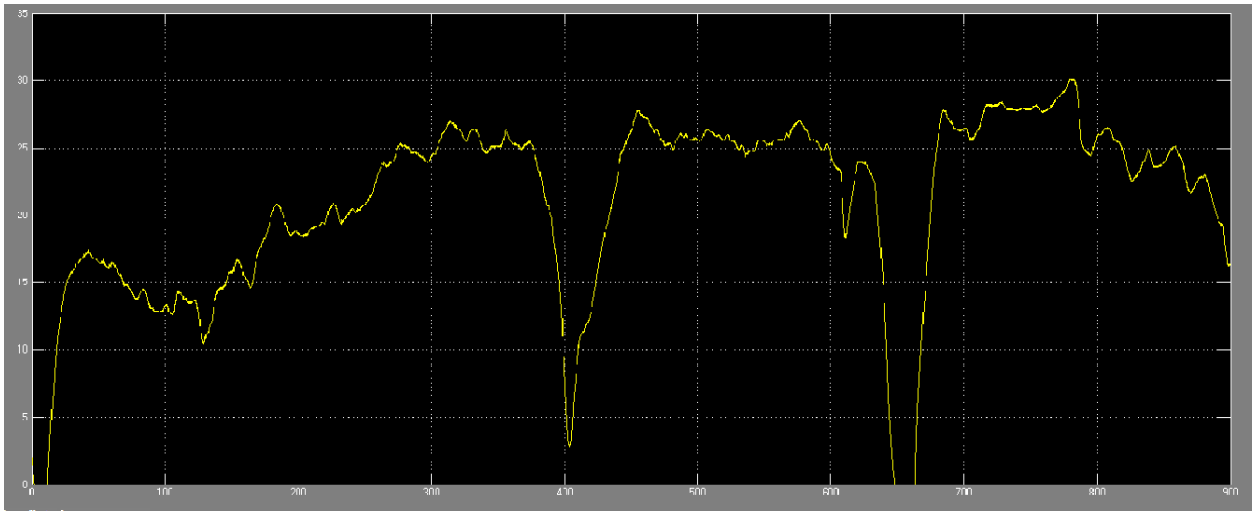
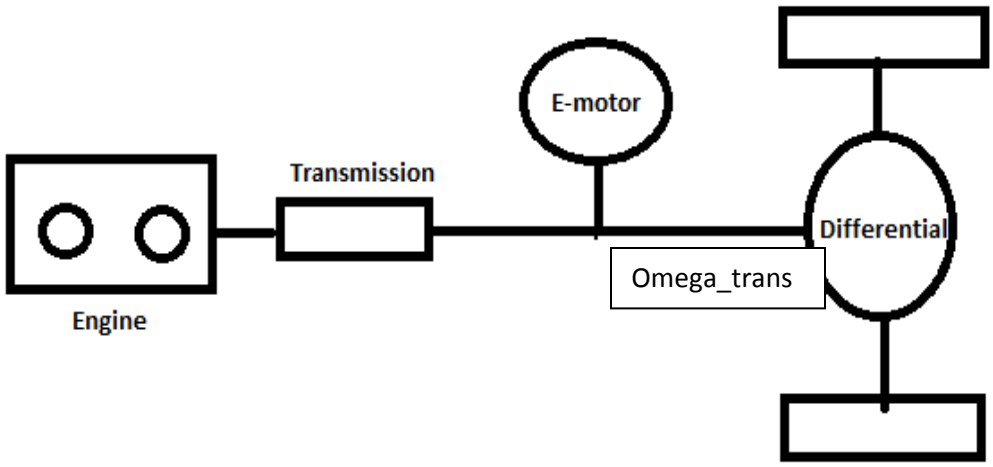
The following are the steps involved in the solution scheme

