The following RMSE requirements should be met (less than the value given):

DATASET 1	0.08	0.08	0.60	0.60
DATA SET 2	0.20	0.20	0.50	0.85

When the following measurement covariance matrices are used as provided by udacity:

R_LIDAR

0.0225 (x)	0
0	0.0255 (y)

R_RADAR

0.09 (rho)	0	0
0	0.0009 (phi)	0
0		0.09 (drho)

We get the following RMSE values:

DATASET 1	0.088088	0.0789795	0.608127	0.595732
DATASET 2	0.184873	0.189381	0.449241	0.669357

Which is unacceptable. We can compute for the measurement variances comparing the measurement values and the ground truth values as written in this python code:

- https://github.com/mithi/Fusion-EKF-Python/blob/master/variances.py
- https://github.com/mithi/Fusion-EKF-Python/blob/master/Fusion-EKF-Variances.ipynb

We get the following values:

Covariances of	Using data1 only	Using data2 only	Both data1 and data2
x	0.0030318456883	0.0432845677688	0.00872031903422
y	0.00232796032072	0.0478147050908	0.00871732038878
vx	1.75231650122	0.0225024900134	1.51063829744
vy	2.81928216089	0.290537073523	2.46571865544
rho	0.0103696181683	0.0391404813605	0.0144125890908
phi	1.0680397691e-06	3.15121868185e-06	1.36108366223e-06
drho	0.011294795278	0.00970452550137	0.0110733569443

Let's use the rounded values from these covariances instead to form our measurement covariance matrices

R_LIDAR

0.01 (x)	0
0	0.01 (y)

R_RADAR

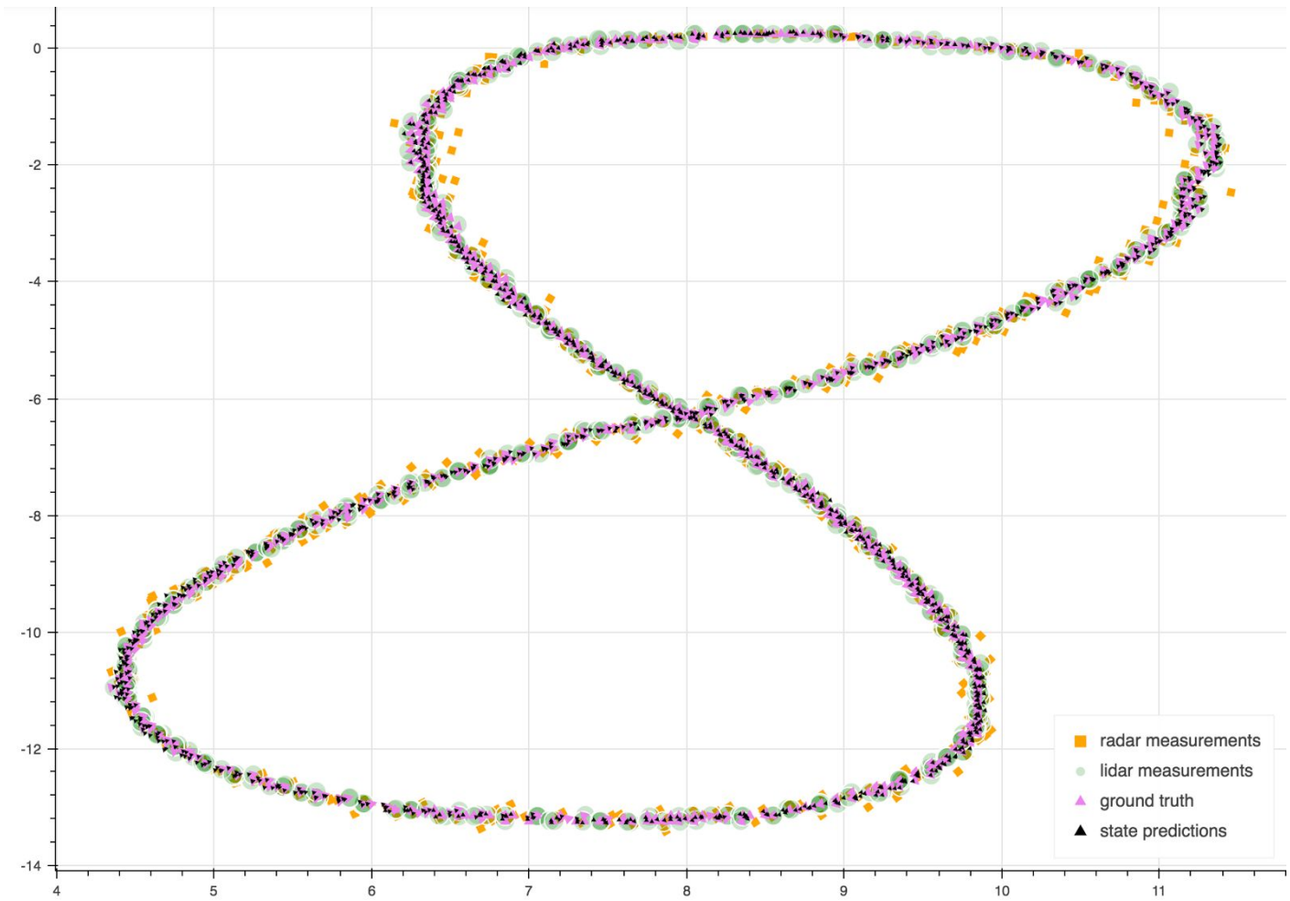
0.01 (rho)	0	0
0	1.0e-6 *(phi)	0
0	0	0.01 (drho)

