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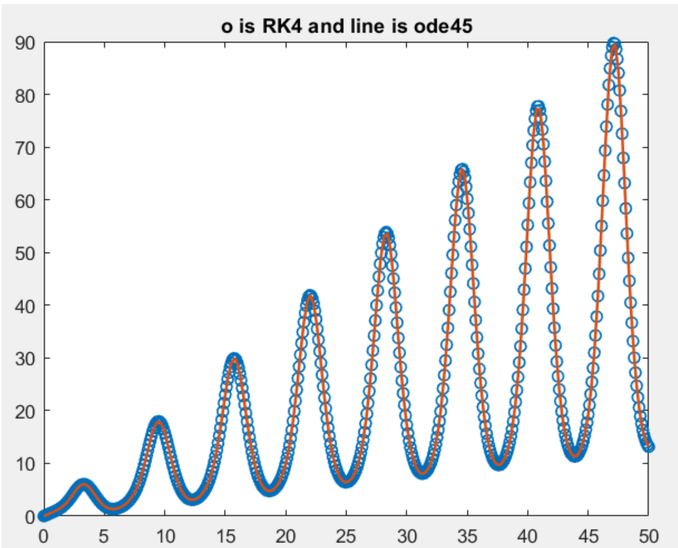
ME118 Project

Q1:




RK4 comparing my results they are practically identical.

Here the blue circles are the rk4 and the orange line is ode45

Q2:
Tesla Model S 2024,
Stats I will be using

Cd = 0.208;
A = (1.987*1.431)*80% = 2.27 m^2
Traction coef.  = 0.9
Roling coef. = 0.015
Mass = 1980 kg
Density air = 1.293

Part A: Hand calculation
Part B: Hand calculation
Part C: (Matlab code)=> Graphed in Matlab

The car an reach 0 - 60 mph in 2.3 seconds according to Matlab code.
The car will also travel a distance of 30.8335 meters in that time.

Part D:(Matlab code)=> Graphed in Matlab
Part E: (Matlab code)=> Graphed in Matlab
Part F: (Matlab code)=> Graphed in Matlab
Part G: (Matlab code)=> Graphed in Matlab

The car will take 2.312 seconds to come to a rest and will have traveled 31.35 meters in that time, according to Matlab code.

Sites:

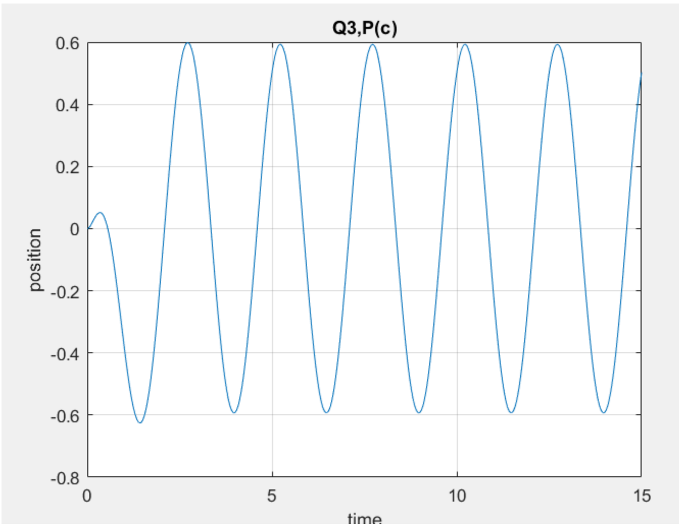
https://www.tesla.com/models#:~:text=With%20a%20drag%20coefficient%20of,quicker%20and%20with%20more%20confidence.

https://en.wikipedia.org/wiki/Automobile_drag_coefficient#:~:text=The%20average%20modern%20automobile%20achieves,of%20body%20of%20the%20vehicle.

https://www.greencarreports.com/news/1092373_aerodynamic-tesla-model-s-electric-car-wins-the-wind-tunnel-wars