1. First the drive cycle is changed to the new drive cycle which looks something like this.



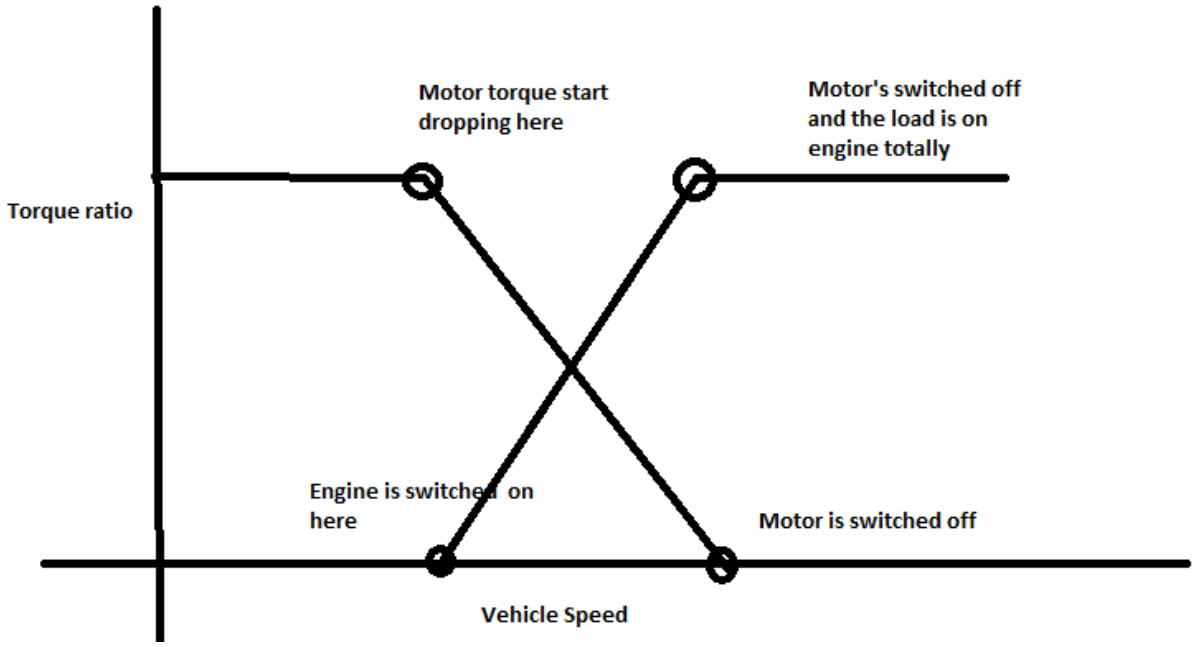
2. The architecture of the system is like this



Apparently, only gear reduction experienced by torque out of e-motor is through a differential (3.73)

3. Omega_trans is more important than the speed of the vehicle given the vehicle architecture.

4. The graph followed for switching and torque blending is shown below.



5. E-motor is switched off at **1000 RPM**. This is because Engines minimum speed is 1000RPM and motor reaches its max power at 1100RPM. Hence it makes sense to start decreasing load on E-motor from 1000 RPM.

6. E-motor is totally switched off at 1800 RPM. This is because its efficiency starts to diminish after this point.

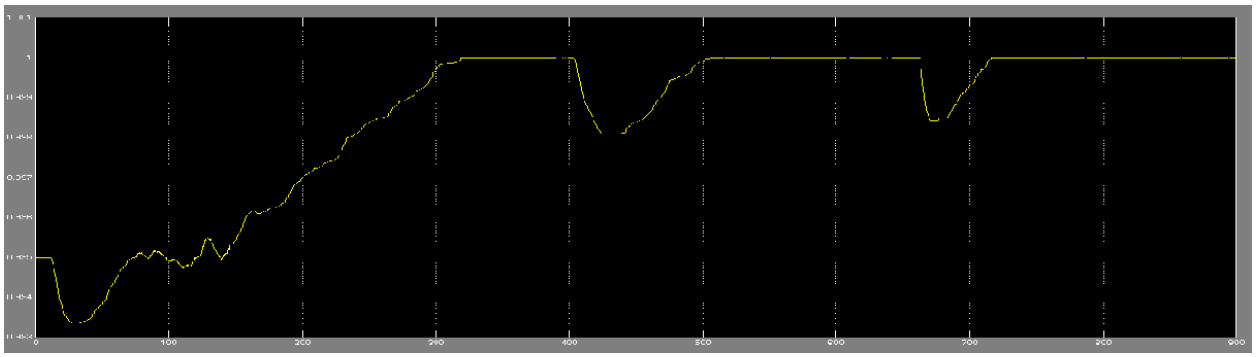
7. The criterion for control in this model is control over acceleration difference rather than velocity difference. I deliberately chose acceleration difference because I could directly use the value of positive and negative torque errors – this is the output of control system. Positive torque insinuate traction and negative torque, braking and potential for regeneration.

8. I calculated total torque request initially by using the graph above and then split the total torque into torque request for ICE and torque request for E-motor in the intermediate speed zone.

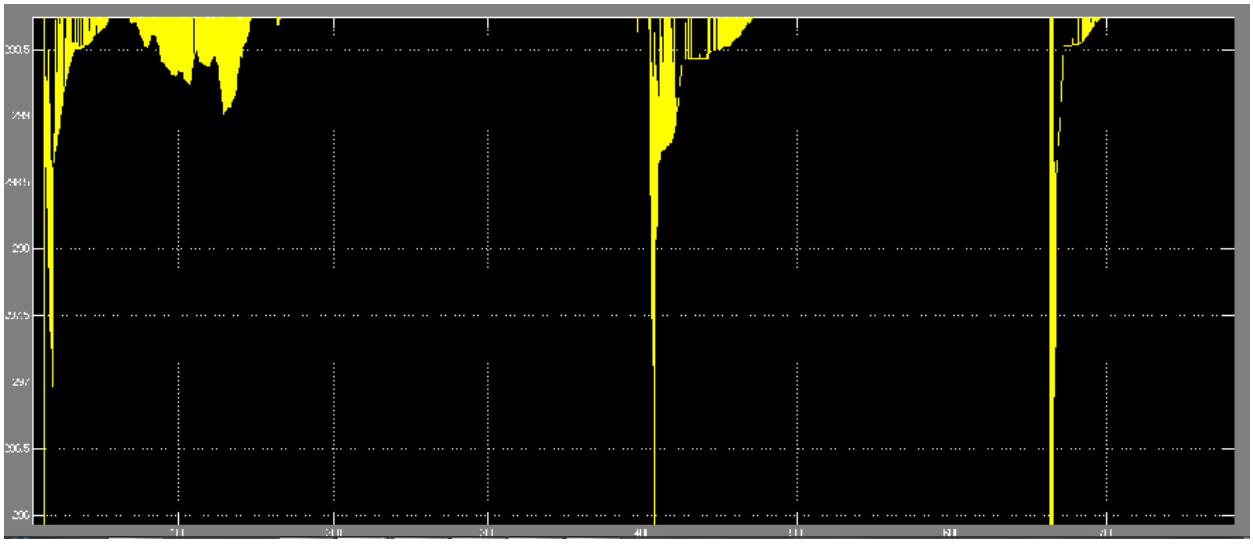
9. Then, this torque is handled separately. E-motor handles both positive and negative torque providing traction during positive cycle and regeneration during negative cycle.