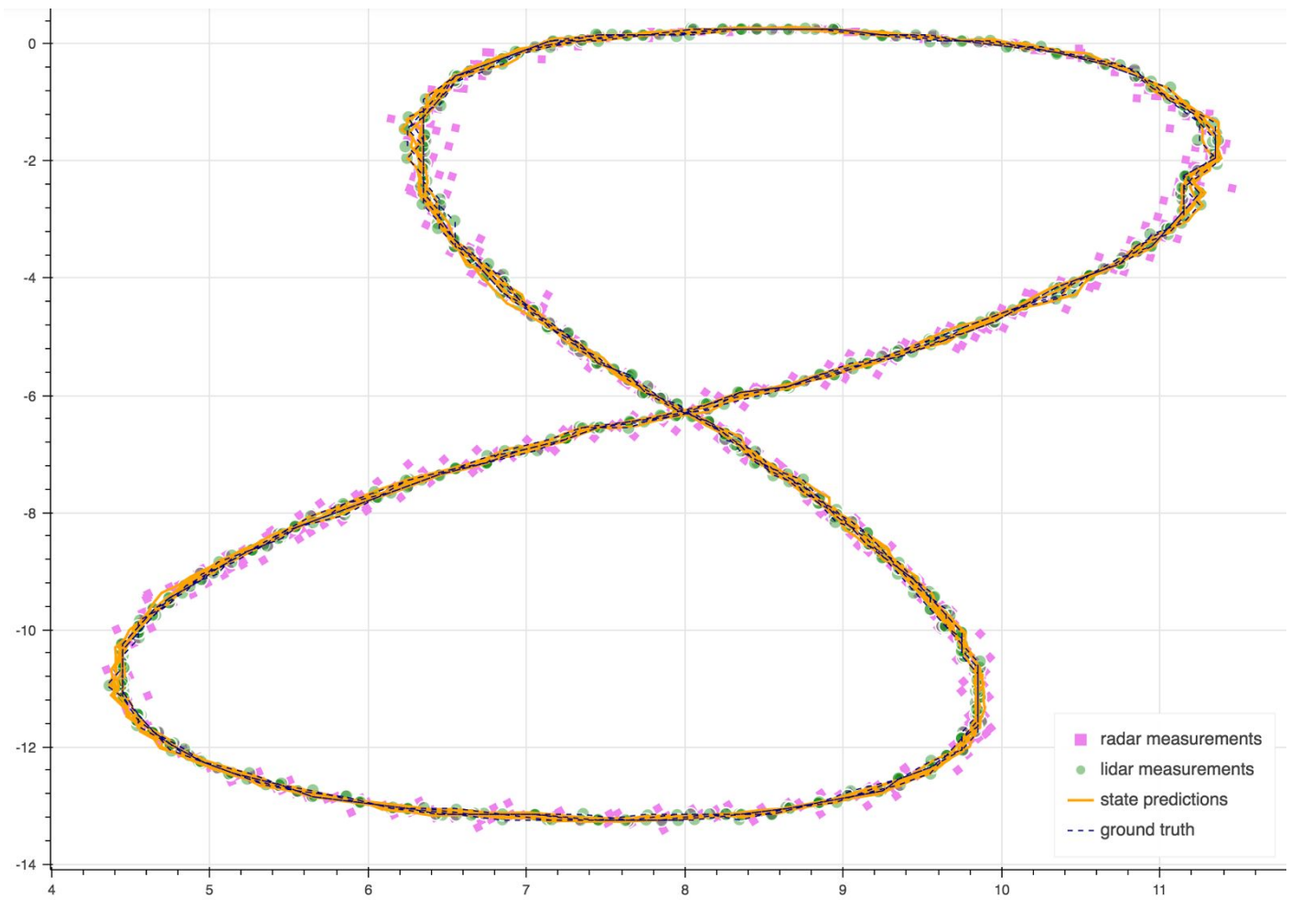
Which produces the following results that meet the required RMSE

