Tracking of a maneuvering vehicle

Abramov Semen,
Belikov Ilia,
Nikolay Zherdev,
Mikhail Kulbeda

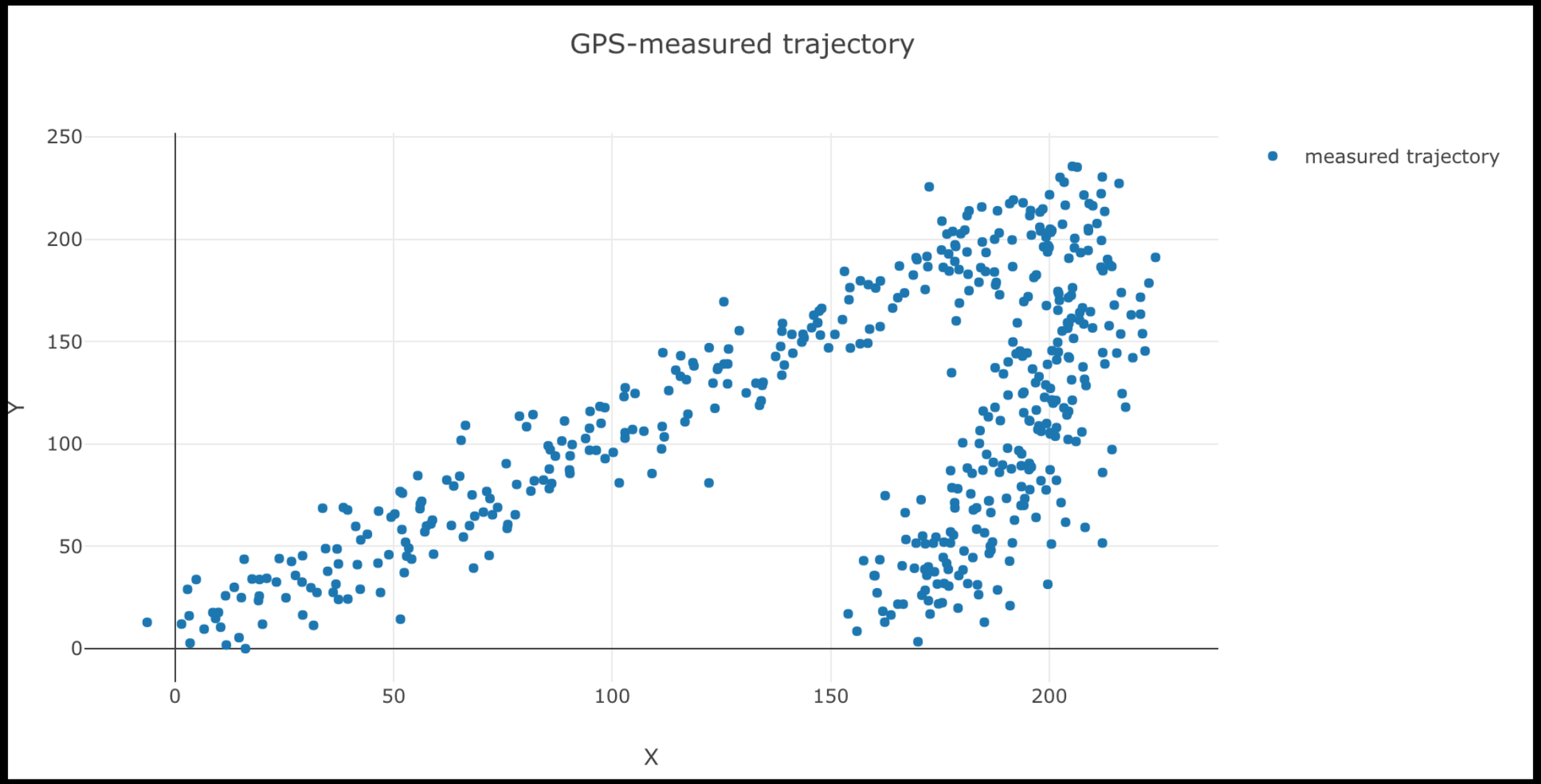
Skoltech 2018

What to do if your vehicle does a strong maneuver?

