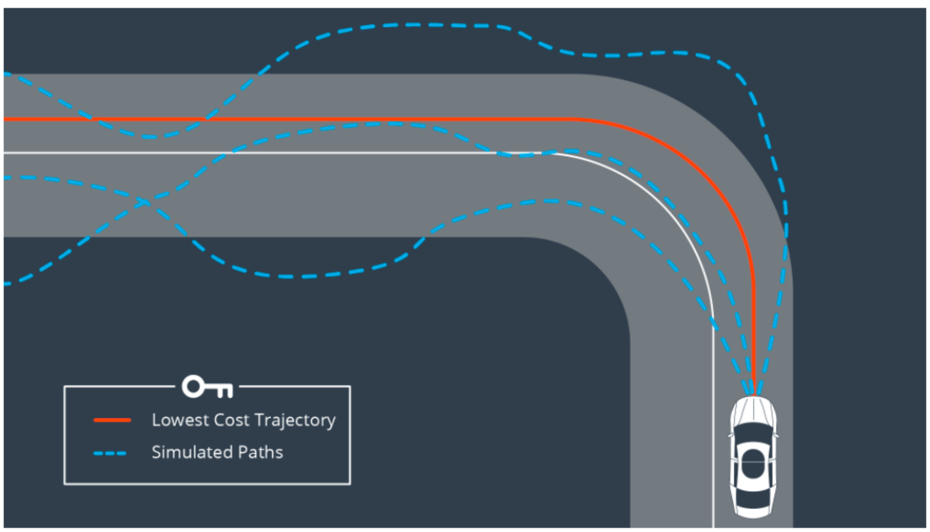
Rubric Points

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

The model predictive control (MPC) rely on dynamic models of the process. One of it mains charachteristics is that allows the current timeslot to be optimized, while keeping future timeslots in account. This is donde by optimizing a finite time horizon, but only implementing the current timeslot. This model can anticipate coming events and take control actions accordingly. The kinematic model of the vehicle includes the x and y coordinates, orientation angle (psi), velocity, cross-track error and psi error (epsi); the actuators are throttle and steering angle. The current timestep is calculated using the following equations:

Model Predictive Control (MPC) uses an optimizer to find the control inputs that minimize the cost function.



We actually only execute the very first set of control inputs. This brings the vehicle to a new state and then we repeat the process.

- **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.*

The MPC optimiser has two variables to represent the horizon into the future to predict actuator changes. They are determined by N (Number of timesteps) and dt (timestep duration) where T (time) = N * dt.

Setting a small value of dt provides finer resolution since the time interval is close to latency , this has an impact in the controller to deal with 100 millisecond latency suggested in the project. Using trial an error I considered a proper value would be 0.1.

In order to determine the timeste duration I had to take in count the computational resources that represents a higher value of N, again after a process of trial and error I determined the value of N = 10 to be optimal.

The time horizon (N*dt) above 3 seconds was too far and usually had problems associated with going out of the road.

- **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 waypoints were preprocessed by transformig them to the vehicle's perspective. This makes easier fitting the polynomial the the waypoints since the x and y coordinates of the vehicle are now the origint and the orientation is zero.

- **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.*

A kinematic model is implemented to predict the state 100 ms ahead of time and then feed that predicted state into the MPC solver. The equations most be modified in order to achive a good performance and an extra cost function was added penalizing the combination of velocity and delta.