DATASET 1	0.0251817	0.0228512	0.339001	0.369616
DATASET 2	0.174266	0.164838	0.394556	0.703697

Here are some visualizations (with Jupyter Notebook and Bokeh)

Visualization of predictions using measurement covariance covariances as computed


0
-2
-4
-6
-8
-10
-12
-14
4
5
6
7
8
9
10
11
radar measurements
lidar measurements
ground truth
state predictions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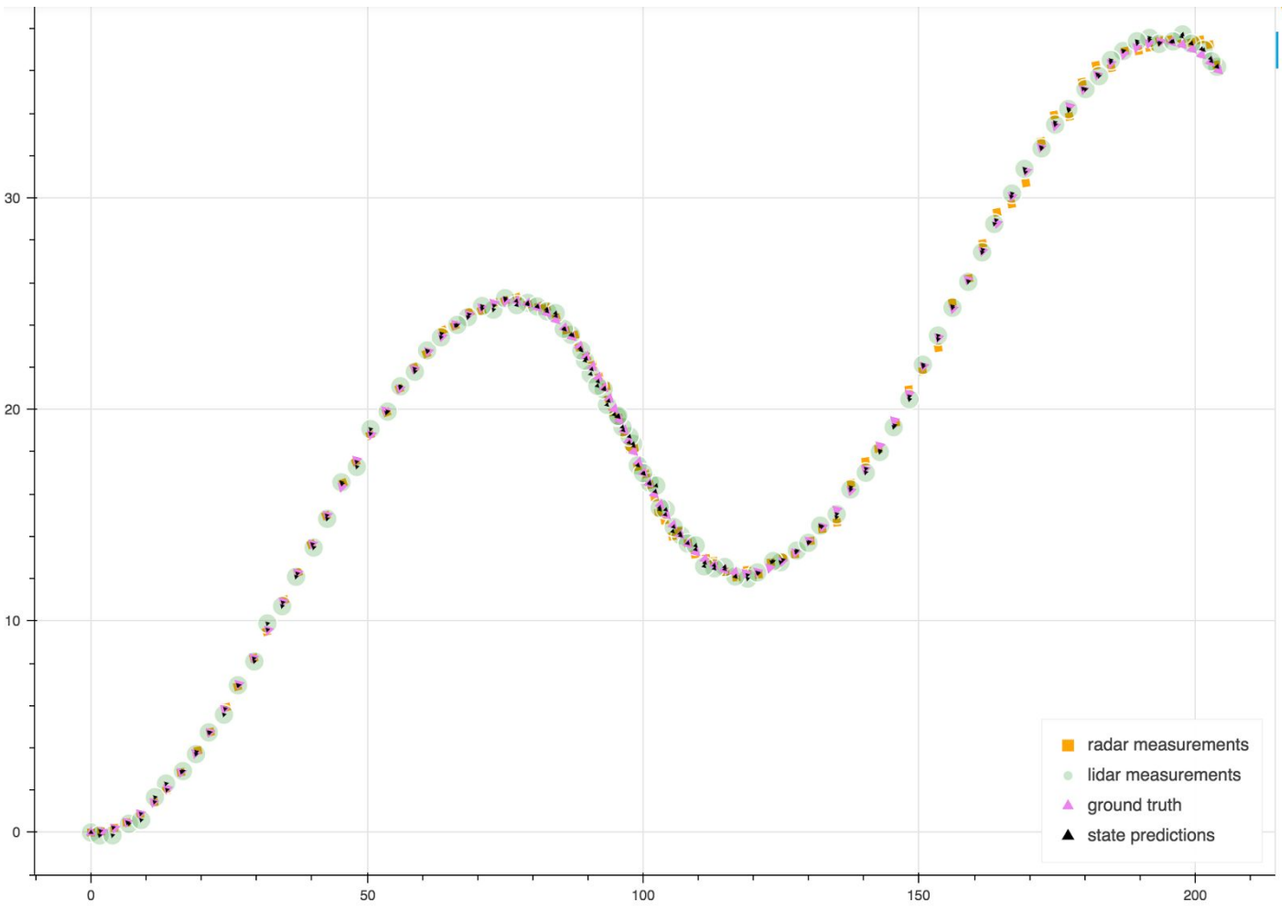
radar measurements
lidar measurements
state predictions
ground truth