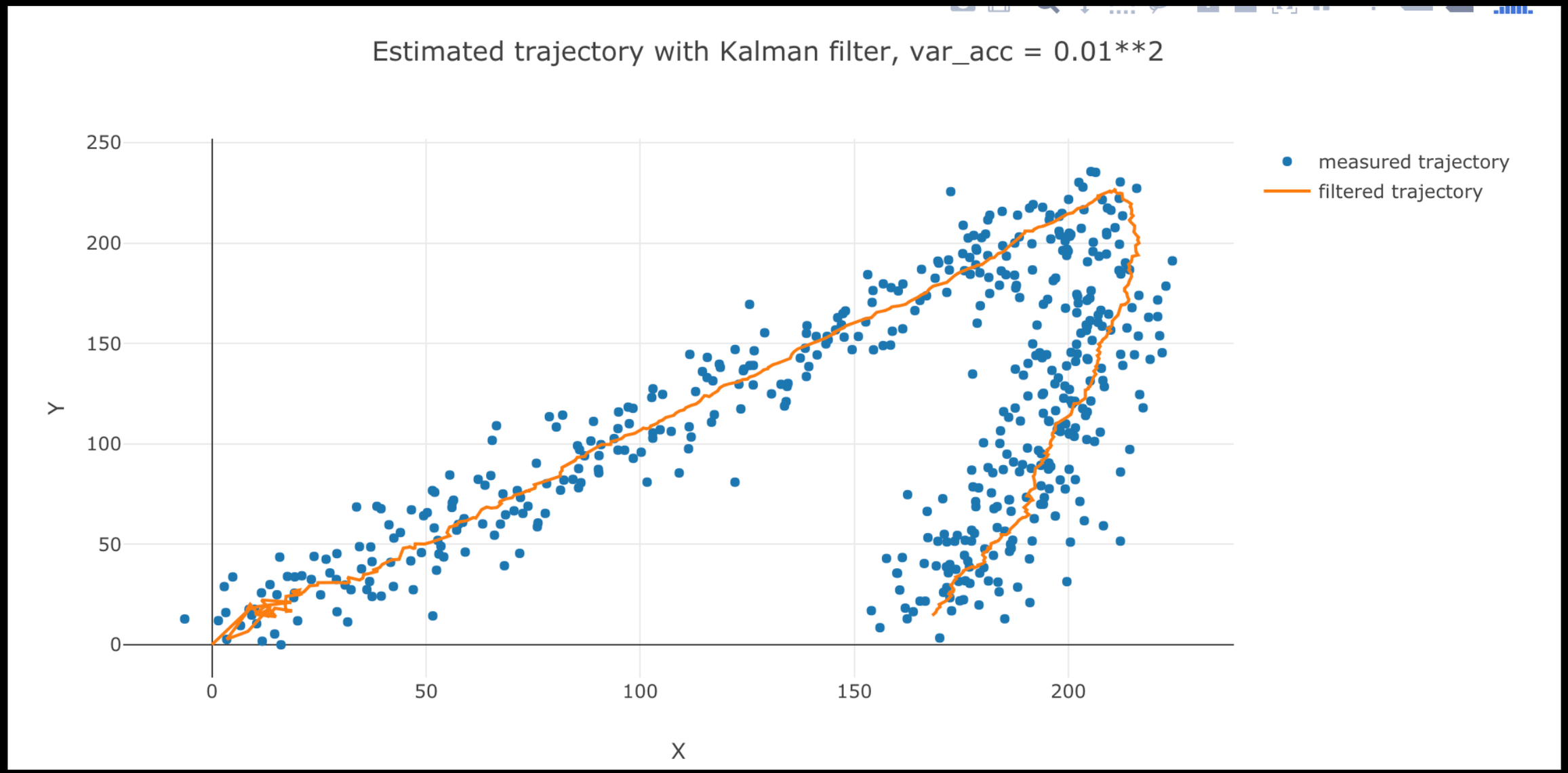
Grounds why the chosen method is the best method

- We have knowledge of model of a moving vehicle
- Linear Kalman filter is easy to implement

