Overview of radars

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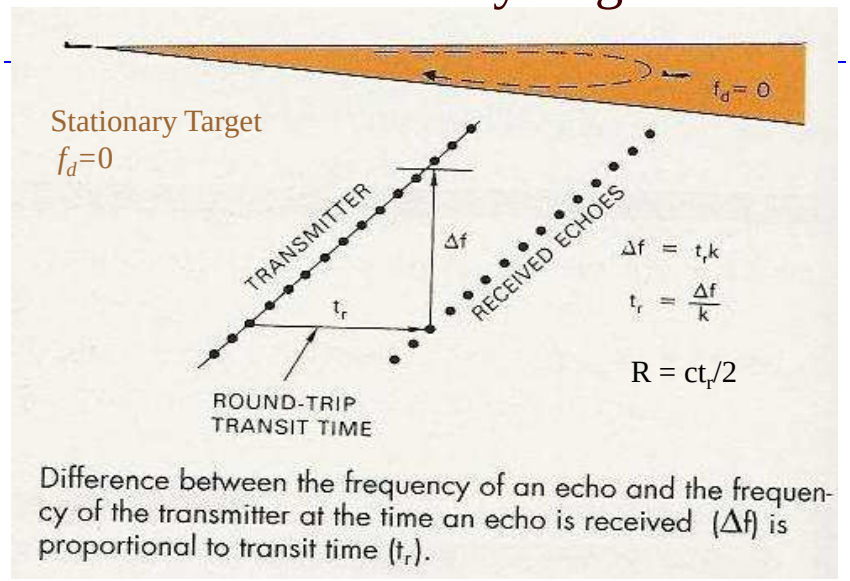
Types of Doppler Radar

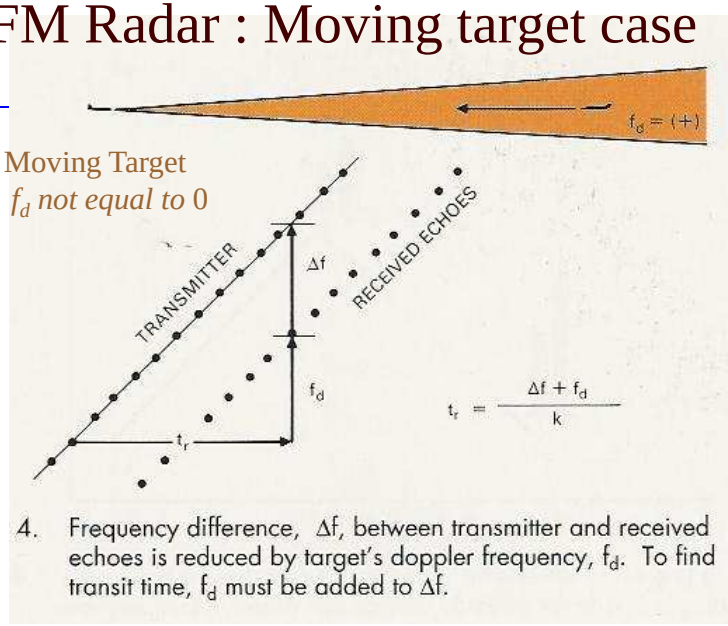
- Continuous Wave (CW)
  - Simple
  - No range information
- Frequency Modulated CW, (FMCW)
  - Fine range resolution
  - Artifacts from target motion
- Pulse Doppler
  - Range and Doppler
  - No artifacts (except when pulse compression used)

FM Radar : Stationary target case

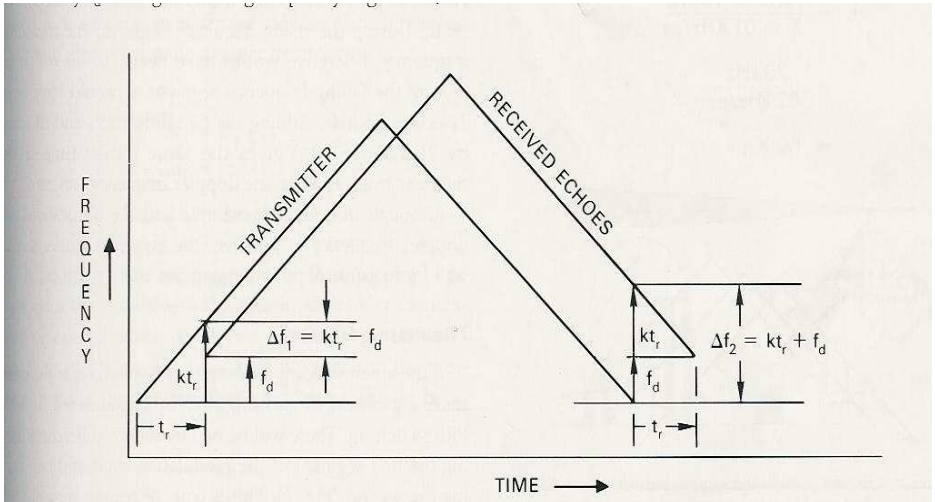


Difference between the frequency of an echo and the frequency of the transmitter at the time an echo is received (Δf) is proportional to transit time (t_r).

FM Radar : Moving target case



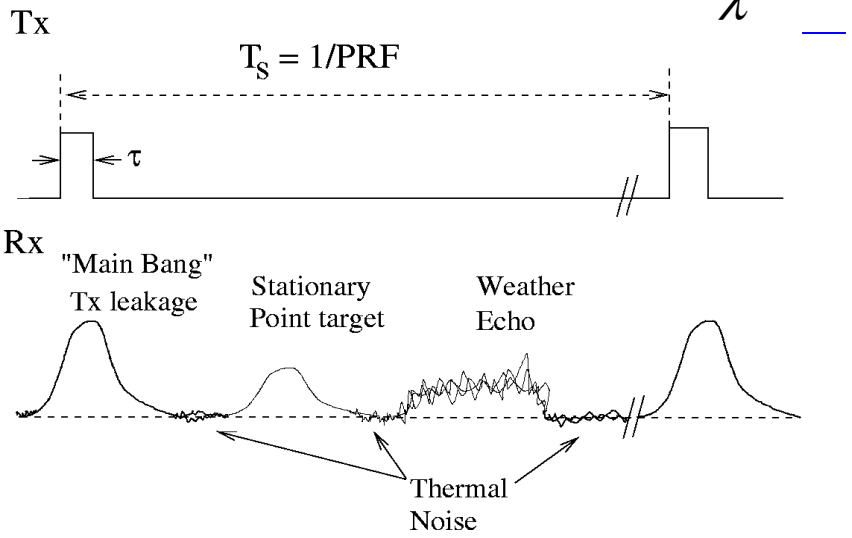
4. Frequency difference, Δf, between transmitter and received echoes is reduced by target's doppler frequency, f_d. To find transit time, f_d must be added to Δf.



6. With two-slope modulation, frequency difference is decreased by f_d during rising slope and increased by f_d during rising slope and increased by f_d during falling slope.

Pulse Doppler Radar

$$f_d = -\frac{v_r}{\lambda}$$



Range Ambiguities

Range Resolution

$$\Delta R = \frac{c\tau}{2}$$

Unambiguous Range

$$R_{\max} = \frac{c}{2PRF} = \frac{cT_S}{2}$$

Doppler Ambiguities

Nyquist frequency

$$f_{d,\max} = \frac{PRF}{2} = \frac{1}{2T_S}$$

Nyquist Interval

(maximum radial velocity that can be measured)

$$v_{\max} = \frac{f_d \lambda}{2} = \frac{PRF\,\lambda}{4}$$