05/03/2019

Ralazaba Electronics

Weekly Report

Done

The Kalman Filter was tested with real measurement with one sensor data which taken from encoders.

Some critical mechanical structures are 3D printed.

To Do

The Kalman Filter will be tested with HRMTM and encoders together.

Mechanical Implementation will be finalized.

Kalman Filter for Self-Localization Problem

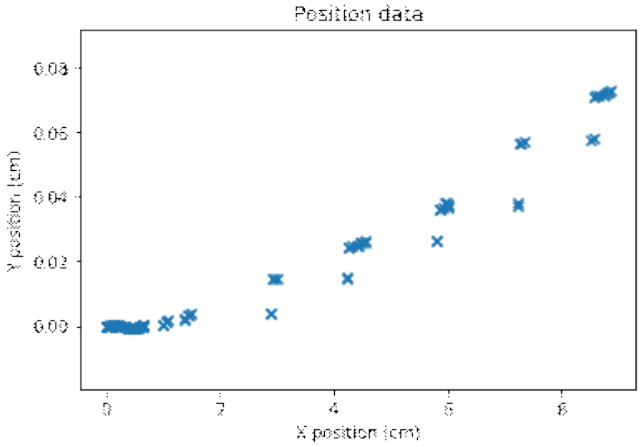

Figure 1: The dataset

In this experiment, we tested the capabilities of the Kalman filter. The measurement data taken from encoders can be seen in *Figure* 1. We added extra measurement noises to the dataset with unit mean and different covariances. Then, we plot both noised signal, ground measurement and estimated values in same figures. The results can be seen in *Figure* 2,Figure **3***Figure* **4***Figure* **5**Figure **6**Figure **7**. Results are also discussed in RMSE