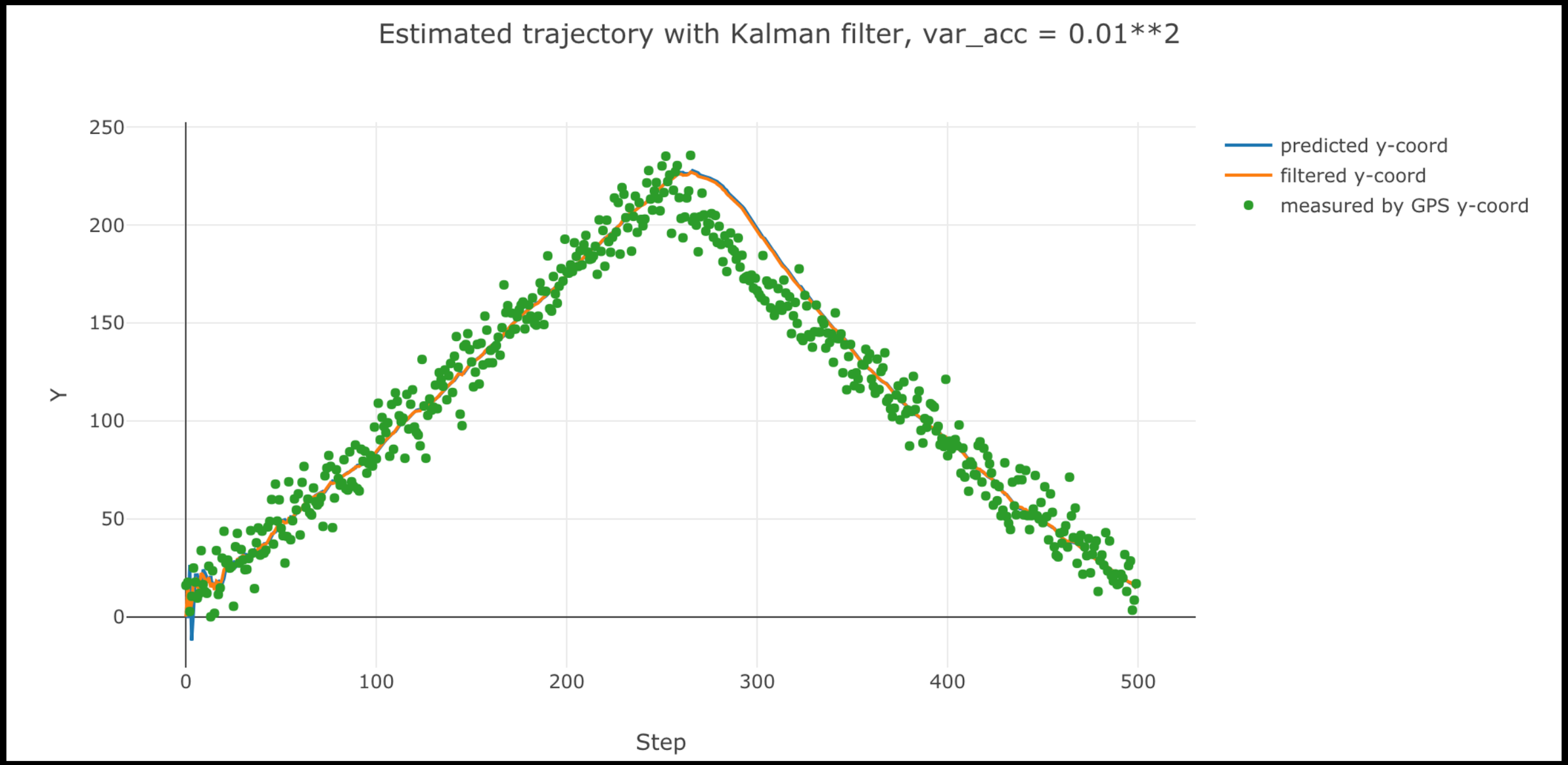
Measured Trajectory



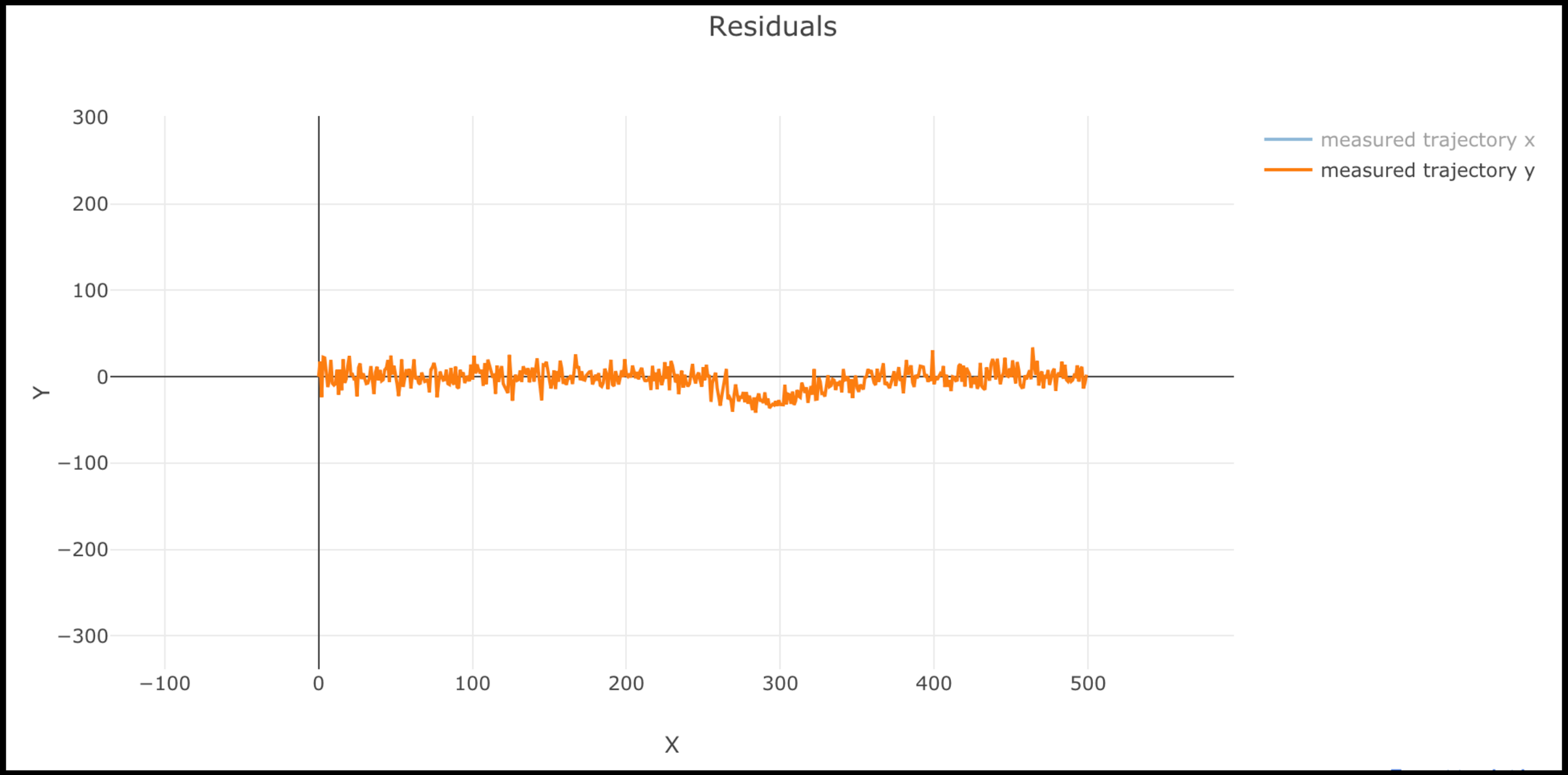
Initially filtered



Initially filtered Y

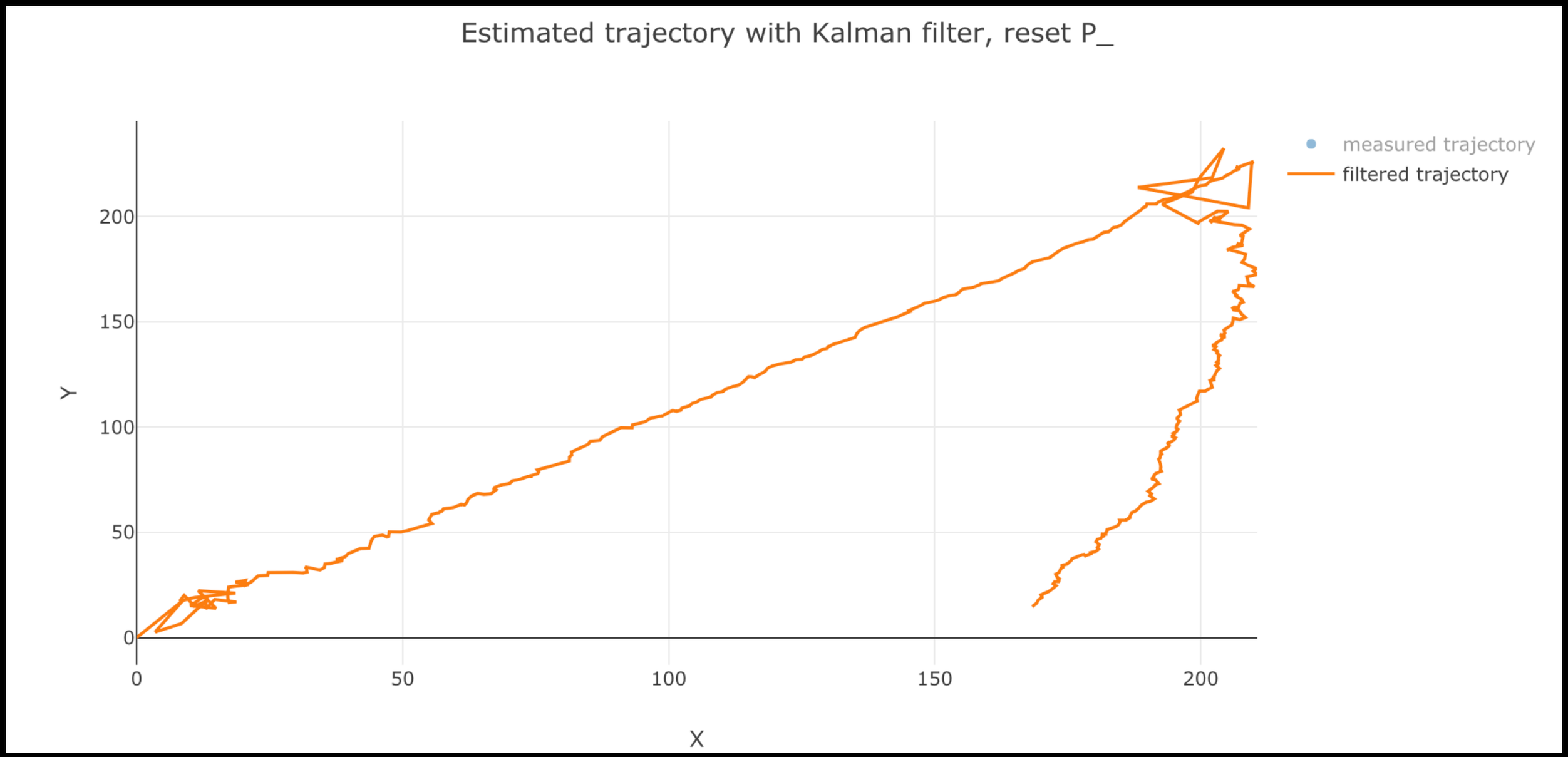


