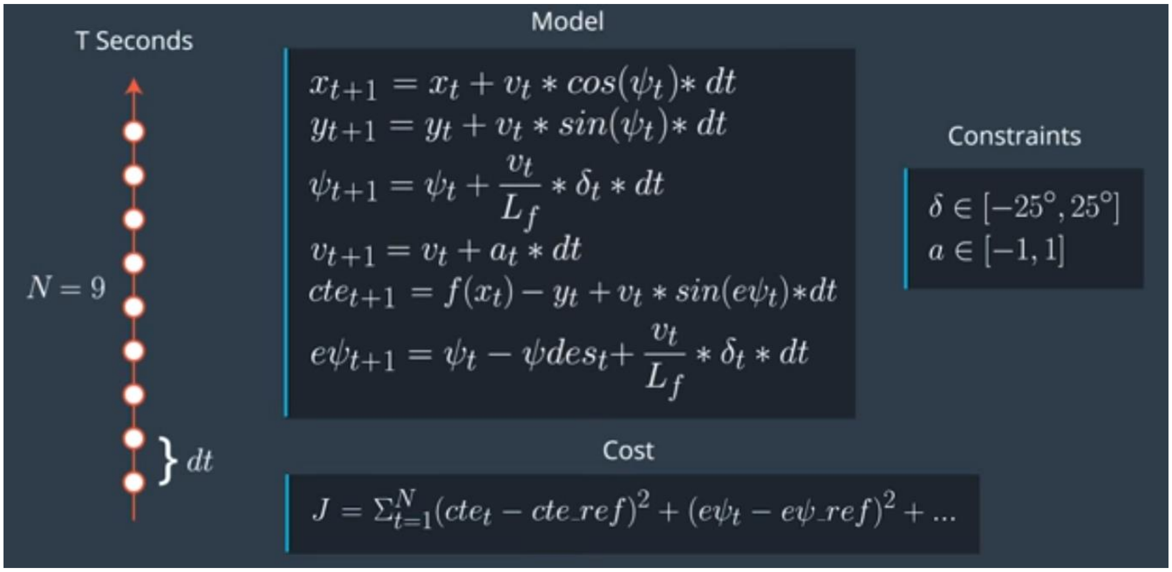
Model Predictive Control Project:

In model predictive control (MPC), the control of car is formulated as an optimization problem. The controller predicts the actual trajectory and selects the actuator inputs that minimizes the error between the actual and reference trajectories. Both the actual and reference trajectories are modelled by a third order polynomial. The cost function to be include following terms:

1- State:
   a. Cross track and wheel orientation error
   b. Reference velocity
2- Control inputs:
   a. Actuator constraints
   b. Temporal smoothness

The state equation, actuator constraints and the cost function is shown in the below figure:



The optimization is executed for the duration of T seconds, which is the product of number of steps (N) and the time increments (dt). In this project I chose the number of steps to be 10 and the length of time increment (dt) to be 0.1. This was discussed in the course that dt should be as small as possible to make the prediction as realistic as possible, but at the same time a very short timestep length will cause the optimization to run very slow. At the same time, N should not very large as it would also cause the optimization slow. The important factor to keep in mind is that the cost function should converge to zero.

To deal with latency, I am calculate cross track error and orientation error assuming position ad orientation in the car coordinate system are zero. Then using the model equation, I update the state of the car for the duration of latency. This updated state is sent to the controller to compute the actuator inputs which is the used to control the car considering latency.