**Application: Driver-Glider Model Questions**

Using the previously generated Glider model, develop a Driver model that produces a tractive force (Ftr) in order to "drive" the glider model. The driver should use a PID controller in order to attempt to match an input drive cycle.

The driver will take a drive cycle and the current vehicle speed as inputs, calculate the difference between the values, and "adjust" the Ftr in order to minimize the error between the two. You must "tune" the driver model (ie. edit the values of Kp, Ki, and Kd) in order to match all of the drive cycles without any trace misses.

The model will also include powertrain force and power output limitations. The maximum power of the vehicle should be 110 kW, while the maximum force should be 8000 N. Keep in mind that limiting factor (in this case, force or power) will change depending on the vehicle speed.

Apply the following vehicle parameters:

* Coefficient of Rolling Resistance (c\_rr): 0.01
* Coefficient of Drag \* Frontal area (CdAf): 0.76 m2
* Air Density (rho): 1.2 kg/m3
* Vehicle Mass (m): 2050 kg (EREV target test mass)
* Inertial Mass (mi): 1.04\*m
* Road Grade (%): 0
* Gravitational Constant (g): 9.81 m/s2

Using the driver-glider model, answer the following questions:

Find the TOTAL tractive energy for the UDDS cycle. (Answer are all approximates)

|  |  |  |
| --- | --- | --- |
|  | 3500 kJ |  |
|  | 4050 kJ |  |

|  |  |  |
| --- | --- | --- |
|  | 3800 kJ |  |
|  | 3650 kJ |  |

Find the PROPEL tractice energy of the HwFET cycle. (Answers are all approximates)

|  |  |  |
| --- | --- | --- |
|  | 9300 kJ |  |
|  | 8200 kJ |  |

|  |  |  |
| --- | --- | --- |
|  | 7000 kJ |  |
|  | 5500 kJ |  |

Find the BRAKE tractive energy of the US06 cycle. (Answers are all approximates)

|  |  |  |
| --- | --- | --- |
|  | -1100 kJ |  |
|  | -2900 kJ |  |

|  |  |  |
| --- | --- | --- |
|  | -3200 kJ |  |
|  | -2300 kJ |  |

Test if your driver reacts properly by performing an acceleration test and braking test. In order to perform an acceleration test, set the drive cycle input to a constant 200 kph (125 mph) and see how the driver reacts. Where is the force limitation active and where is the power limitation active? Generate an Ftr vs. Time plot in order to observe this. To perform a braking test, set an initial vehicle velocity of 30 kph (~20 mph) and have a constant input of 0 mph. Watch the velocity vs. time and see if the driver attempts to stop the vehicle as soon as possible. In the braking case you may run into a problem called "integrator wind up" cause by the integration term in the PID controller. What does this problem do to your vehicle's behavior? How can you fix this? \*The solutions to this question are contained in the PDF document\*