Residuals Y

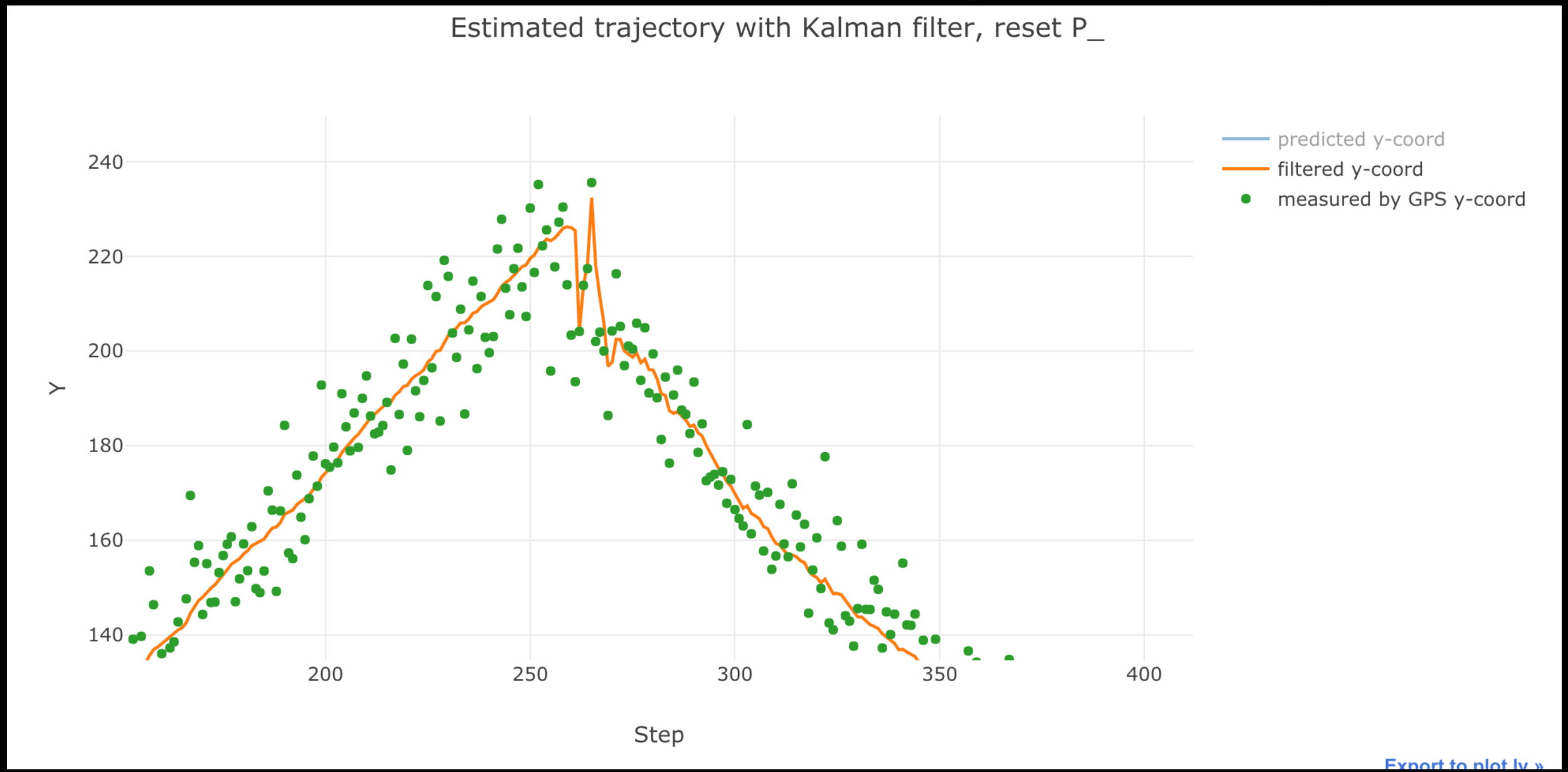

Residuals
300
200
100
0
−100
−200
−300
Y
−100
0
100
200
300
400
500
X
measured trajectory x
measured trajectory y

