Master 2 MRT

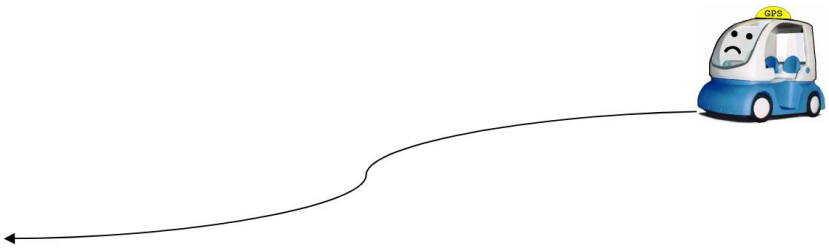
Sensor fusion module

Dynamic state estimation of a vehicle equiped with a GPS and wheel odometers

Practical Application with Matlab

We consider an intelligent vehicle moving with a variable speed.

In the considered problem, the vehicle is operated by a human driver.



We want to estimate its dynamic state *X* characterized by its abscisse *x*, its ordinate *y* and its yaw angle θ.

The vehicle is equipped with a GPS receiver (that provides x_{GPS},y_{GPS}) and incremental encoders installed on the rear wheels. These two sensors are sampled at a period *Te=1s*.

1. System modeling

Give the discrete state representation of the nonlinear system assuming that the odometric measurement is the input (*U*) of the system (=> odometric evolution model) and the GPS measurement is the observation (*Y*).

Calculate the Jacobian matrices of the system (linearize). The result is a state representation denoted (A_k, B_k, C_k).

2. State estimation

Give the equations of a discrete Extended Kalman Filter to estimate *X*. Quantify the covariance matrices of the different noises. What initial matrix of error covariance estimate will you take ?

3. Simulation

Using Matlab as well as the provided simulation kit and the file with real data, test the performance of the EKF. The data file provided contains the GPS data and odometric data for an actual test trip performed by the robotised vehicle.