Project 1 Questions Document - Wyatt Moore, Mark Menezes, Esteban De Leon

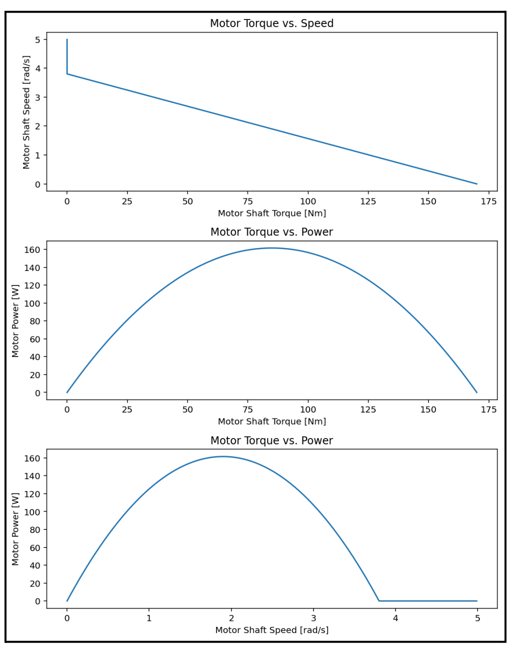
Question 1: We had you define the acceleration due to gravity as a field in a structure that you had to pass as an input argument to several functions. Instead, we could have had you type the value for the constant, 3.72 m/s2, directly in those functions. Do you believe there is an advantage to how we had you do it? Explain. Would you have done it differently? Explain why or why not.

The value for Mars's gravity, 3.72 m/s^2, is simple; storing it as a variable would add unnecessary complexity to the program. I don't think we would have done it differently, as even though storing the gravity of mars as a common variable like 'g_mars' might be simple, it also might have more chances to fail if the file that value is stored in has a runtime error, or if the value gets accidentally overwritten.

Question 2: What happens if you try to call F_gravity using a terrain slope of 115 degrees? Is this desirable behavior? Explain why you think this.

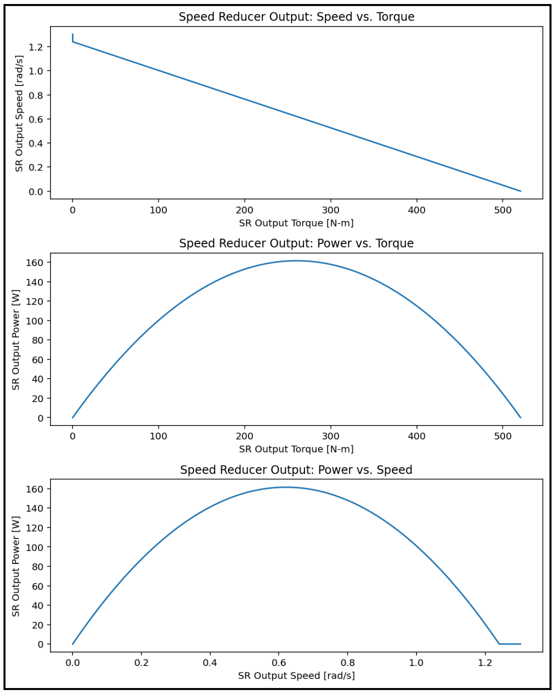
If you try to call F_gravity at 115 degrees, the code will return an error, as this is beyond the range of the rover. This is not a desirable behavior because the slope is effectively inverted and impossible to traverse.
A correction for the future is to return an incident error flag, as this sort of 'out of range' error could indicate either some sort of sensor failure in the rover, or that the rover has gotten into a bad position and needs troubleshooting before continuing operations.

Question 3: What is the maximum power output by a single rover motor? At what motor shaft speed does this occur? Provide graphs or other data to support your answer.



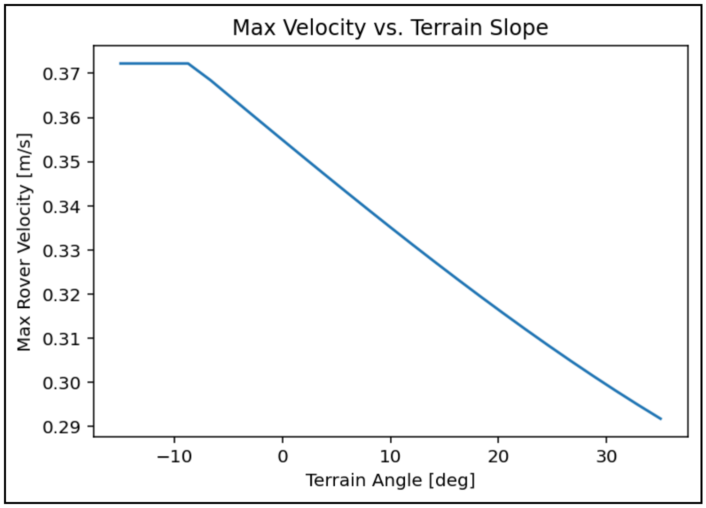
The maximum power output by a single rover motor is 161.5W at a motor shaft speed of 1.9 rad/s.