Try to reset P-filtered if residuals > 2.5 * σ-noise for both X and Y

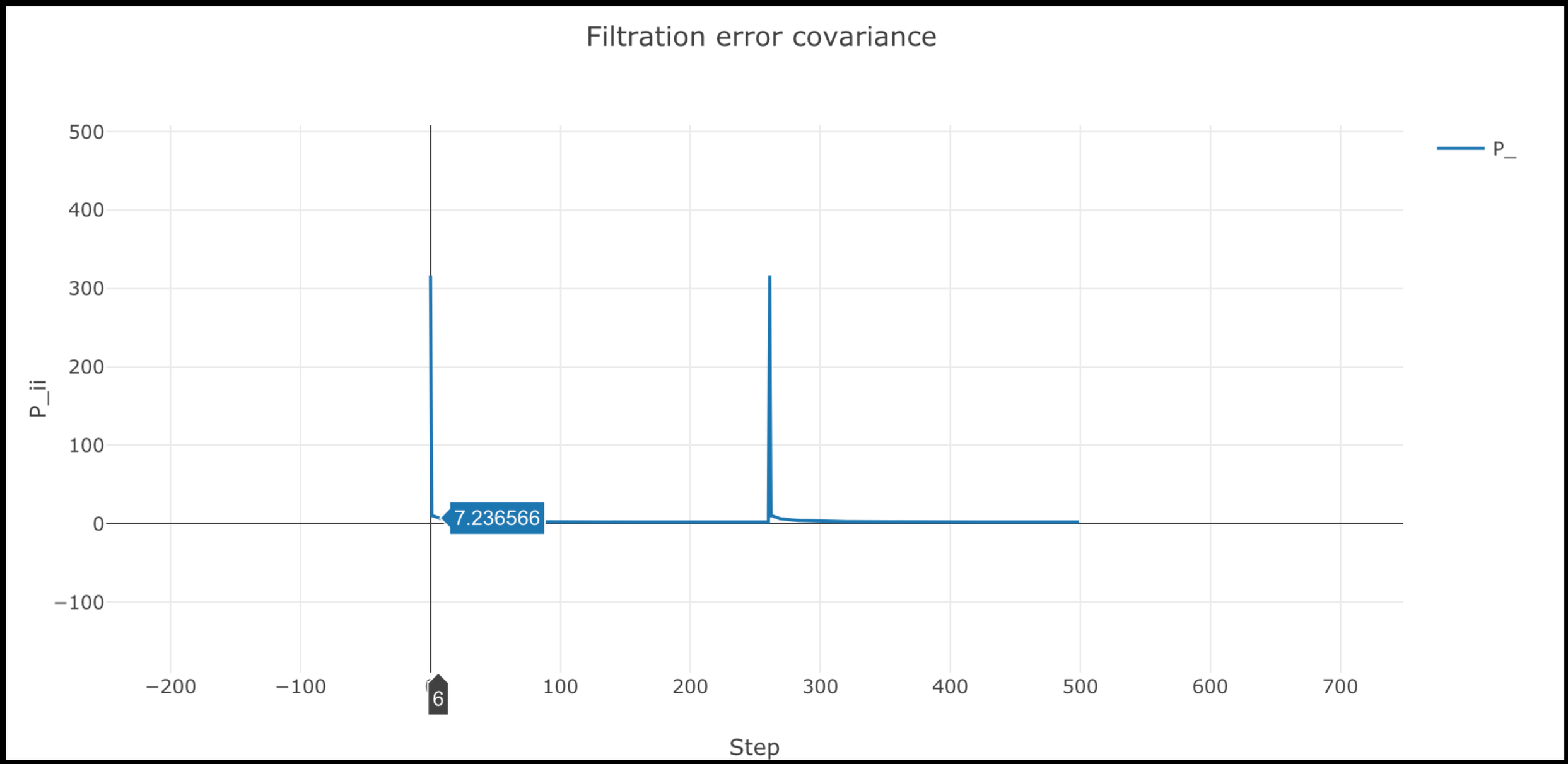
Filtered Trajectory with reset P



Filtered Y Trajectory



