Polynomial Trajectory

Get Trajectory in local coordinates

The trajectory is generated for a constant steering wheel angle input and for a fixed number of steps. This polynomic will be fited to this trajectory.

Get polynomic for the trajectory

A minimization method is used to fit the local trajectory to a nonlinear function defined with a polynomic.

$$y(t) = a5 * t^5 + a4 * t^4 + a3 * t^3 + a2 * t^2 + a1 * t + a0$$

The objective function is defined like a sum of squared errors where the time are t_i and the responses are $y_i, i = 1, \ldots, n$.

$$\sum_{i=1}^{n} (y_i - (a5 * t_i^5 + a4 * t_i^4 + a3 * t_i^3 + a2 * t_i^2 + a1 * t_i + a0)^2)$$

Its used the Quasi-Newton method. It´s posible to probe from first to fifth order functions.

Method 1

In this method is tried to fit the local coordinates of the trajectory to the x(t) and y(t) functions, is obtained the first and second derivatives. Then we use a method to obtain the curvature and get the steering wheel angle from the polynomics and their derivatives.

Method 2

In this method first is obtained the curvature from the yaw rate and longitudinal speed of the trajectory and them is obtained a polynomic that fit this curvature function.

Conclusions

Method 1

With polynomials of degree greater than 3 it is necessary to do extra work on the optimization algorithm to solve overfitting problems, but in principle a good fit of the polynomials can be achieved.

It has been tested on both circular and lane change trajectories

Method 2

There is a good fit of the polynomials of degree 1 to 2 above overfitting problems appear.

General

Both methods are very dependent from the initialization point and from the kind of trajectory function.