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Embedded Systems

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Q2. $\frac{\Delta F}{\Delta t} = 0.2\ MHz/\mu s$; $\Delta t = 10ns$

Range Resolution (ΔR) = $\frac{c\Delta t}{2}$

$= \frac{3 \times 10^8 \times 10 \times 10^{-9}}{2}$

$= 1.5m$

Abs range = $\frac{c}{2} \frac{\Delta F}{\frac{\delta F}{\delta t}}$

$\therefore \Delta t = \frac{\Delta F}{\left(\frac{\delta F}{\delta t}\right)} = 10ns = \frac{\Delta F}{0.2 MHz/\mu s}$

$\therefore \Delta f = 2\ MHz$

Q1.

S band: 2-4 GHz

Taking operating frequency = 2 GHz.

Doppler shift = f_d = 20 cycles/second = 20 Hz

∴ Relative velocity - V_r =

$$\frac{f_d \times c}{2f} = \frac{20 \times 3 \times 10^8}{2 \times 2 \times 10^9} \text{ m/s}$$

$$= 1.5 \text{ m/s}.$$

Q4.

$d = 0.5$ mm

Frequency of FMCW lidar

(F_x) = 12 GHz

Phase variation = $F_x \times \frac{2d}{c} \times 2\pi$

$$= \frac{12 \times 10^9 \times 2 \times 0.5 \times 10^{-3}}{3 \times 10^8} \times 2\pi.$$

$$= 0.04 \times 2\pi \text{ rad.}$$

$$= 0.251 \text{ rad}$$

=

Q5. The frequency range of the Ka band is 26.5 GHz – 40 GHz.

∴ Bandwidth $= (40 - 26.5) = 13.5\ GHz = B$

Range resolution $= \frac{c}{2B}$

$= \frac{3 \times 10^8}{2 \times 12.5 \times 10^9}\ m$

$= 0.011\ m$

$\boxed{d_{res} = 0.011\ m}$

Q2

Range resolution = $\frac{c}{2B}$.

& since bandwidth for both the given chirps are same, the resolution will be same.