How Different Factors Affect Projectile Motion

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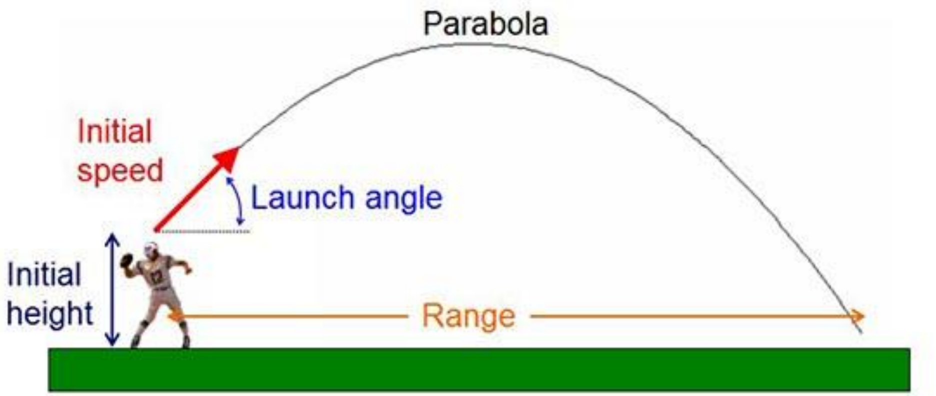
Computational Physics

The Behavior of Projectile Motion

- Factors which had an effect on the projectile that we looked at:
    - Air Drag
    - Initial Velocity
    - Launch Angle
    - Elevation

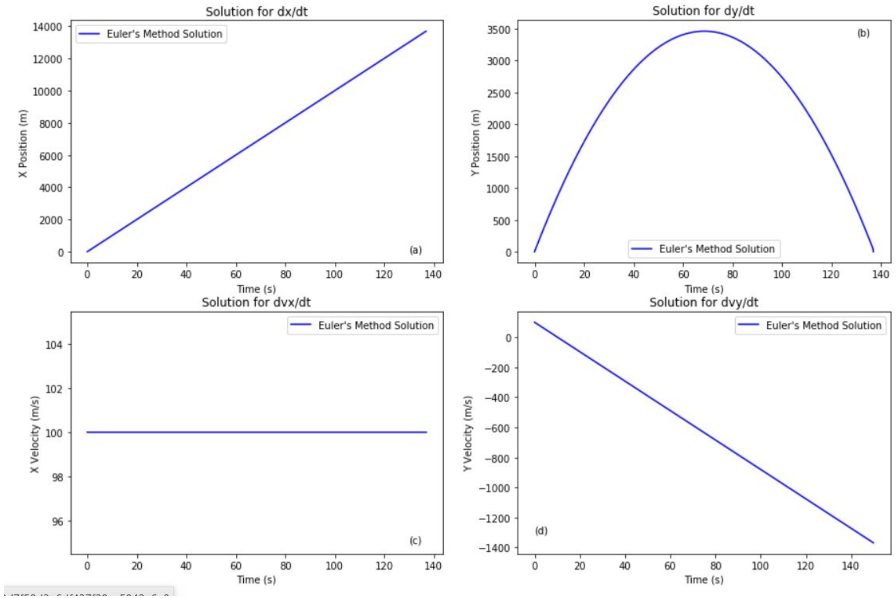


Model

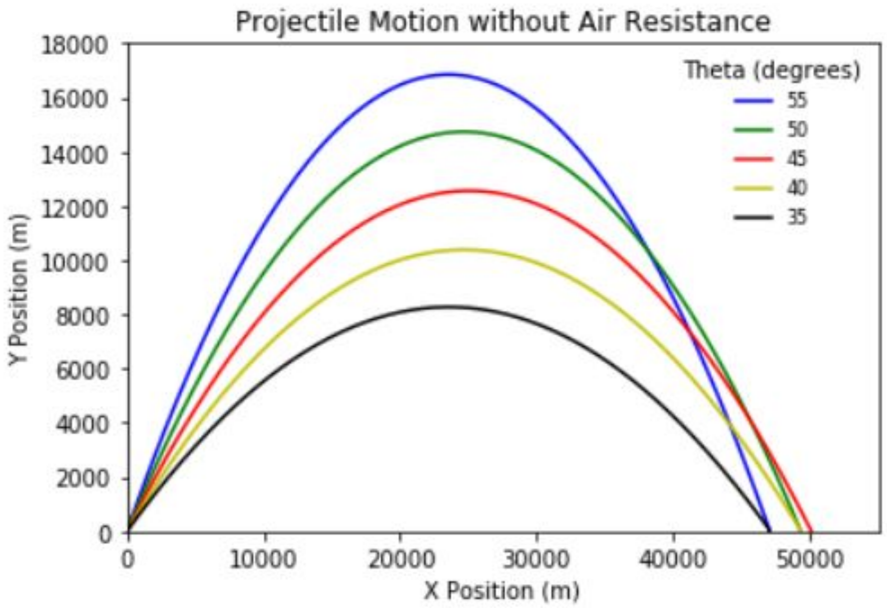
- $$\frac{d^2x}{dt^2} = 0\,,\ \frac{d^2y}{dt^2} = -g$$
- $$\frac{dx}{dt} = v_x\,,\ \frac{dv_x}{dt} = 0\,,\ \frac{dy}{dt} = v_y\,,\ \frac{dv_y}{dt} = -g$$
- $$F_d = \frac{C_d \rho A v^2}{2}$$
- $$\rho = \rho_0 e^{-\frac{y}{y_0}}$$

Numerical Methods

- We used Euler's method to solve the differential equations of projectile motion, as well as to solve for each position and velocity value in all three simulations. If a value is known for a time t, using Euler's method, the new value can be calculated a short time later. This can be repeated to calculate our value over a certain interval.

