

SELF DRIVING CARS

KALMAN FILTER PROJECT

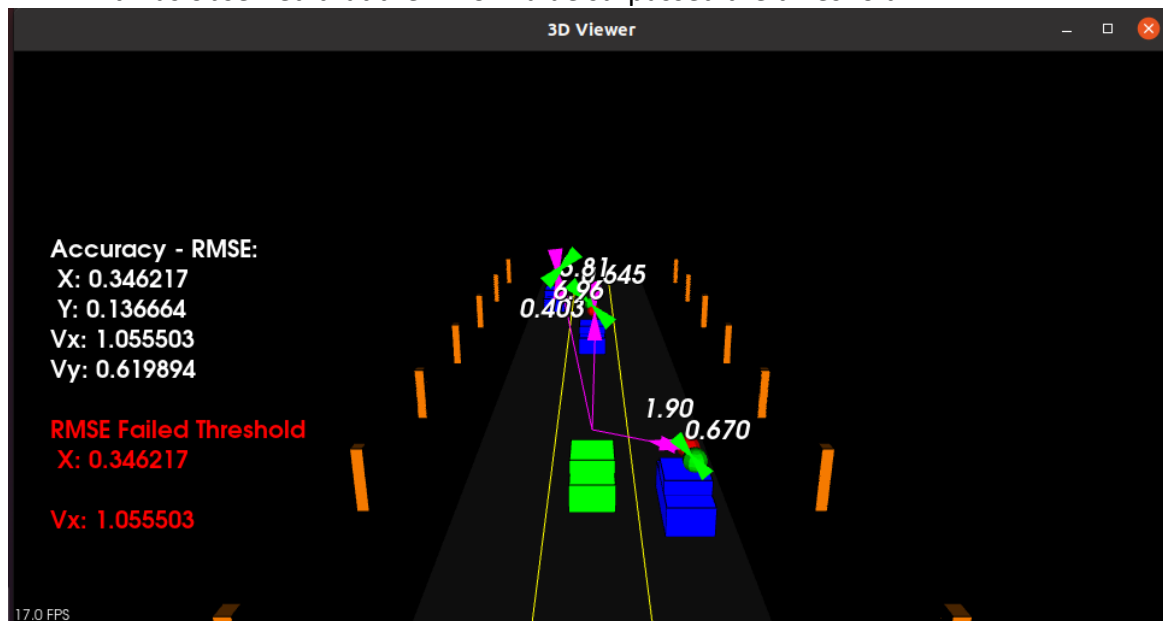
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The unscented Kalman filter is a suboptimal non-linear filtration algorithm, however, in contrast to algorithms such as EKF or LKF, it uses an unscented transformation (UT) as an alternative to a linearization of non-linear equations with the use of Taylor series expansion.

UNSCENTED KALMAN FILTER OUTPUT

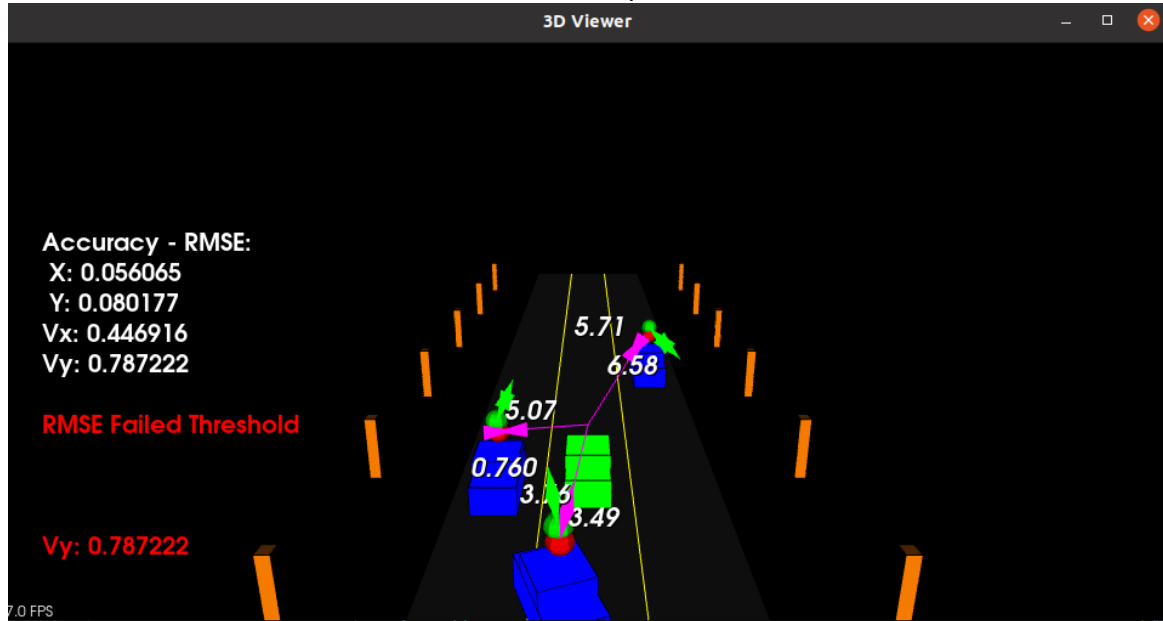
std_a_ value of 0.5
std_yawdd_ value of 0.5

