Where, $n = 1, 2, 3, ...$

$$\Rightarrow \quad f_d = \frac{n}{T} = nf_p$$

Where, f_p – Pulse repetition frequency.

Thus blind speed is given by the following relation,

$$V_n = \frac{n\lambda f_p}{2} = \frac{n\lambda}{2T}$$

Where,

$n = 1, 2, 3, ...$

f_p – Pulse repetition frequency

V_n – n^{th} blind speed

T – Pulse repetition period.

The above equation can be further modified as,

$$V_n = \frac{n\lambda f_p}{1.02}$$

$$\Rightarrow \boxed{V_n \approx n\lambda f_p}$$

This equation is applicable if, f_p is measured in Hz, λ in meters and relative velocity in knots.

Blind speeds can be eliminated by operating MTI radar in long wavelengths (small frequencies). However, this is not the ideal method because at low frequencies, the angular accuracy and angular resolution are not upto desired value. Hence, blind speeds cannot be eliminated completely.