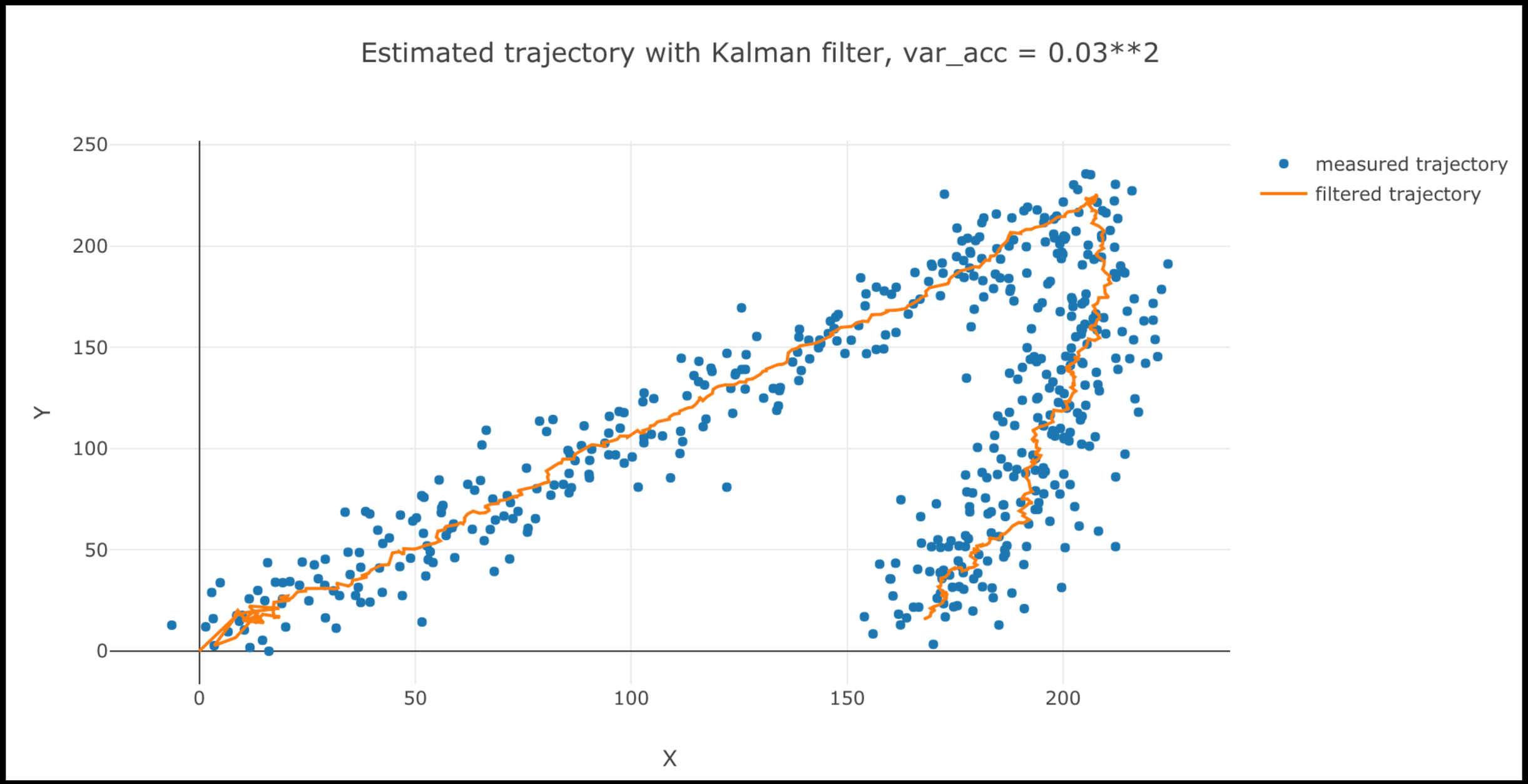
Filtration error covariance



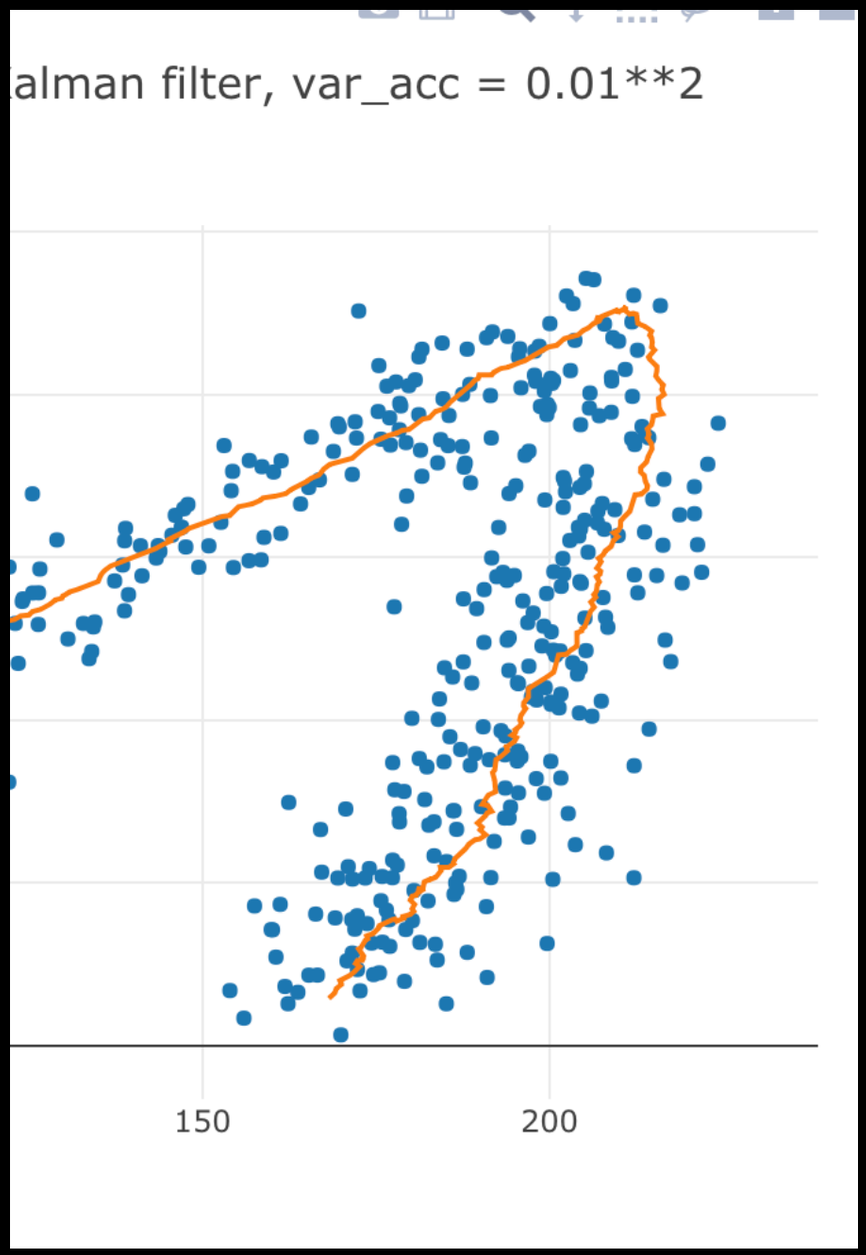
Let’s try to change variance of random acceleration

