Project, Phase 2: Rover Dynamical Analysis

Group 16

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5.2 Task 2: Visualizing the Terrain

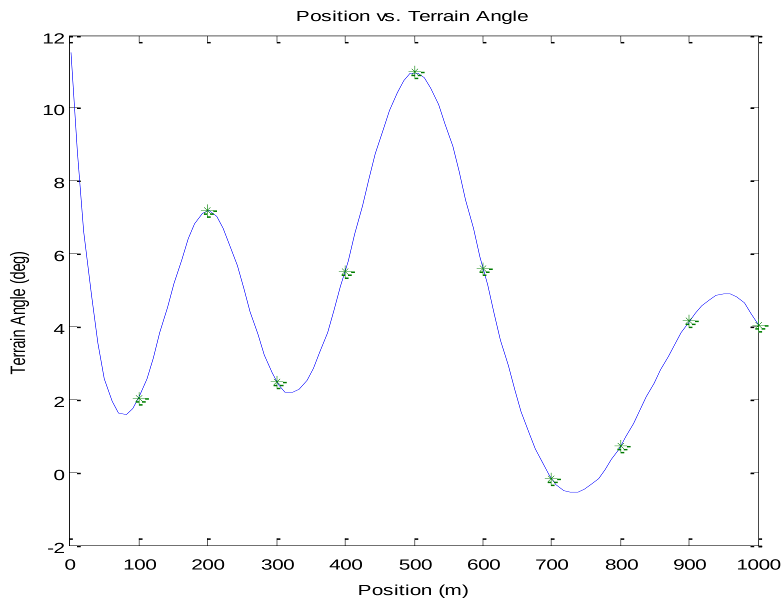

Figure 1: Position vs. Terrain Angle

In Figure 1, one can see there is a positive terrain angle for most of the distance covered, except near 725m. This means the rover is travelling uphill for the majority of the simulation. The terrain angle oscillates over the given distance, meaning there are steeper areas and flatter areas of terrain. The steeper regions occur around the maximums of the plot, and the flatter regions occur around the minimums (as terrain angle nears zero degrees).

5.5 Task 5: Visualizing Motor Efficiency

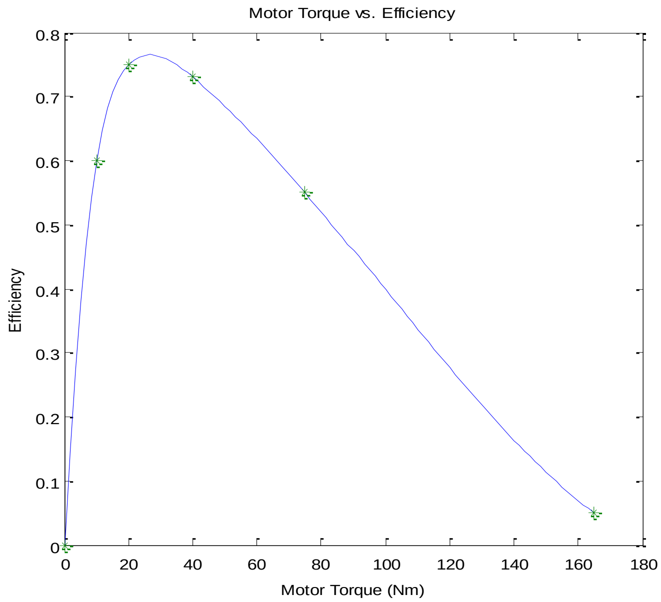

Figure 2: Motor Torque vs. Efficiency

In Figure 2, the maximum efficiency of 0.7651 occurs at 27N-m. This is very similar to the efficiency curve provided in the project outline document. This physically means that the DC motor can only convert 75% of electrical energy supplied by the batteries into rotational mechanical energy, at best. The efficiency curves climbs quickly to the maximum value. But after reaching the peak efficiency, the efficiency steadily decreases back down to 0.05 at 165N-m. We will utilize this curve to determine the efficiency of the DC motor that corresponds to a given motor torque, which is affected by the terrain angle in Figure 1. As the terrain angle increases, the torque needed by the rover increases as well because it requires more power to overcome the larger gravitational force.