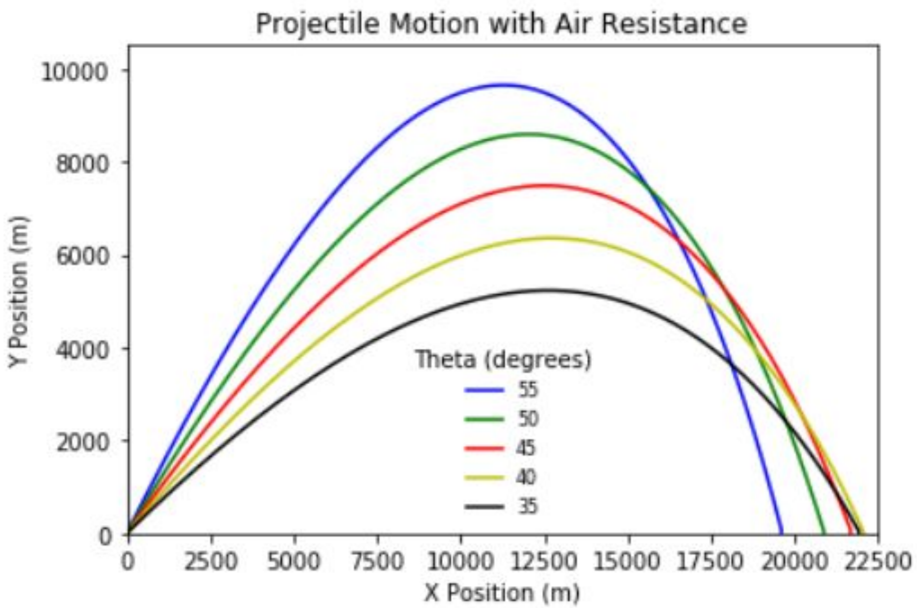


Results



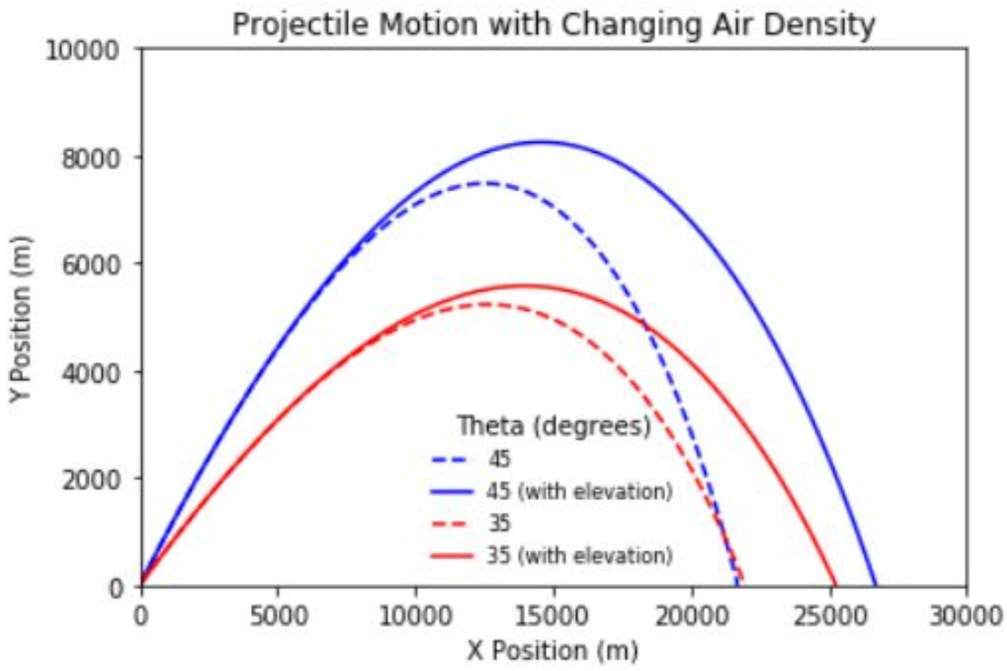
Angle (Degrees)	Final X-displacement (meters)
55	47076.286013511635
50	49269.67028247294
45	50116.19311659685
40	49333.26213686243
35	47019.327342187826

Results



Angle (Degrees)	Final X-displacement (meters)
55	19603.240388104426
50	20874.206479373133
45	21671.38861076387
40	22055.305219727895
35	21915.110811837614

Results



Angle (Degrees)	Final X-displacement (meters)
45	21671.38861076387
45 (with elevation)	26697.914232738196
35	21915.110811837614
35 (with elevation)	25241.745732494026

Summary

This project uses Euler's method and the basic model for projectile motion to test how different factors affect the projectile motion of an object. The factors that we tested were the launch angle, initial velocity, air drag, and elevation. These results can be used to find the most ideal parameters to use to throw a perfect pass. This is important because throwing a perfect pass can be very difficult and can involve a lot of scientific techniques. So, using these results, throwing a perfect pass can become much easier.

References

[1] Giordano, Nicholas J. Computational Physics. Prentice-Hall, Inc., 1997. p. 23-28

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[3] Newman, Mark. Computational Physics. Createspace, 2013.

[4] NBC. “Science of NFL Football: Projectile Motion; Parabolas.” NBC Learn, 7 Sept. 2010, www.nbclearn.com/science-of-nfl-football/cuecard/50689.

Questions?