radar measurements
lidar measurements
ground truth
state predictions
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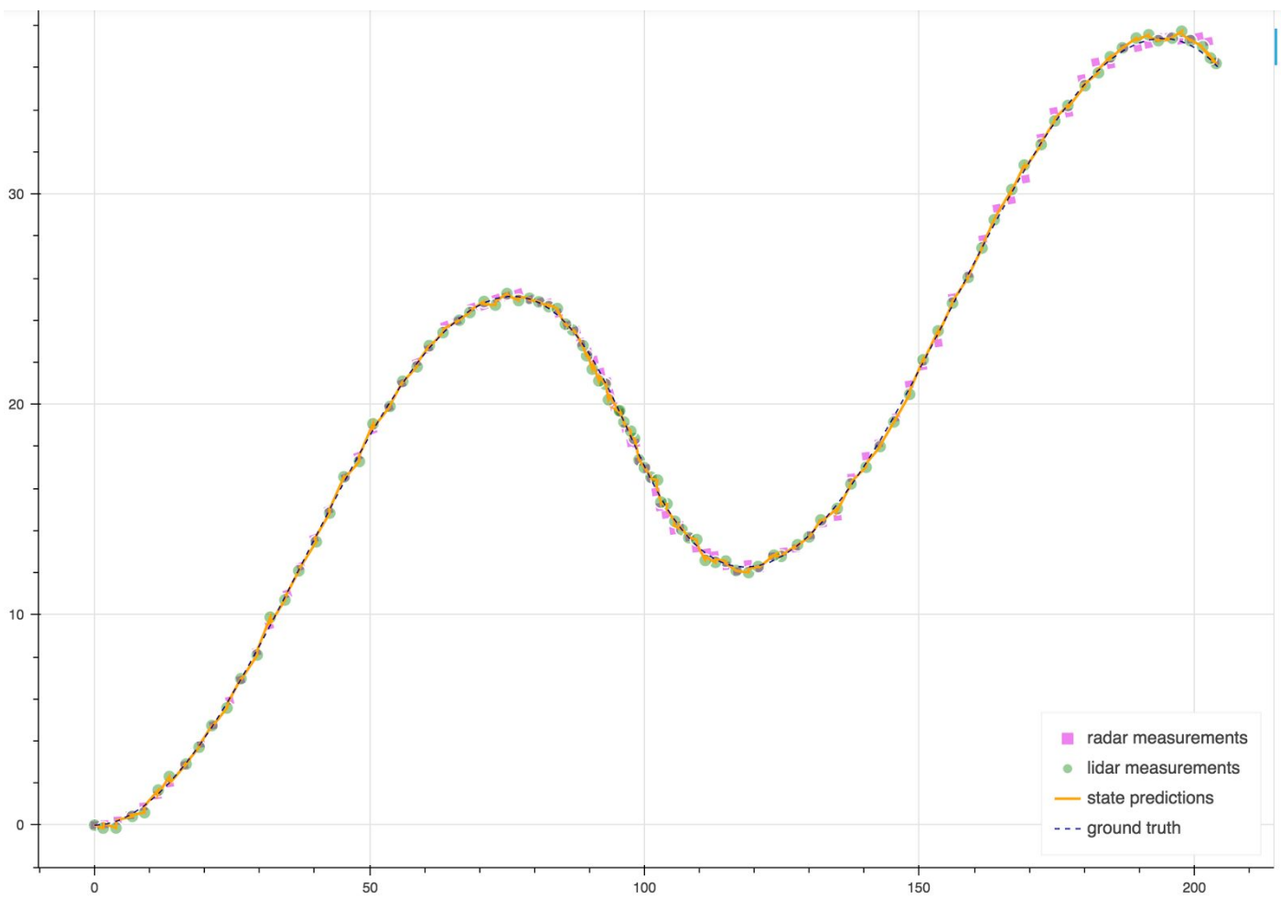
200


