Sohag University | Electronic & Comm Sec.

Faculty of Engineering | RADAR Systems

Electrical Engineering Dept. | Sheet (**4**)

Q1) A radar mounted on an automobile is to be used to determine the distance to a vehicle traveling directly in front of it. The radar operates at a frequency of 9375MHz with a pulse width of 5ns. The maximum range is to be 150m.

(a) what is the pulse repetition frequency?

(b) What is the range resolution (meters)?

(c) If the antenna beam width was 3deg what would be the cross-range resolution (m) at a range of 50m, 100 m and 150m? do you think the resolution is sufficient?

(d) If the antenna dimensions were 0.5ft by 0.5ft and the antenna efficiency were 0.8, what would be the antenna gain?

(e) Find the average power required to detect a 10m2 radar cross section vehicle at a range of 150m, if the minimum detectable signal is 5x10^(-12) W?

Q2)

(a) What is the peak power of a radar whose average transmitter power is 100W ,pulse width of 2us and prf of 2kHz?

(b) What is the range in nmi of this radar if it has to detect a target with a radar cross section of 1m^2 operating at 3GHz with a rectangular-shaped antenna with gain 6dBi and minimum detectable signal of 10^(-12) W?

(c) Sketch the received echo signal power as a function of range from 10-80nmi.

Q3) A VHF radar at 220MHz has a maximum unambiguous range of 180nmi.

(a) What is the first blind speed (in knots)?

(b) Repeat for an L-band radar at 1250 MHz.

(c) Repeat for an X-band radar at 9375 MHz.

(d) What would be the unambiguous range (nmi) of the X-band radar of part (c) in order to give the same blind speed you found in part (a) for the VHF radar?

Q4)

(a) A monostatic radar with the parameters indicated in Table 1, compute the SNR on a 6-dBsm target at a range of 60 Km?

(b) Find the range at which the SNR on a 6-dBsm target is 13 dB.

RADAR RANGE EQUATION PARAMETER	VALUE (MKS)	VALUE (dB)
P_T	10^6 w	60 dBw
G_T	6309.6 w/w	38 dB
G_R	6309.6 w/w	38 dB
$\lambda = c/f_c$	0.0375 m	-14.26 dB(m)
σ	3.98 m^2	6 dBsm
kT_0	4×10^{-21} w-s	-204 dB(w-s)
$B = 1/\tau_p$	2.5×10^6 Hz	64 dB(Hz)
F_n	6.31 w/w	8 dB
$L = L_t L_r L_{other}$	5.01 w/w	7 dB

Table 1 – Radar Range Equation Parameters

Q5) The average time between false alarms is specified as 30 min and the receiver bandwidth is 0.4 MHz.

(a) What is the probability of false alarm?

(b) What is the threshold-to-noise power ratio ($VT2/\Psi o$)?

(c) Repeat (a) and (b) for an average false alarm time of one year (8760h).

(d) Assume the threshold-to-noise power ratio is to be set to achieve a 30-min false-alarm time [value as in part (b)], but for some reason, the threshold is actually set lower by 0.3dB than the value found in part (b). What is the resulting average time between false alarms with the lower threshold?

(e) What would be the average time between false alarms if the threshold were to increase by 0.3dB?

(f) Examine the two values of threshold-to-noise ratio you have calculated in (d) and (e) and comment on the practicability and sensitivity of precisely achieving a specified value of false alarm time.