Gene Wang

Dr. Nelson

ATCS: Numerical Methods Period 7

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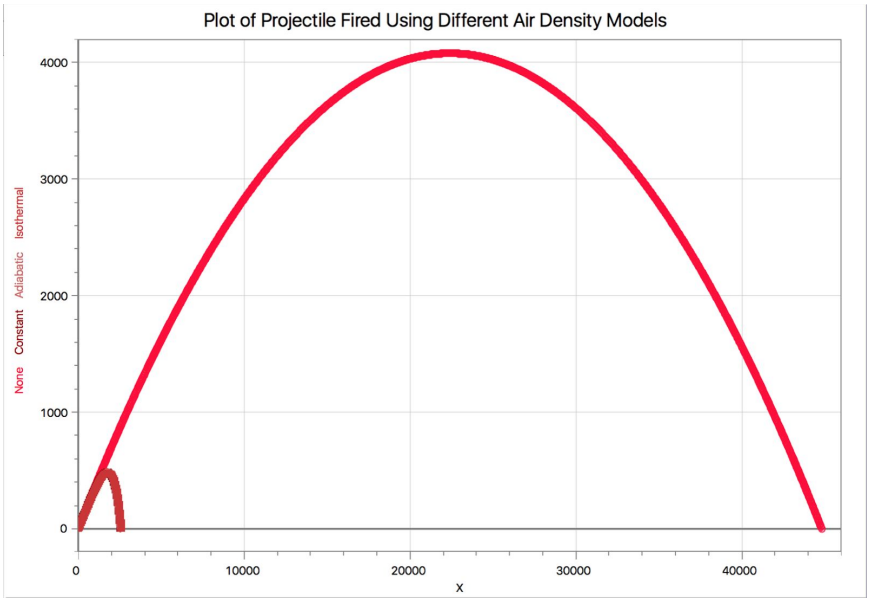
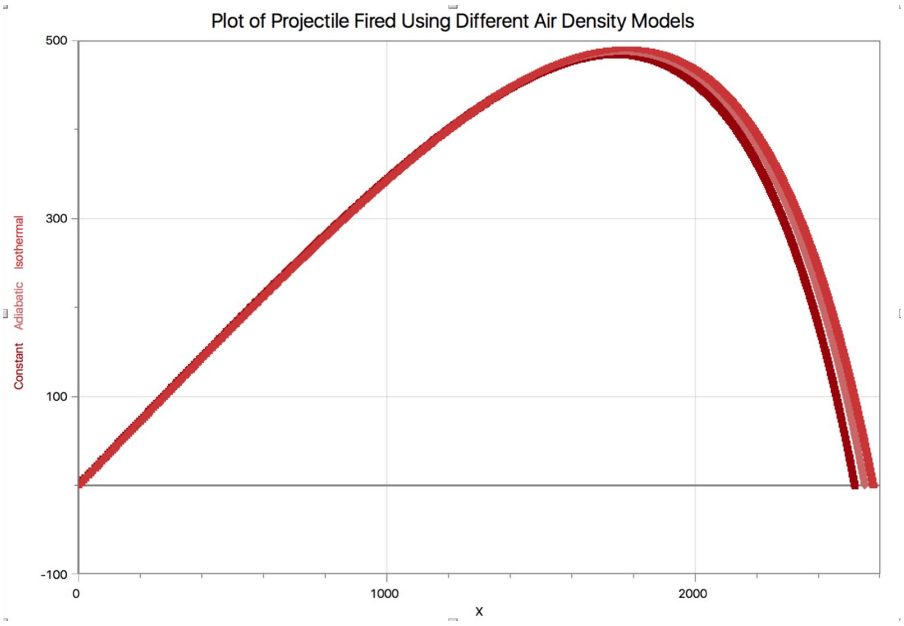
Projectile Motion Analysis