radar measurements
lidar measurements
state predictions
ground truth
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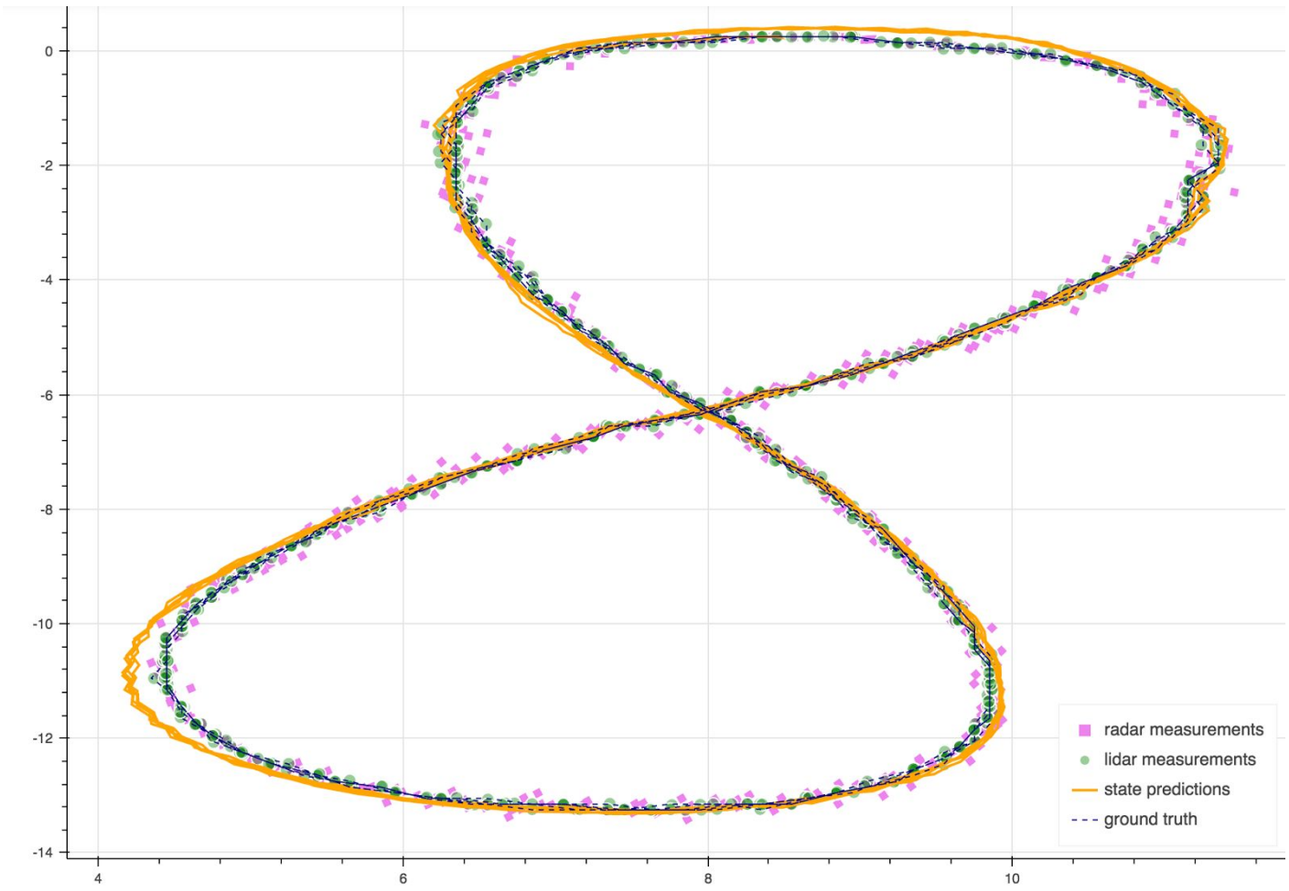
