Assignment 1

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Download all python codes from

https://github.com/sachinkarumanchi/EE3900/blob/main/assignment_1.pdf

and latex codes from

https://github.com/sachinkarumanchi/EE3900/blob/main/assignment_1.tex

Problem

(Vectors 2.15)A bullet fired at an angle of 30° with the horizontal hits the ground 3.0 km away. By adjusting its angle of projection, can one hope to hit a target 5.0 km away ? Assume the muzzle speed to be fixed, and neglect air resistance.

Solution

Let's assume the speed of the bullet be 'u', and given range(R) is 3.0 km
The angle of elevation (θ) = 30°
Time taken by bullet to reach the ground (T)

$$T = \frac{2usin\theta}{g} \tag{0.0.1}$$

where 'g' is the acceleration due to gravity.
Therefore,

$$ucos\theta \times T = R \tag{0.0.2}$$

$$\frac{u^2 sin2\theta}{g} = R \tag{0.0.3}$$

from the above data we can say that

$$\frac{u^2}{g} \times \frac{\sqrt{3}}{2} = 3 \tag{0.0.4}$$

$$\implies \frac{u^2}{g} = 2\sqrt{3} \tag{0.0.5}$$

let the Maximum value of R be R_{max}
R_{max} is achieved when sin2θ =1, given u constant from (0.0.3) and (0.0.5)

$$\implies R_{max} = \frac{u^2}{g} \tag{0.0.6}$$

$$R_{max} = 2\sqrt{3} \tag{0.0.7}$$

$$R_{max} \approx 3.464\text{km} \tag{0.0.8}$$

The Maximum Range the bullet can reach is close to 3.464 km, So it cannot hit a target 5.0 km away