Module 17 : Assignment
Autonomous Planning And Control Of EV

Problem Statement:

As a radar engineer, your mission is to assess the performance of a radar system employed for target detection within a designated area. Your objective encompasses calculating various parameters crucial for the radar system's operation and determining distances to detected targets.

Tasks To Be Performed:

1. Radar Spectrum Radio Waves:

Given:

- Speed of light (c) = 3 × 10^8 meters/second (m/s)
- Wavelength (λ) = 10 centimeters (cm)

Calculate the frequency of the radar spectrum of radio waves, given the speed of light and wavelength.

2. Power of the Reflected Signal at the Target:

Given:

- Power of the transmitted signal (Pt) = 10 watts (W)
- Gain of the transmitting antenna (Gt) = 20 decibels (dB)
- Radar cross-section of the target (σ) = 5 square meters (m^2)
- Distance between the radar and the target (R) = 1000 meters (m)

Determine the power of the reflected signal at the target based on the transmitted signal power, antenna gain, radar cross-section, and target distance.

3. Power Density of Reflected Signal at the Radar:

Calculate the power density of the reflected signal at the radar using the same parameters as above.

4. Noise Power at the Receiver:

Given:

- Boltzmann's constant (k) = 1.38 × 10^-23 joules/kelvin (J/K)
- System noise temperature (T) = 300 Kelvin (K)
- Noise bandwidth of the receiver (B) = 1 megahertz (MHz)

Compute the noise power at the receiver considering Boltzmann's constant, system noise temperature, and receiver noise bandwidth.

5. Signal to Noise Ratio of Radar:

Determine the signal-to-noise ratio of the radar using the signal power calculated in question 2 and the noise power calculated in question 4.

6. Ultrasonic Sensor Distance:

Given:

- Speed of sound (SpeedOfSound) = 343 meters/second (m/s)
- Time taken for ultrasonic signal to return (Time) = 0.05 seconds (s)

Calculate the distance to the detected target using an ultrasonic sensor, given the speed of sound and the time taken for the ultrasonic signal to return.

7. LiDAR Distance:

Given:

- Time taken for LiDAR signal to return (t) = 10 microseconds (μs)
- Speed of light in a vacuum is approximately 299,792,458m/s.

Determine the distance to the detected target using LiDAR, given the time taken for the LiDAR signal to return and the speed of light in a vacuum.