

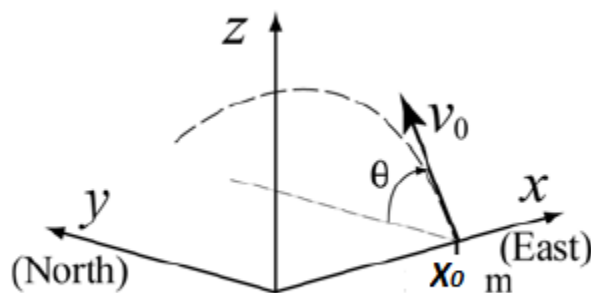


COLLEGE OF ENGINEERING
MECHANICAL ENGINEERING DEPARTMENT
MCE226L CMP I

S20 Project

Problem

A projectile is fired with an initial velocity of v_0 m/s at an angle of θ relative to the ground. The projectile is aimed directly north. In case of a strong wind blowing to the west or east, the projectile also moves in this direction at a constant speed of A [So, $v_x = -A$ or $v_x = A$].



Determine and plot the trajectory of the projectile until it hits the ground.

Solution

Since the projectile is fired directly north, the initial velocity V_0 can be resolved into a horizontal y component and a vertical z component:

$$v_{0y} = v_0 \cos(\theta) \quad \text{and} \quad v_{0z} = v_0 \sin(\theta)$$

In addition, due to the wind the projectile has a constant velocity in the x direction,

$$v_x = -A \text{ or } A, \text{ depends on the direction}$$

The initial position of the projectile is at point (x_0, y_0, z_0) . In the vertical direction the velocity and position of the projectile are given by:

$$v_z = v_{0z} - gt \quad \text{and} \quad z = z_0 + v_{0z}t - \frac{1}{2}gt^2$$

The time it takes the projectile to reach the highest point:

$$t_{hmax} = \frac{v_{0z}}{g}$$

The total flying time is twice this time

$$t_{tot} = 2t_{hmax}$$



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MCE236L Solid Modelling

S20 Project

In the horizontal direction the velocity is constant (both in the x and y directions), and the position of the projectile is given by:

$$x = x_0 + v_x t \quad \text{and} \quad y = y_0 + v_{0y} t$$

- Inputs are: v_0 , θ , x_0 , y_0 , z_0
 A and its direction
- The outputs are:
 - Maximum height [z at t_{hmax}]
 - Maximum traveled distance in x direction
 - Maximum traveled distance in y direction

Program :

- ✓ Using arrays, write a C program that calculates and plots the trajectory of a projectile that is fired at a velocity's, angle, and a position entered by user.
- ✓ Program should show a list of options to let user to select one of the following:
 - Plot the trajectory (x, y, z) that the projectile would have had if there was wind, given a value of A .
 - Plot the trajectory (x, y, z) that the projectile would have had if there was no wind ($A=0$).

*Hint: for 3D plots, use the function **plotxyz***

<https://www.softintegration.com/docs/ch/plot/>

- ✓ Program should print out the following:
 - Maximum height [z at t_{hmax}]
 - Maximum traveled distance in x direction [x at $2t_{hmax}$]
 - Maximum traveled distance in y direction [z at $2t_{hmax}$]