357 Project 2

Task 2

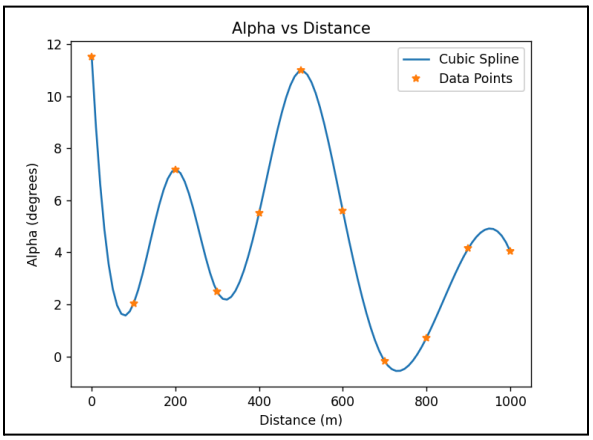


Figure 1: Graph of Terrian Angle at certain Distances

Figure 1 shows a smooth curve because the function used to generate the plot interpolates between points using a cubic spline. It generates a continuous function that is smooth all over. Furthermore, the line goes through all data points (stars) because the step size is small. A smaller step-size results in a higher resolution graph at the expense of more computational expense. If we wanted to be efficient, we could reduce the number of points used to plot the graph, but for this project, the increase in computational cost is very small since we are just using a built-in function that is fast and not resource intensive to create the points for our graph.

Task 5

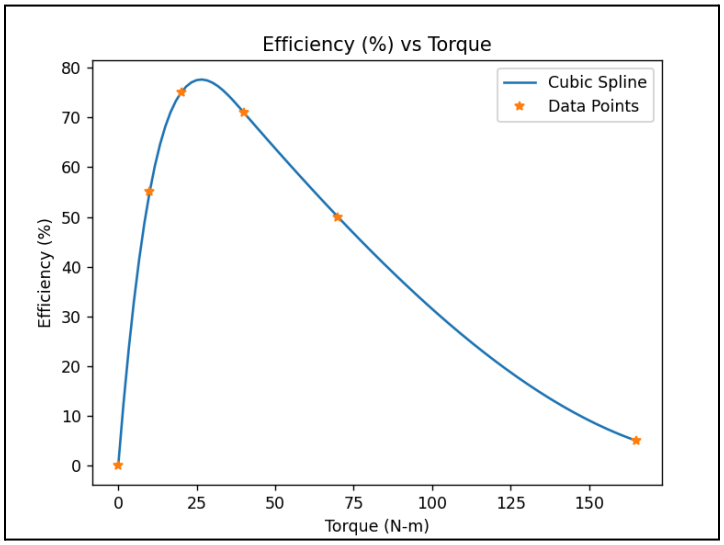
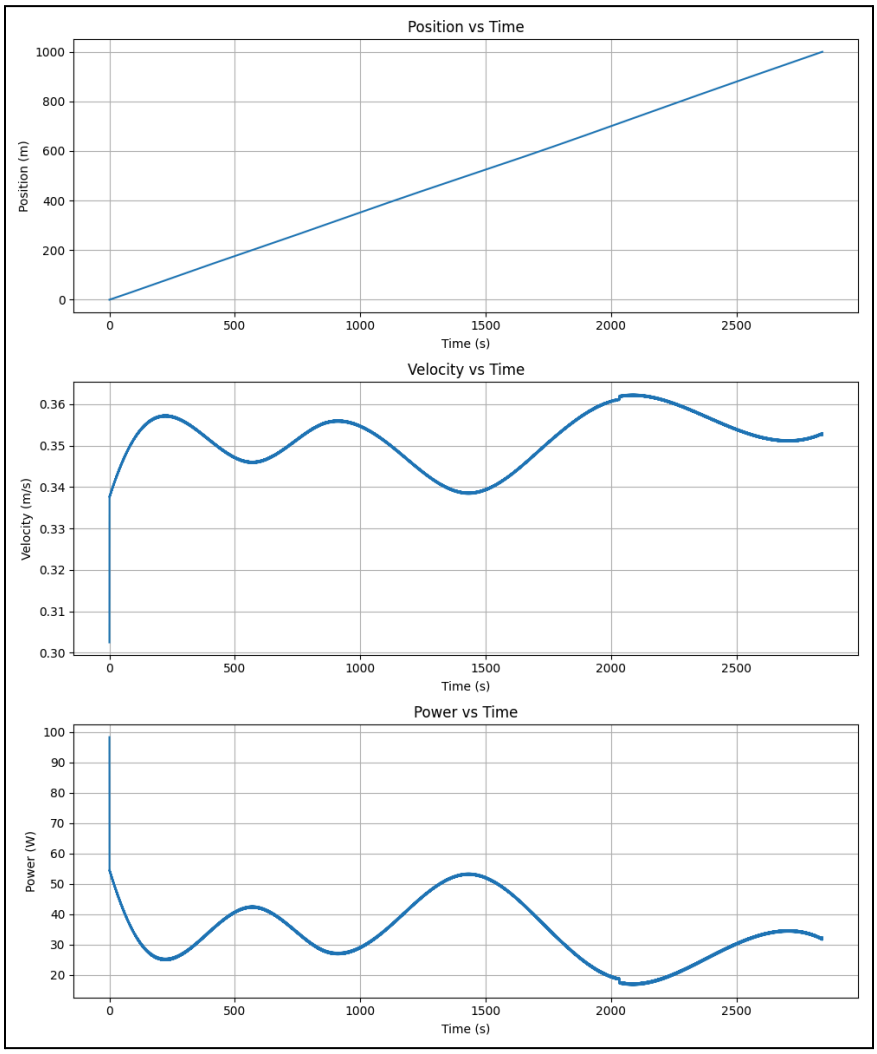