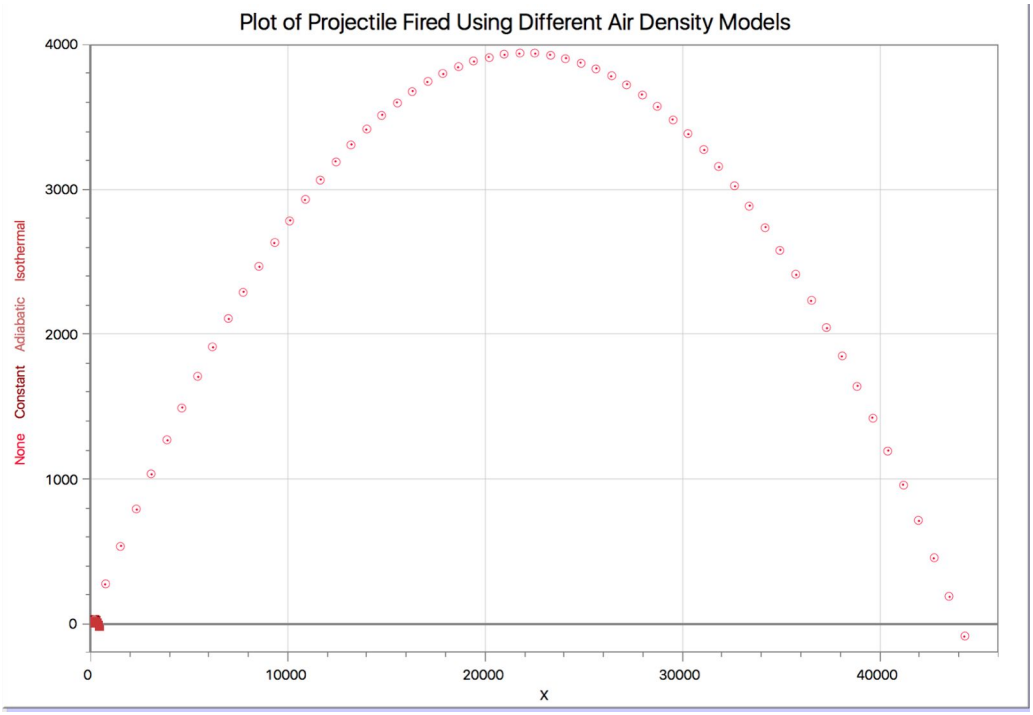


Plot 1



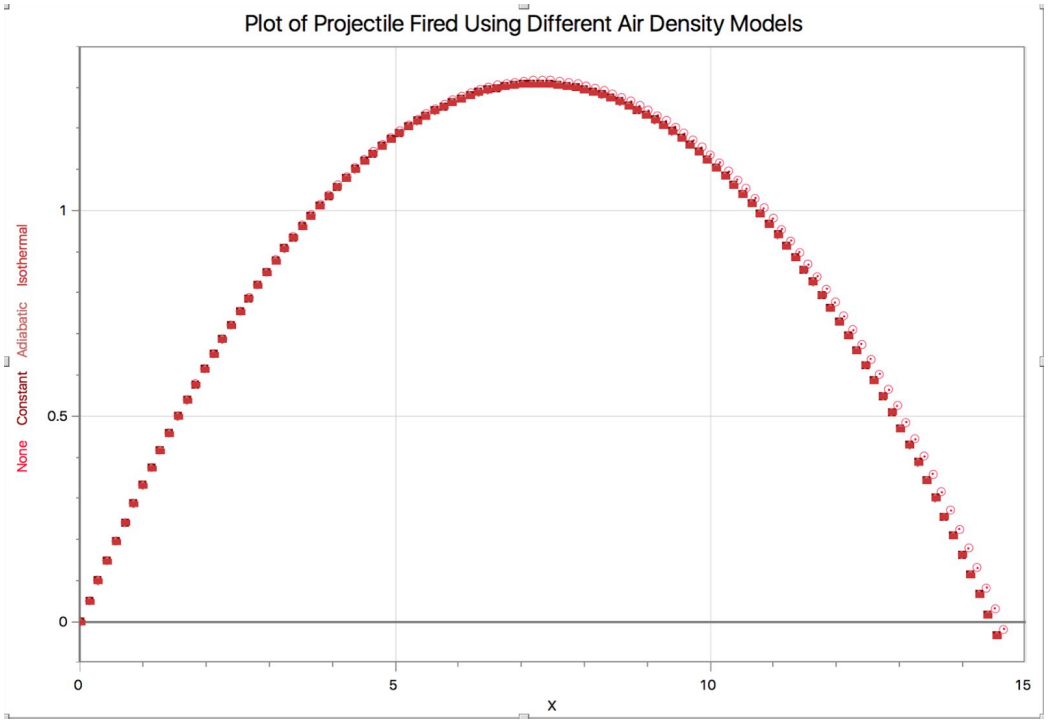
Plot 2

These first two plots show the projectile described in the design document fired against the four different types of air density models with a time interval of 0.01 seconds. The projectile has a radius of 7.75 cm, has a mass of 43.2 kg, and is fired at an initial velocity of 827 m/s at an initial angle of 20º. We can clearly see that the projectile fired against the no air density model in the first plot stayed in the air for much longer and flew much higher and further than the other three air density models. However we can see that the constant sea-level, Adiabatic, and Isothermal air density models all converge pretty well in Plot 2.



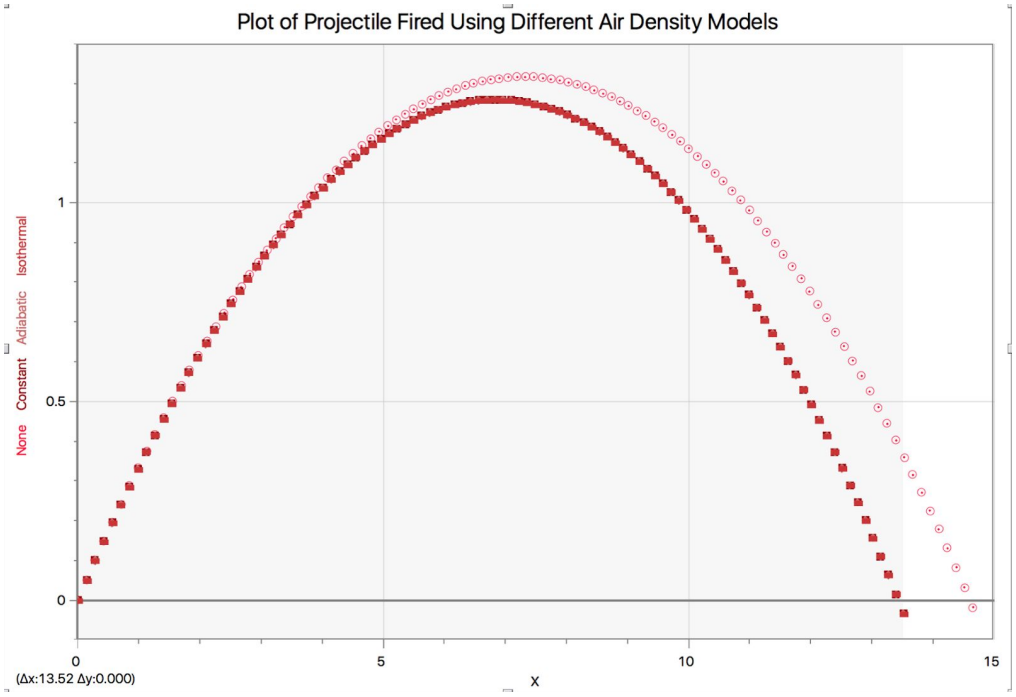
Plot 3

Plot 3 shows the same projectile fired with a much larger time interval of 1 second, and the difference is that there are a lot fewer points plotted, resulting in a less detailed curve.



Plot 4

I found that all four models converged rather well when I lowered the initial velocity down to 15 m/s and kept all the other values constant. Raising the initial velocity any higher than around 15 m/s causes the no-air density model to diverge from the other three.



Plot 5

Raising the constant sea-level air density from 1.225 kg/m^3 to around 10 kg/m^3 causes the projectile to fly lower for all three models that incorporate a value for the air density. The projectile in Plot 5 uses the exact same values as the one in Plot 4 except for the increased sea-level density, and we can see that the constant, adiabatic, and isothermal models stray from the no-air model, which means that the value of convergence would be a lower velocity.