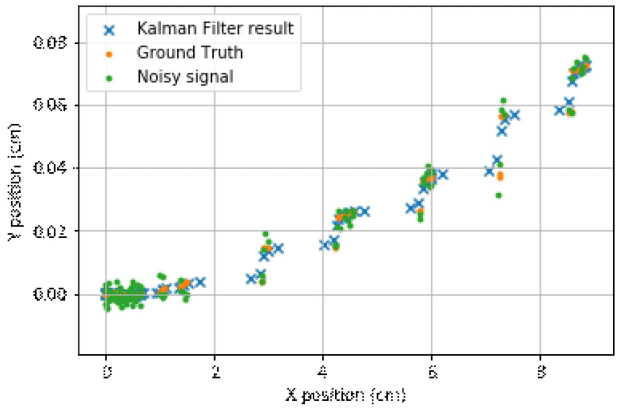

Figure 2: $\sigma = 0.002$

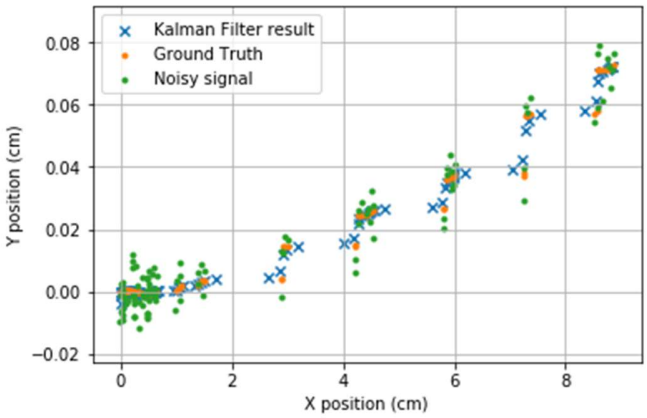

Figure 3: $\sigma = 0.005$

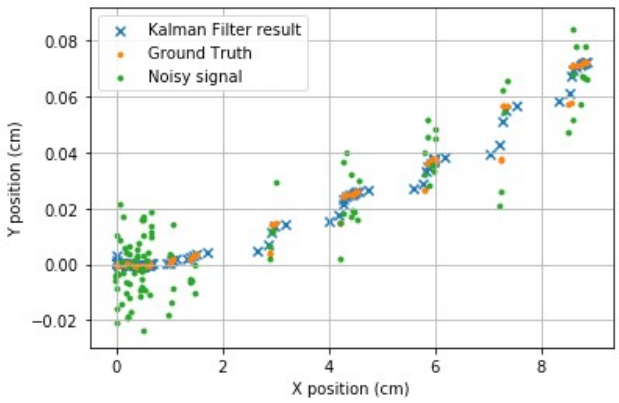

Figure 4: $\sigma = 0.01$

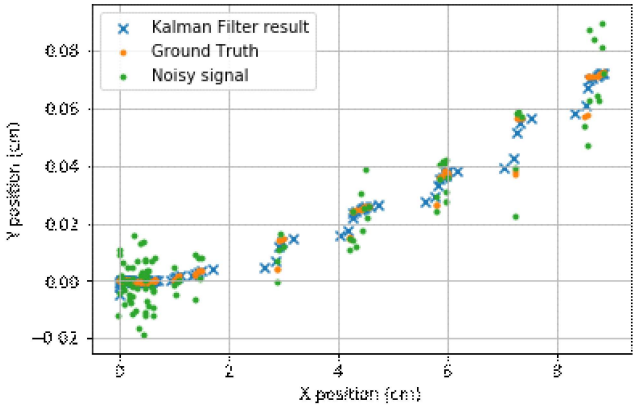

Figure 5: $\sigma = 0.0075$

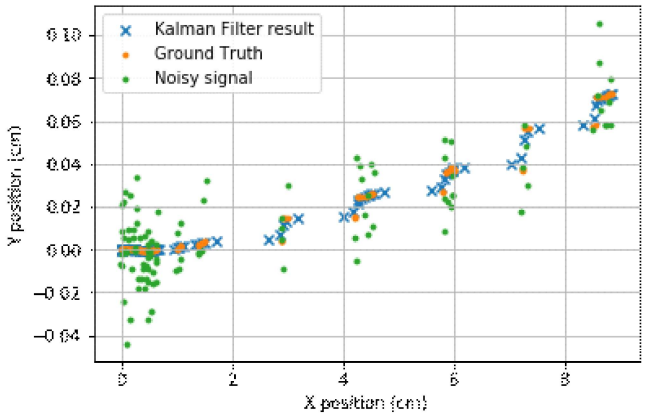

Figure 6: $\sigma = 0.015$

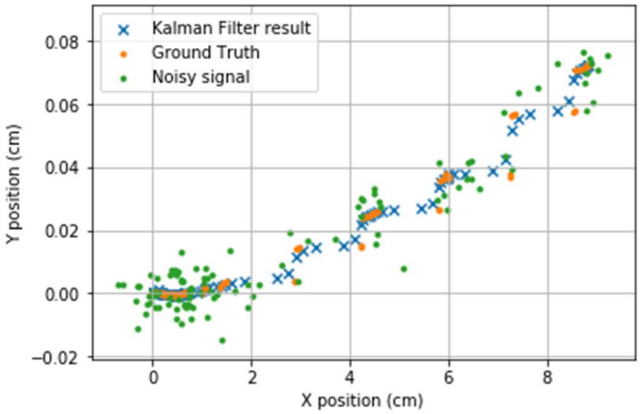

Figure 7: $\sigma_1 = 0.01$ *and* $\sigma_2 = 0.45$

RMSE errors that we found at worst case have values 0.001 and 0.13 in y and x directions directly. Although the error in x direction looks like really high, when we look in Figure 7 we saw that the error caused by missed data points rather than estimation error.

Kalman Filter Second Test

Another test is made with a measurement that we took from encoder data again. To realize filter that we will use for our application, we created another dataset which is created by adding an enormous noise to encoder measurement data. Two data are shown in Figure 8. By changing measurement variances, we tried to obtain an optimal output. Let's assume that pure measurement in Figure 8 is taken from HRMTM and noisy measurement is taken from encoders. After filtering each measurement one by one, we need to combine two filtered output to obtain an optimal result. For that reason, the relation between output and inputs are shown below expression.

Measurement(final) = (Filtered_Measurement(encoder)+6*Filtered_Measurement(HRMTM))/7

Result can be shown in Figure 9.

The main operation principle of this filter is to update future measurement data by comparing data taken delta t time before. In each iteration, filter computes variance of the data and according to this information, predict future point.

