Udacity Self driving car nano degree term2 project5 writeup report

・Model detail
 The state includes vehicle position((x, y) coordinate), yaw angle(psi), vehicle speed, cross track error(cte) of y position between the ideal one (the lane center) and the actuated one, error of yaw angle(epsi) between the ideal one and the actuated one.
 The actuator includes steering angle delta and acceleration a.
 I used these equations to predict the ideal vehicle state.

$$x_{t+1} = x_t + v_t * cos(\psi_t) * dt$$

$$y_{t+1} = y_t + v_t * sin(\psi_t) * dt$$

$$\psi_{t+1} = \psi_t + \frac{v_t}{L_f} * \delta * dt$$

$$v_{t+1} = v_t + a_t * dt$$

Xt+1: x position of the next time step
yt+1: y position of the next time step
psit+1: yaw angle of the next time step
vt+1: velocity of the next time step
Xt: x position of the current time step
Yt: y position of the current time step
Psit: yaw angle of the current time step
Vt: velocity of the current time step
Dt: difference between the next and current time step
Lf : the distance between the center of mass of the vehicle and it's front axle
Delta: steering angle
At: acceleration

・Choice of N and dt
 I finally set N as 10 and dt as 0.1, because the vehicle traces the lane center well.
 When I chose bigger or smaller N value than 10(while dt was 0.1 at all), the vehicle oscillated.
 Regarding to dt, the vehicle oscillated when dt was bigger or smaller than 0.1(while N was 10 at all).

·Preprocessing of the vehicle state and the actuator before MPC

　I used the cost function to move the vehicle smoothly.

　I optimized current cte, epsi, delta, a, difference between next and current delta, and difference between next and current a by the CppAD.

　I weighted each cost function like below.

	Weight
Cte	1
Epsi	50
Delta	1
A	1
Difference between next and current delta	500
Difference between next and current a	100

I learned it's essential to move the vehicle smoothly that differential has quite bigger weight than proportional. So I gave bigger weight to differential of the delta than proportional of that. I did the a as well.

And the reviewer advised me to weight epsi more than cte. So I followed that advice and the vehicle worked well as a result.

·Latency

　I add the latency to the vehicle state before I send the update function of the vehicle state.