# Model Predictive Control

In the model predictive control controller the following kinematic model was used:

*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] + v[t] / Lf \* delta[t] \* dt*

*v\_[t+1] = v[t] + a[t] \* dt*

*cte[t+1] = f(x[t]) - y[t] + v[t] \* sin(epsi[t]) \* dt*

*epsi[t+1] = psi[t] - psides[t] + v[t] \* delta[t] / Lf \* dt*

Each state is described by 4 state parameters: {x,y,psi,v}, 2 errors {cte,epsi} and 2 actuators {steering angle, acceleration}.

The time step length (N) was chosen in order to allow the PC to calculate predictive trajectory. I’ve tried different options (N=5, 25) and stick to 10 due to the proper model performance. Duration of time step (dt) was chosen equal to 0.1 experimentally. dt=0.05 was tried but discarded.

In order to take into account the latency the following equations was used to predict coordinates and velocity taken into account velocity:

double latency = 0.1;

px = px + v\*cos(psi)\*latency;

py = py + v\*sin(psi)\*latency;

v = v + throttle\_value\*latency;

Latency was not introduced into the angle, due to the minimizing value gap between sequential actuations of steering angle in the cost function.

A lot of iterations were done varying weights of 7 components in the cost function in the range [1,10000]. Final solution was used 1 weight for all components and 1000 in the component minimizing value gap between sequential actuations of steering angle.