- It was observed that the RMSE value surpassed the threshold



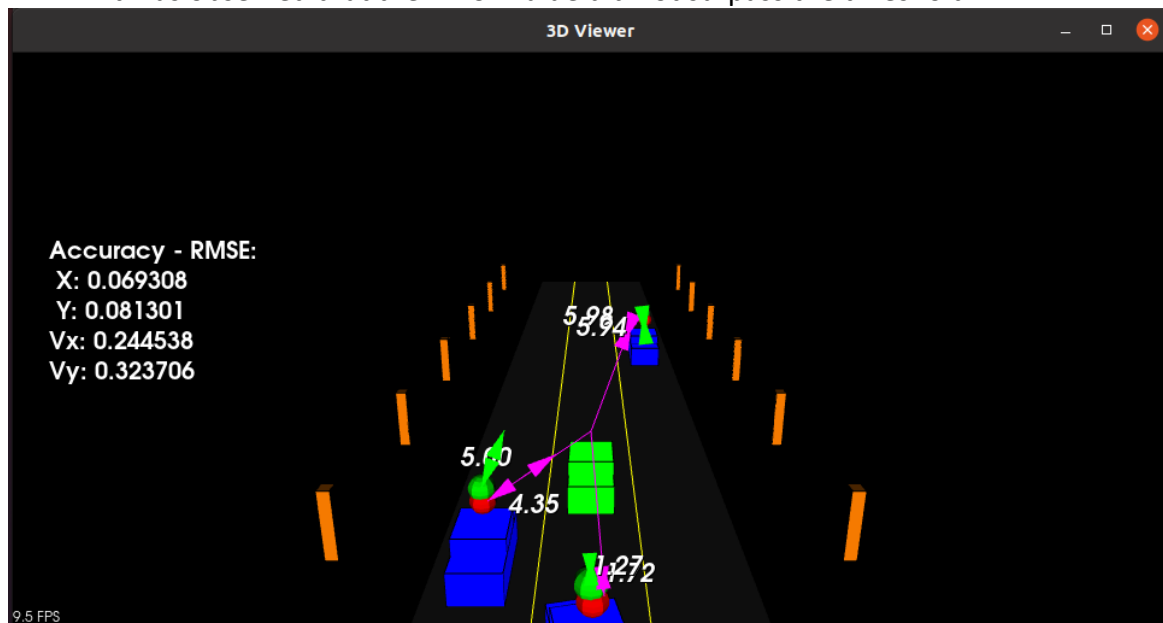
std_a_value of 30
std_yawdd_value of 30

- It was observed that the RMSE value surpassed the threshold



std_a_value of 0.8
std_yawdd_value of 0.5

- It was observed that the RMSE value did not surpass the threshold

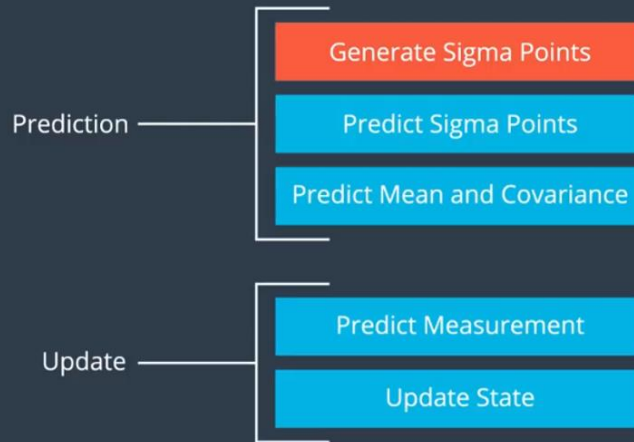


UNSCENTED KALMAN FILTER RULES

UKF implementation:

UKF Generate Sigma Points

UKF Roadmap



UKF Update

Kalman Gain

$$K_{k+1|k} = T_{k+1|k} S_{k+1|k}^{-1}$$

State update

$$x_{k+1|k+1} = x_{k+1|k} + K_{k+1|k} (z_{k+1} - z_{k+1|k})$$

Covariance matrix update

$$P_{k+1|k+1} = P_{k+1|k} - K_{k+1|k} S_{k+1|k} K_{k+1|k}^T$$

New here: Cross-correlation between sigma points in state space and measurement space

$$T_{k+1|k} = \sum_{i=0}^{2n_\sigma} w_i (\mathcal{X}_{k+1|k,i} - x_{k+1|k}) (\mathcal{Z}_{k+1|k,i} - z_{k+1|k})^T$$