10. Regeneration occurs only at front wheels. Hence I had to multiply 52% of the vehicles weight by coefficient of friction to get maximum possible tractive force and hence regeneration.

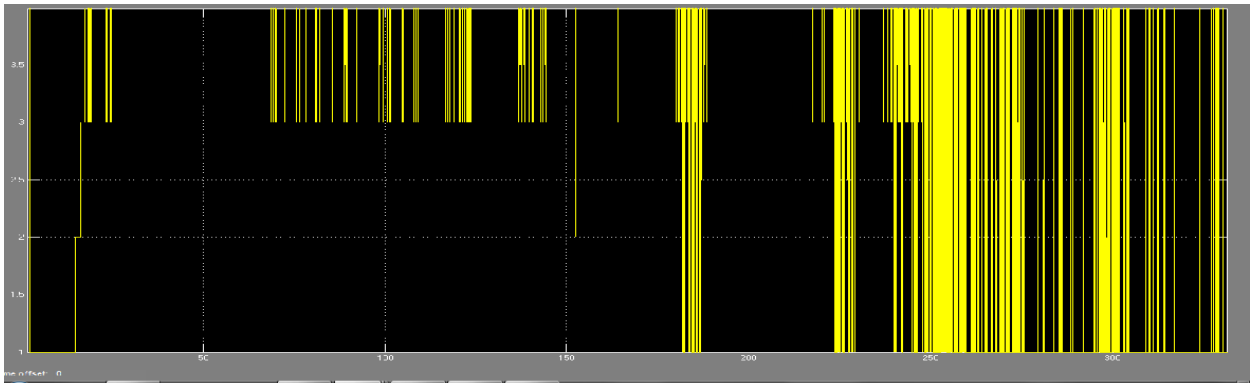
11. The battery should get recharged during regeneration and hence SOC has to increase. This can be noticed in the figure below which has periods of falling and rising SOC.



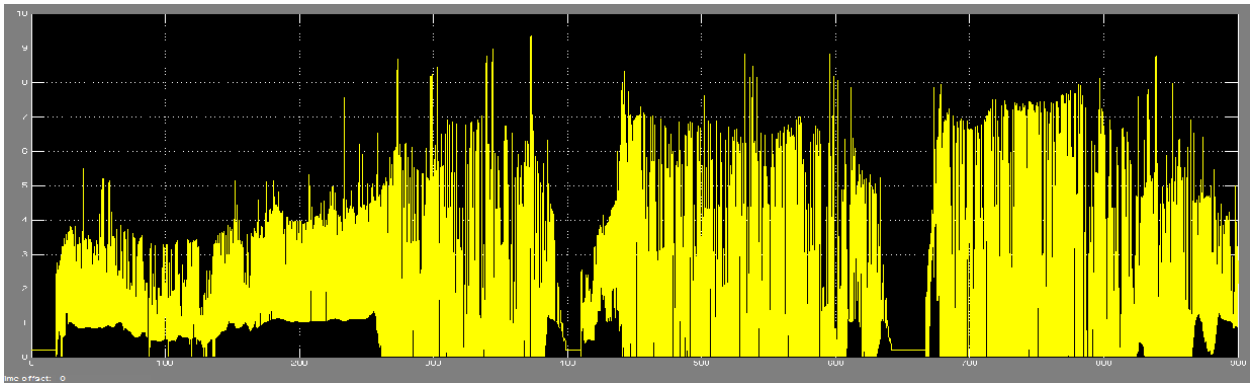
12. A similar trend can be noticed in the Voltage of battery which gets charged and discharged accordingly.



13. Torque on IC-Engine is handled through transmission. The torque requested at a particular RPM is sought and the corresponding fuel flow looked up. Then a particular gear which has lowest fuel ratio is selected. This actually lead to continuous and impossible shifting which is highly impractical. However, the graph is displayed below.



14. Fuel flow rate is also obtained at different gears and at different points on the cycle. The plot is shown below.



15. Engine stop start is calculated by using a flag. Then its integrated to find out the total time during which the engine was running, the value of which is 840s for a total of 900 seconds.

16. Finally, SOC flag is also set up above 0.35.