Question 4: What impact does the speed reducer have on the power output of the drive system? Again, provide any graphs or supporting data.



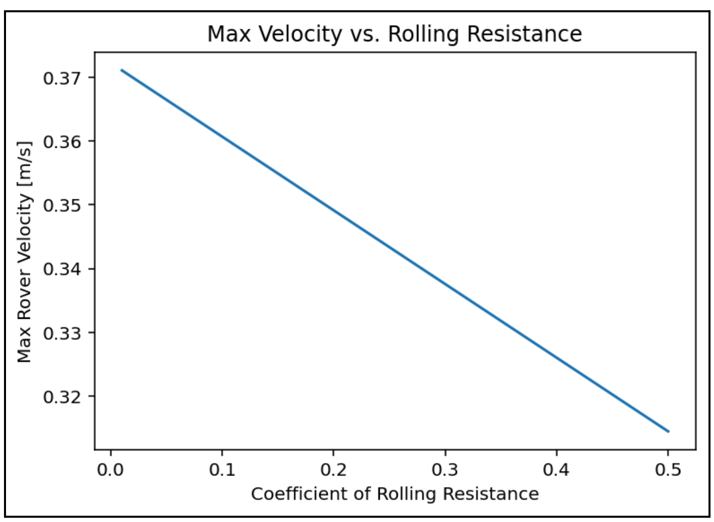
The speed reducer increases the maximum torque output of the drive system, both when measured against the power input of the motor and the motor's speed.

Question 5: Examine the graph you generated using analysis_terrain_slope.py. (Provide the graph in your response for reference.) Explain the trend you observe. Does it make sense physically? Why or why not? Please be precise. For example, if the graph appears linear or non-linear, can you explain why it should be the way you observed? Refer back to the rover model and how slope impacts rover behavior.



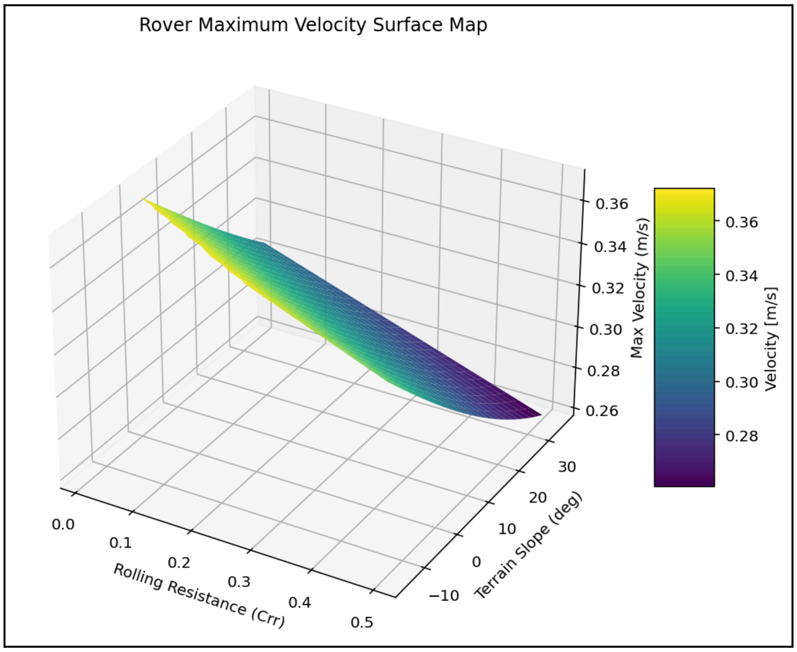
The trend illustrated shows a negative, nonlinear relationship between the terrain angle and max velocity. This is due to the friction force being proportional to the sine of the terrain angle. It also makes sense as well since as the slope becomes steeper uphill, the rover will be fighting the force of its own weight due to gravity.

Question 6: Examine the graph you generated using analysis_rolling_resistance.py. (Provide the graph in your response for reference.) Explain the trend you observe. Does it make sense physically? Why or why not? Please be precise. For example, if the graph appears linear or non-linear, can you explain why it should be the way you observed? Refer back to the rover model and how the coefficient of rolling resistance impacts rover behavior.



The graph generated shows a negative linear relationship between the coefficient of rolling resistance and max velocity. This makes sense since the coefficient of rolling resistance is proportional to the resistive component of the rover's motion.

Question 7: Examine the surface plot you generated using analysis_combined_terrain.py. (Provide the graph in your response for reference.) What does this graph tell you about the physical conditions under which it is appropriate to operate the rover? Based on what you observe, which factor, terrain slope or coefficient of rolling resistance, is the dominant consideration in how fast the rover can travel? Please explain your reasoning.



It is better to operate the rover downslope on areas with low rolling resistance. The dominant factor is definitely the terrain slope, as it is responsible for the largest gradient in maximum velocity over the surface map. Compared to this, the rolling resistance only provides a minor modifying factor to the maximum velocity of the rover.