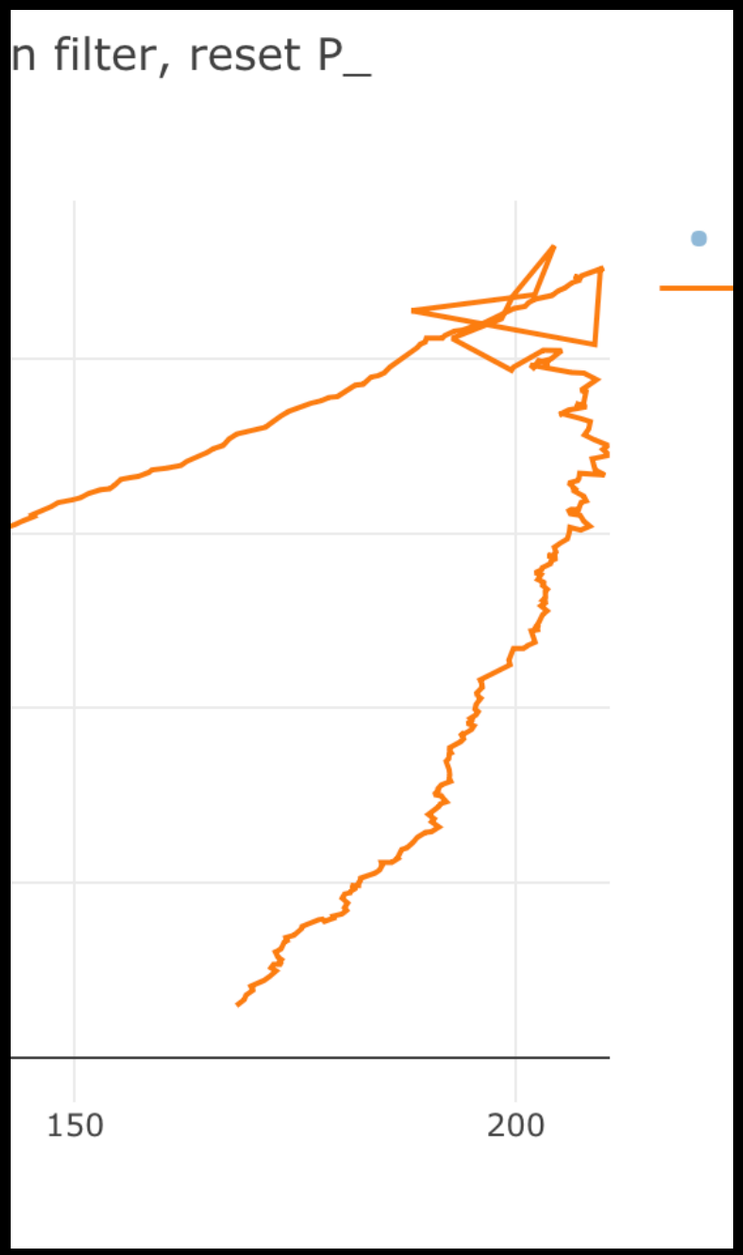
0.01^2 —> 0.03^2

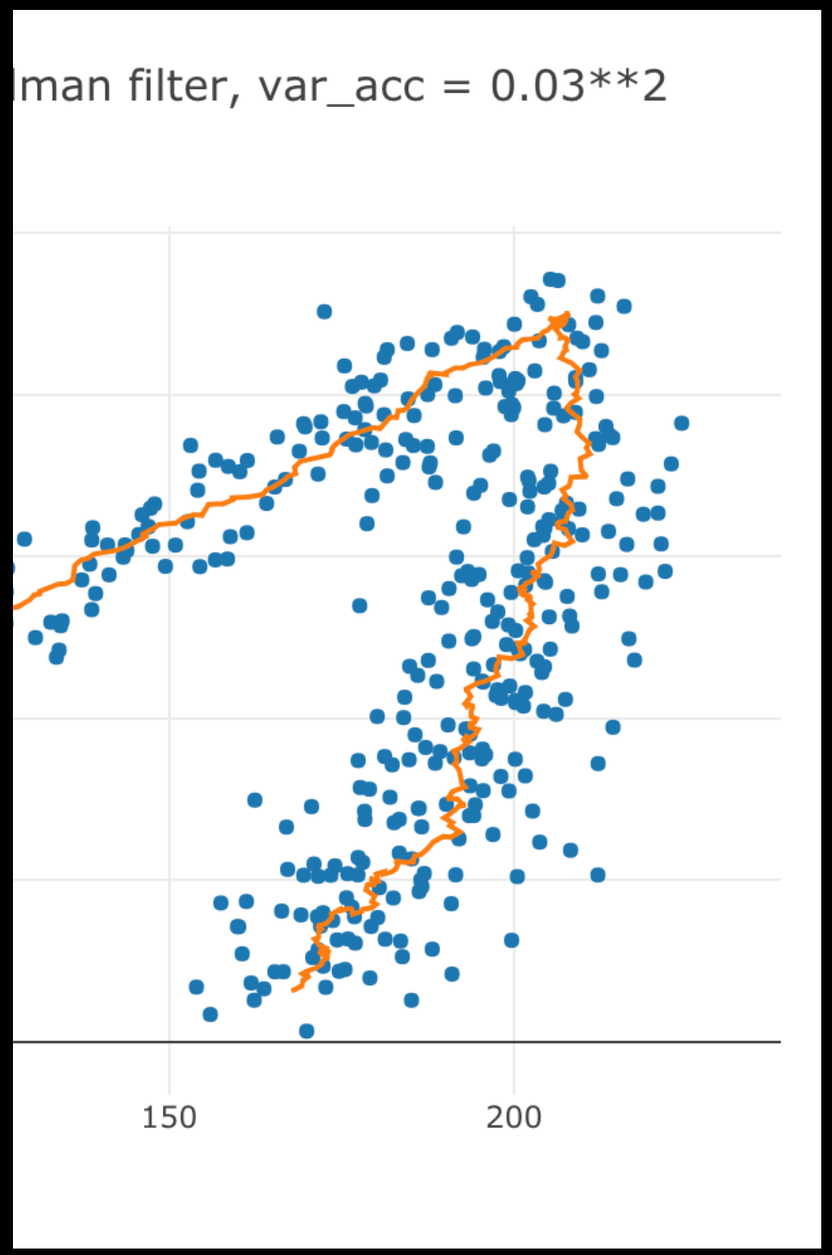
Filtered Trajectory