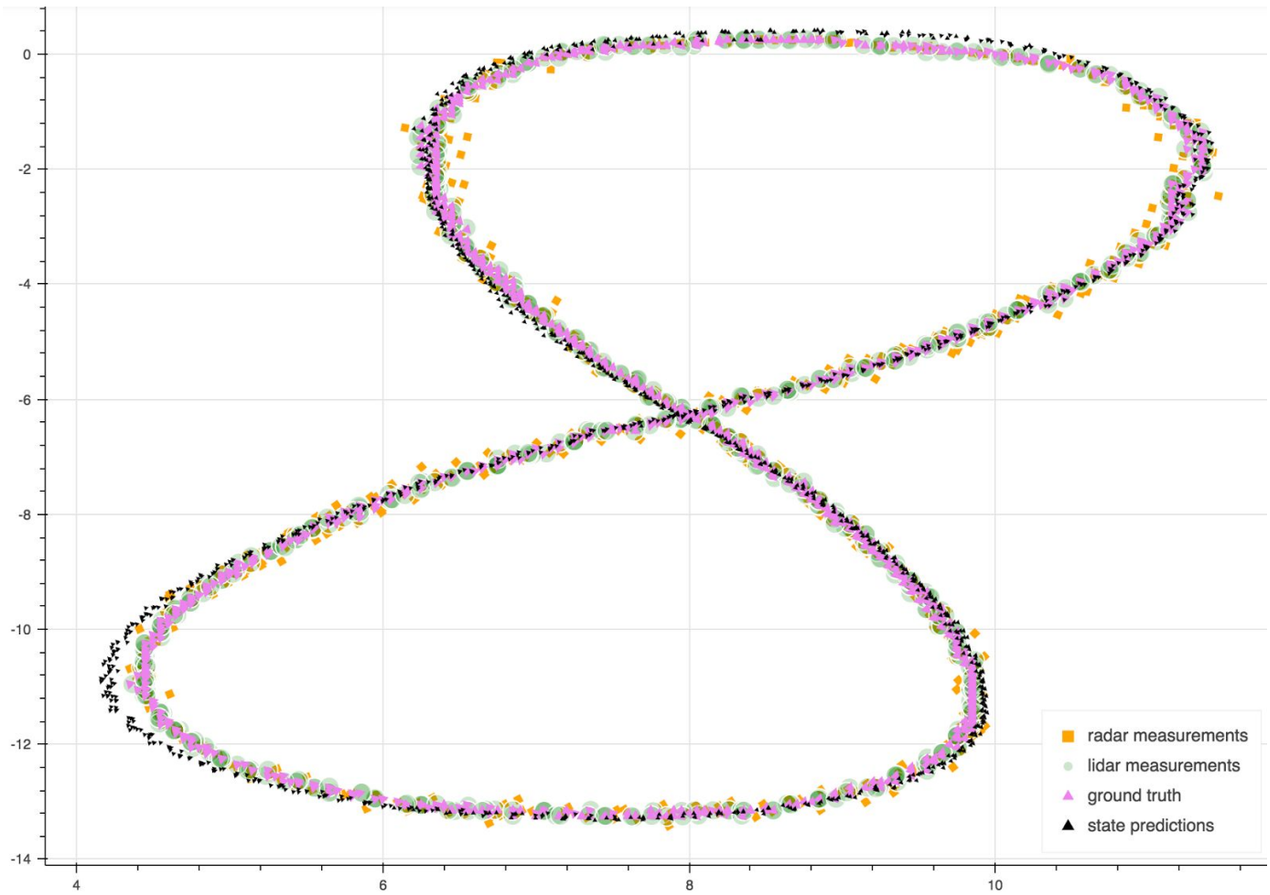
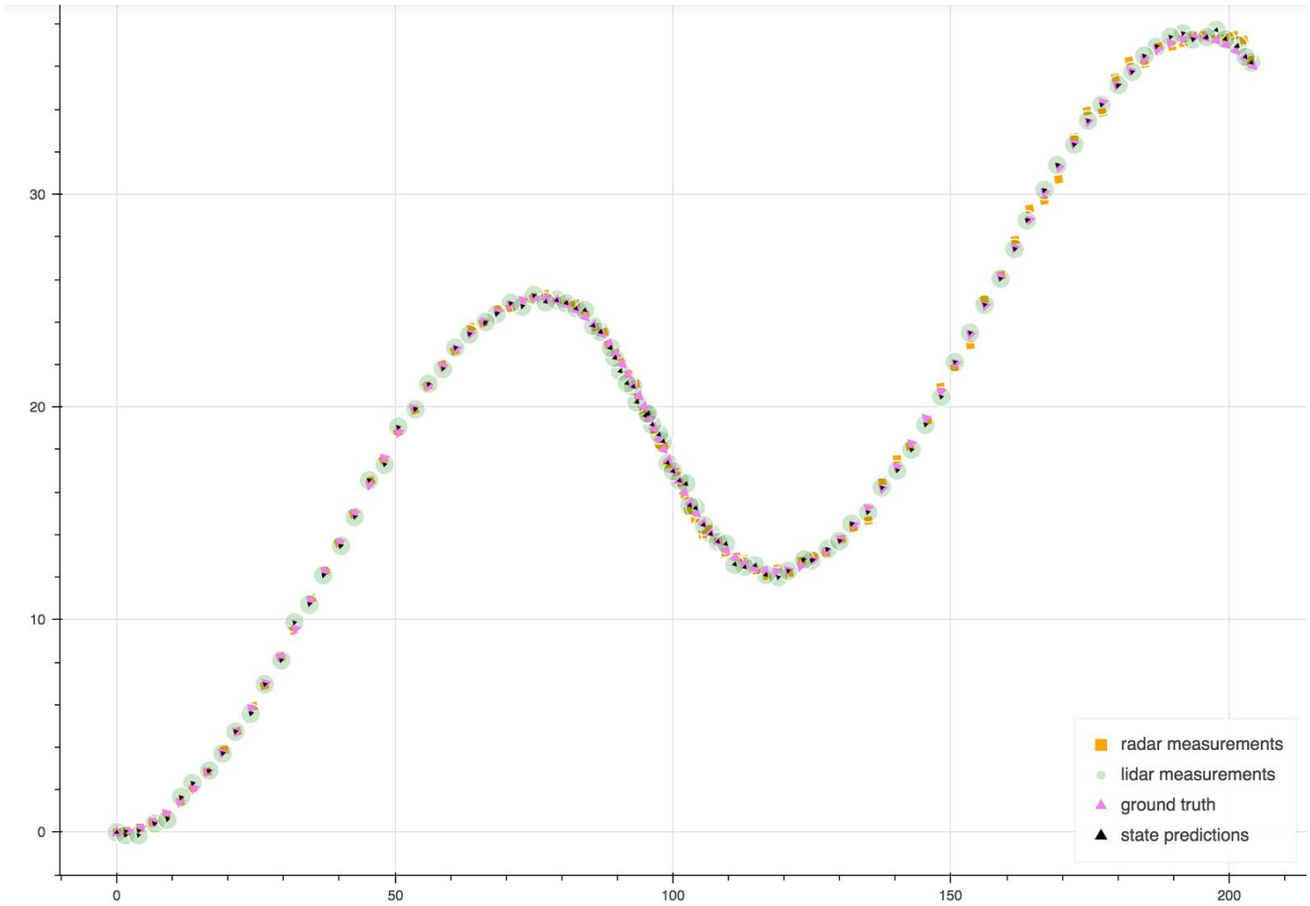
100
150
200