Figure 2: Scatter plot and Graph of Efficiency vs Torque

Figure 2 resembles Fig 2 in the handout. Both curves have a max efficiency at lower torques, with a decline in efficiency as torque increases. However, they are slightly different in shape. Fig 2 in the handout has a linear relationship after reaching max efficiency, while **Figure 2** shows a quadratic-looking relationship. **Figure 2** is a smooth curve and passes through all of the points because of the step size. I We used 100 points to great the graph, but if we had used fewer points under the same bounds, the graph would have looked choppier and may not have passed through all of the points denoted by stars.

Task 8



A. Position vs. Time is approximately linear when you look at the graph as the velocity stays approximately constant. The velocity graph is set on an offset so the only fluctuations are really quite minor compared to the magnitude.

B. Velocity and power appear to be inversely proportional, which is to be expected. This can arise because of too reasons. A lower velocity means a sleeper incline, meaning more force and therefore power is needed to get the rover up the incline. Additionally, the greater the torque, at a certain point, the more inefficient the rover is. Which means more power is needed to produce the same amount of torque from the motor

C. The velocity profile seems to give higher velocities when the terrain angle is low, and lower velocities when the terrain angle is high. This makes sense as the rover can move quicker at level terrains, and must move faster, and use more power (like stated above) to go over higher inclines.

D. The velocity graph is smooth, as the curves are not jagged, except the startup speed jumps to .34 to start, as it comes off of the initial high incline. The velocity graph is not jagged, which makes sense as the angle of the incline is not changing rapidly but rather in similar curved patterns.

Task 9

Completion Time (s)	Distance Traveled (m)	Maximum Velocity (m/s)	Average Velocity (m/s)	Battery Energy Used (J)	Energy per Distance (J/m)
2842.92	1000.00	0.36	0.35	1094688.75	1094.69

The provided **0.9072e6 J** Lithium Iron Phosphate battery pack is insufficient to complete the experiment. According to the telemetry data from Task 8, the rover consumed **1,094,688.75 J** of energy to complete the task, which exceeds the energy available in the battery by **187,488.75 J**.

As a result, the rover would need a larger battery pack or a more efficient energy management system to complete the mission defined in **experiment1 successfully**.