5.8 Task 8: Rover Simulation

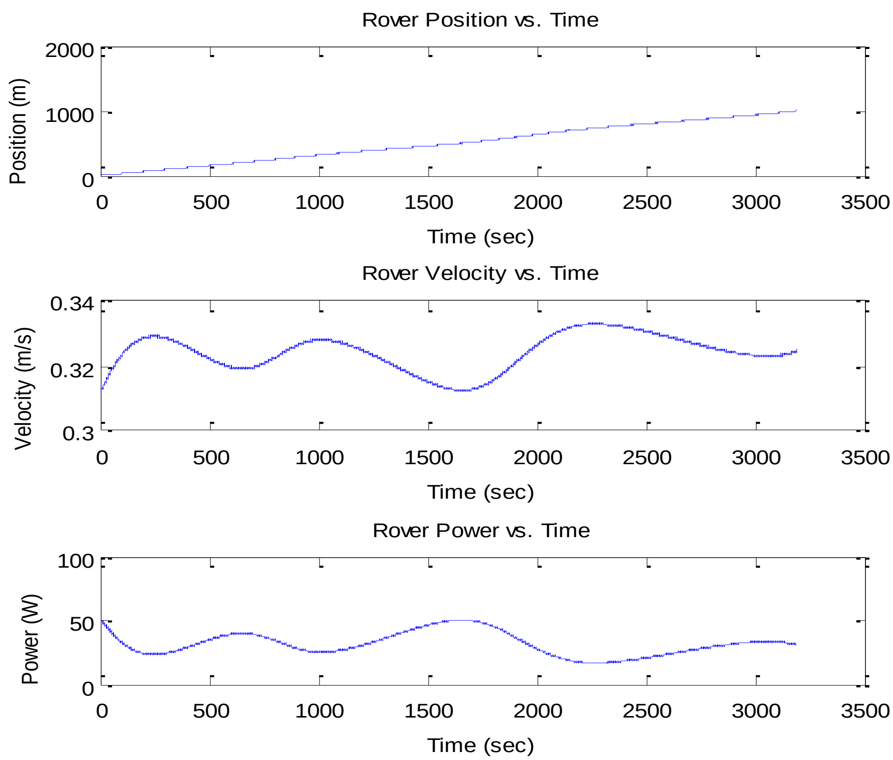

Figure 3: a) Rover Position vs. Time, b) Rover Velocity vs. Time, and c) Rover Power vs. Time

In Figure 3 a), the rover's position is not completely linear due to the fact that the terrain is not constant. This means that the rover's velocity decreases at times because of the sudden increases in terrain angle causing the rover to travel less distance. In Figure 3 b), as discussed previously, the velocity varies in an oscillating manner, and is all explained from Figure 1. If the terrain angle fluctuates, the velocity does also because at a steeper angle, the rover has to work more to climb. In Figure 3 c), the power fluctuates, as in Figure 3 b), but to a lesser degree and in opposite directions of the velocity profile (indicating an inversely proportional relationship). When the graph outputs positive slopes, it indicates that the terrain angle is increasing, since it needs more power to ascend higher angled terrain.

Completion Time	3109.3 sec
Distance Traveled	1000 m
Max Velocity	.3332 m/s
Average Velocity	.3242 m/s
Battery Energy	1.1013e6 J
Batt Energy per Distance	1.1013e3 J/m

5.9 Task 9: Analysis of Energy Needs

The rover will not able to complete the case defined by experiment1.mat with the 0.9072e6 [J] Lithium Iron Phosphate battery pack. This is due to the fact that the energy output of our rover defined by experiment1.mat was computed to be 1.1013e6 [J].