* **The Model**: *Student describes their model in detail. This includes the state, actuators and update equations.*

A: The model includes the vehicles x, y coordinates, orientation and velocity including CTE. The outputs of the algorithm are Steering angle and Acceleration. The cost involves the effect of the cte, steering, actuation and the time gaps between steering and actuation using the following equations

for (unsigned t = 0; t < N; t++) {

fg[0] += CppAD::pow(vars[cte\_start + t], 2);

fg[0] += 1000\*CppAD::pow(vars[epsi\_start + t], 2);

fg[0] += CppAD::pow(vars[v\_start + t] - ref\_v, 2);

}

//Actuations

for (unsigned t = 0; t < N - 1; t++) {

fg[0] += 500\*CppAD::pow(vars[delta\_start + t], 2);

fg[0] += 100\*CppAD::pow(vars[a\_start + t], 2);

}

// value gap between actuations

for (unsigned t = 0; t < N - 2; t++) {

fg[0] += 600\*CppAD::pow(vars[delta\_start + t + 1] - vars[delta\_start + t], 2);

fg[0] += CppAD::pow(vars[a\_start + t + 1] - vars[a\_start + t], 2);

}

Based on the classes I tried adding a Multiplication factor to smoothen the effects of individual error compensations on the final cost of the MPC model.

The first function increases the oscillations of the Car across the center line.

The second reduces settling time by manipulating the Epsi angle.

The third one manipulates the speed while decreasing it if it gets close the the ref value.

The second set of equations, are for actuations while the third set manipulates the value gap between Consecutive actuations helping to smoothen the gap.

* **Timestep Length and Elapsed Duration (N & dt)**: *Student discusses the reasoning behind the chosen N (timestep length) and dt (elapsed duration between timesteps) values. Additionally the student details the previous values tried.*

A: The values chosen for N and dt are 10 and 0.1, respectively. This was based on the solution of the MPC quiz from udacity and then after reducing the number anything below 7 seemed to be too small to compensate for the latency and bigger than 10 would never reach actuation. Tried values to reduce the Minimum time gap and a sufficient value seem anywhere between 0.85 to 1.5. Too big and it caused erratic movements.

* **Polynomial Fitting and MPC Preprocessing**: *A polynomial is fitted to waypoints. If the student preprocesses waypoints, the vehicle state, and/or actuators prior to the MPC procedure it is described.*

The way points are transformed to vehicle reference point and then the values initially in double format were converted to Eigen Vector form to be used in the Polyeval and polyfit functions.

* **Model Predictive Control with Latency**: *The student implements Model Predictive Control that handles a 100 millisecond latency. Student provides details on how they deal with latency.*

The actuations are applied based on the actuations from a previous timestep(line 69 in MPC.cpp) and are applied after two actuations to make up for the double 100 ms latency (lines 112 in MPC.cpp).