Visualization of predictions using measurement covariances as given by udacity



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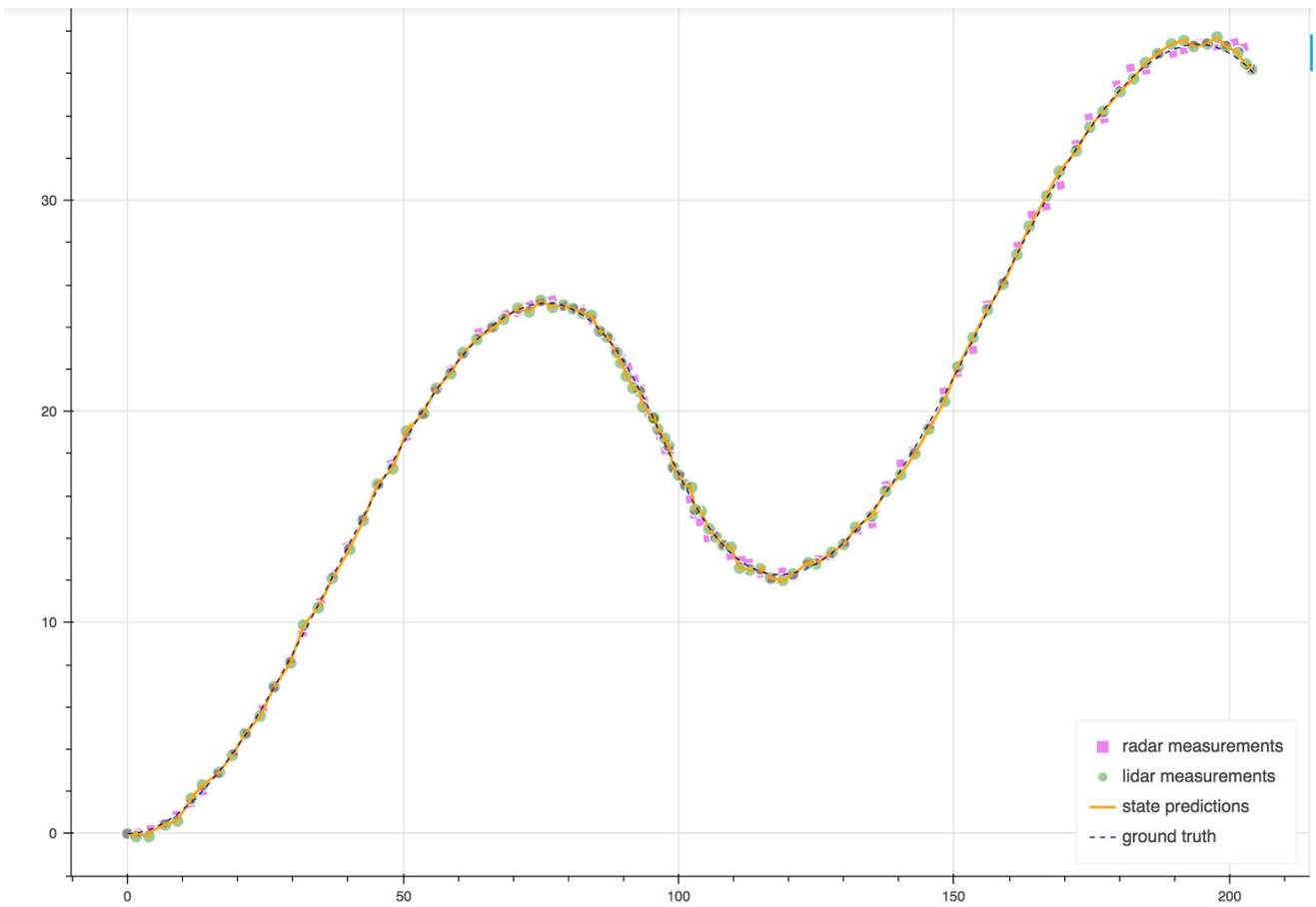
radar measurements
lidar measurements
ground truth
state predictions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radar measurements
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