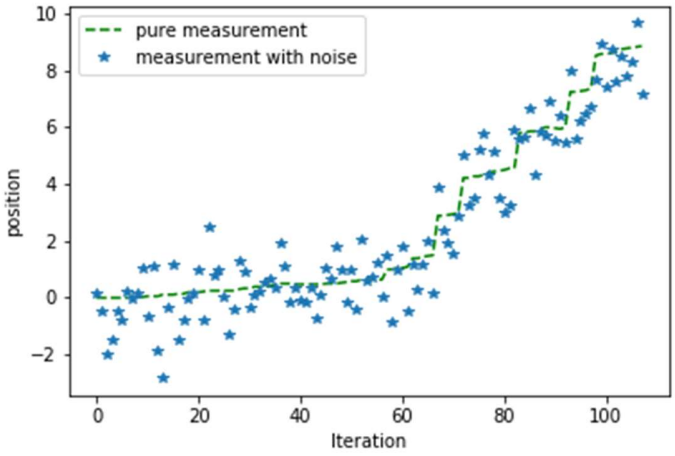

Figure 8: Pure measurement and noisy measurement data

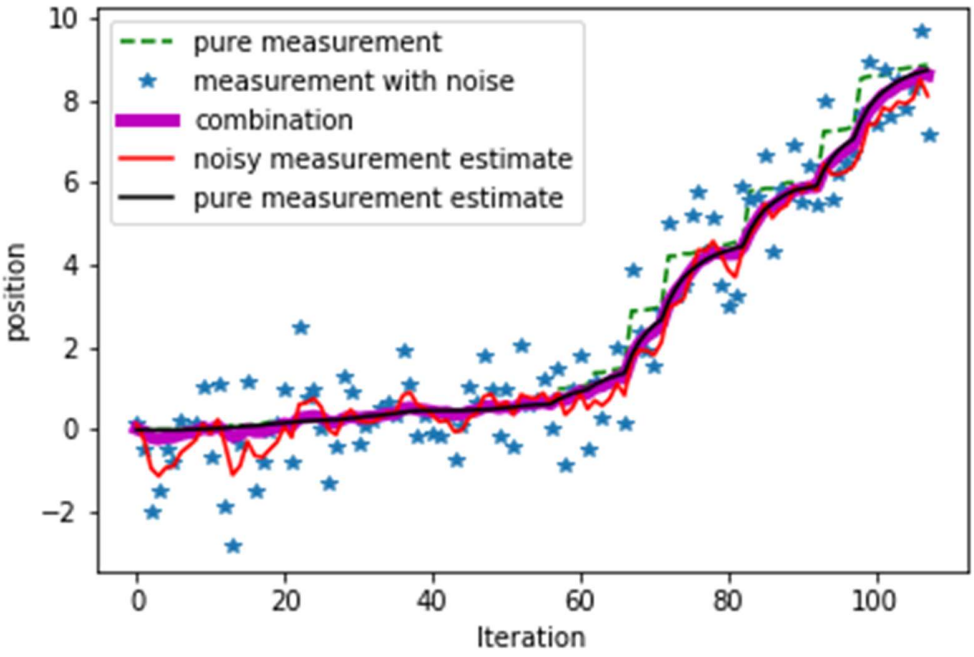

Figure 9: Result for filtered outputs

3D printing

For sensors and HRMTM, we drew 3d models of the structures and printed them. They are shown in Figure 10.

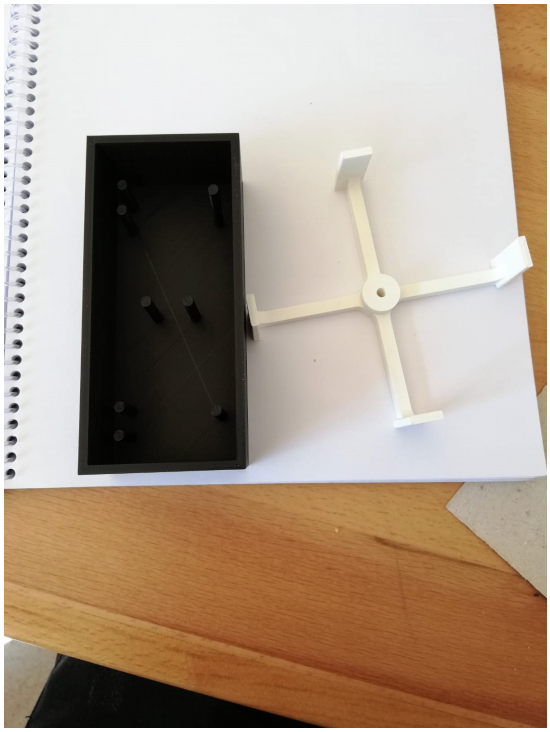

Figure 10: Mechanical parts that 3D printed