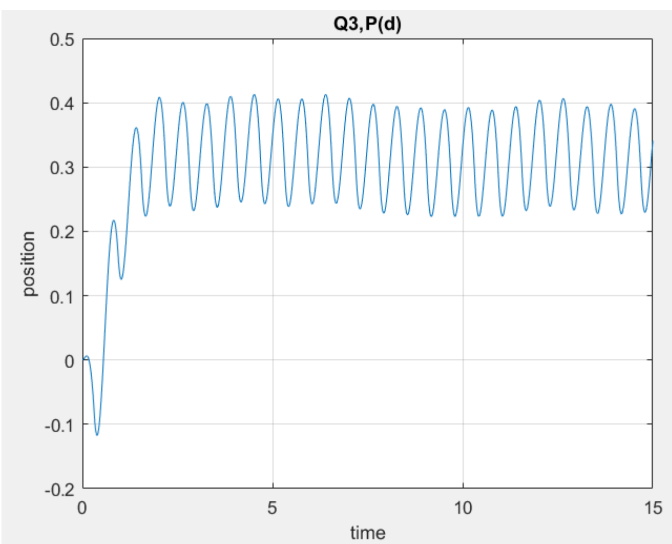
Q3:

Part (A): Hand Calculation
Part (B): Hand Calculation
Part (C): (Matlab code)




Cosine wave road input will result in my spring-mass system following a similar path.

Part (D) : (Matlab Code)

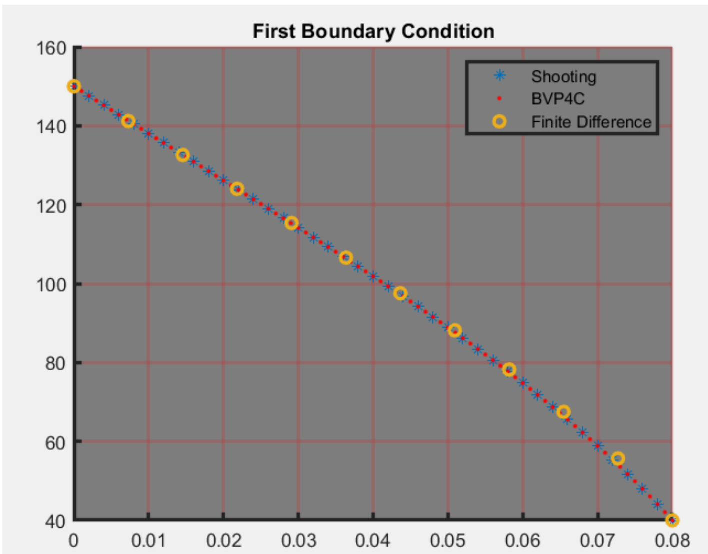



With a cosine wave that never dibs below zero, my spring mass damper system will oscillate at a resident frequency that will allow it to have an average height of 0.35 meters

Part (E) : Hand Calculation

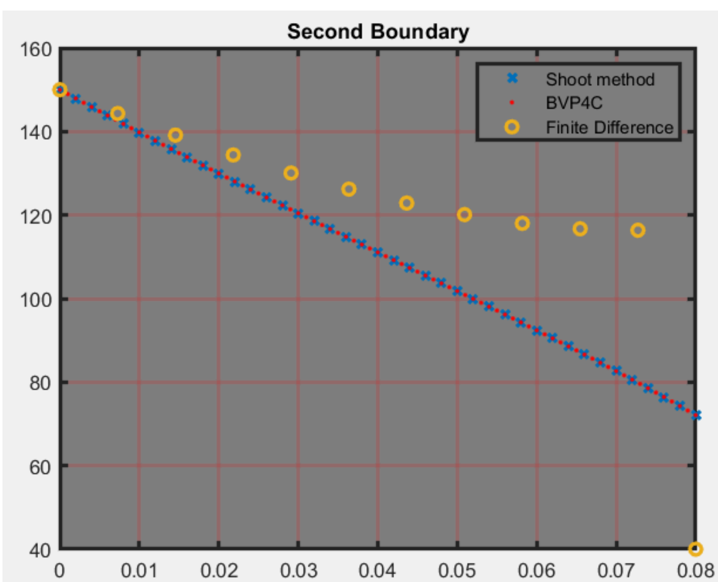
Q4:

Part (A) : (Matlab code)=> Graphed in Matlab
Part (B) : (Matlab code)=> Graphed in Matlab
Part (C) : (Matlab code)=> Graphed in Matlab




Preview of graphs:

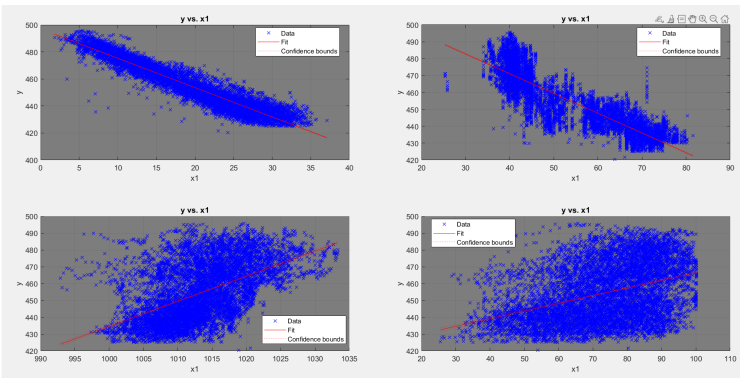
As we can see both the shooting method and finite difference method were both good approximations under the first boundary condition.




Under seconds Boundary condition the shooting methods prove to be a good approximation, but we see that the finite Difference method over shooters and follows the incorrect path.

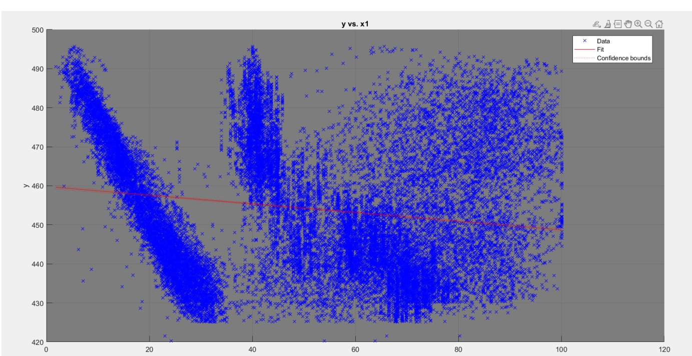
Q5:

Part (A) : (Matlab code)=> Graphed in Matlab
The R squared that was calculated for each graph was:
AT = 8.98e-01
V = 7.56e-01
AP = 2.68e-01
RH = 1.51e-01




Looking at the four graphs we can see that the best-fit line shows the correlation between energy output vs our variable input. In the first line, the correlation is at its greatest compared to the rest, and that is because the data shows a stronger correlation relationship to the energy output.
Now if we look at the last graph, we can see that the relationship is the weakest, and thats because the relationship to to the energy output is not that prevalent. When observing from the naked eye, it can be difficult to see any type of relationship, but doing a linear regression can show us the mathematical true relationship.

Part (B) : (Matlab code)=> Graphed in Matlab
Multilinear regression, the R squared was calculated to be MLR = 2.69e-01




As stated above the linear regression helps us identify even the small bit of relationship between the output energy vs our input variable. When doing a multi-variable regression we can see the net relationship between variables and energy is negative. Whereas before we have two positive and two negative relationships. This tells us that the two negative relationships are stronger than the two positive relationships. This also gives us a general idea of the overall relationship between the entire power plant's energy consumption vs varble output.