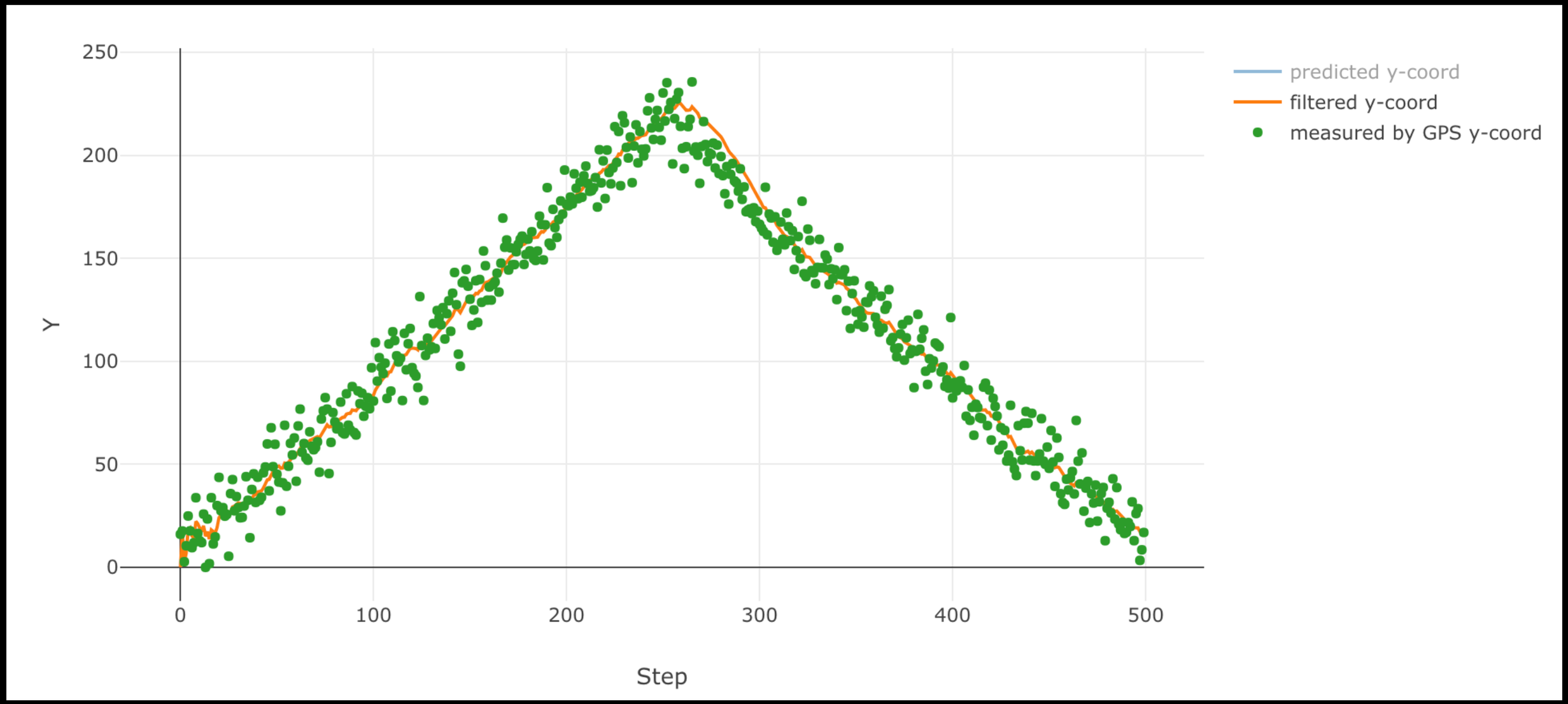
0.01^2 reset-P 0.03^2



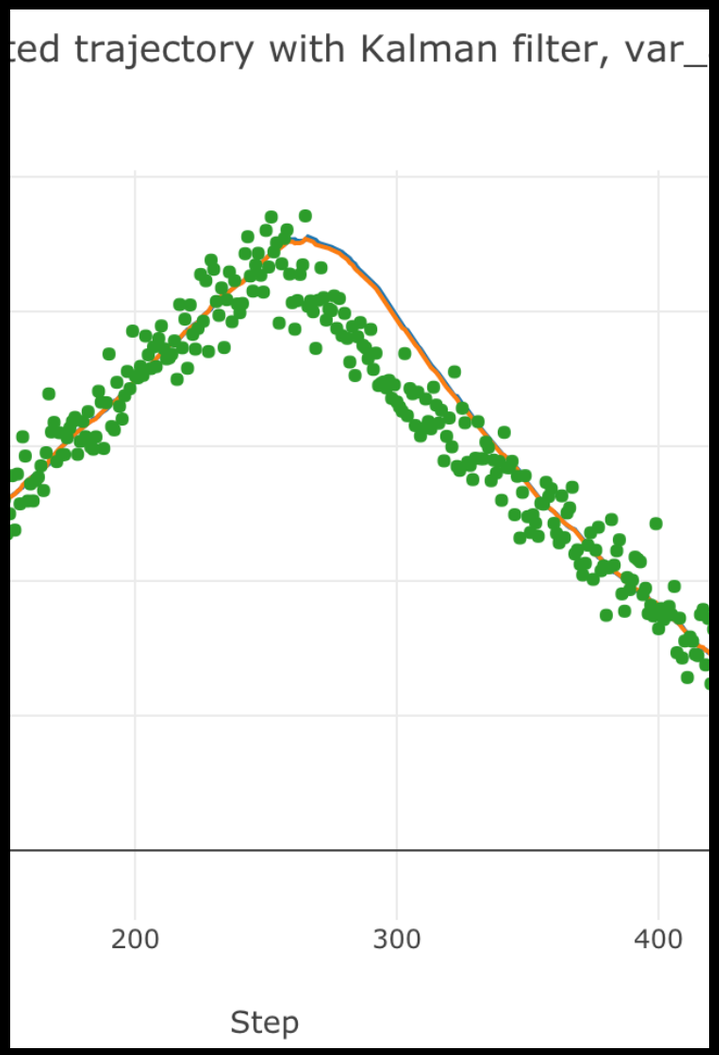


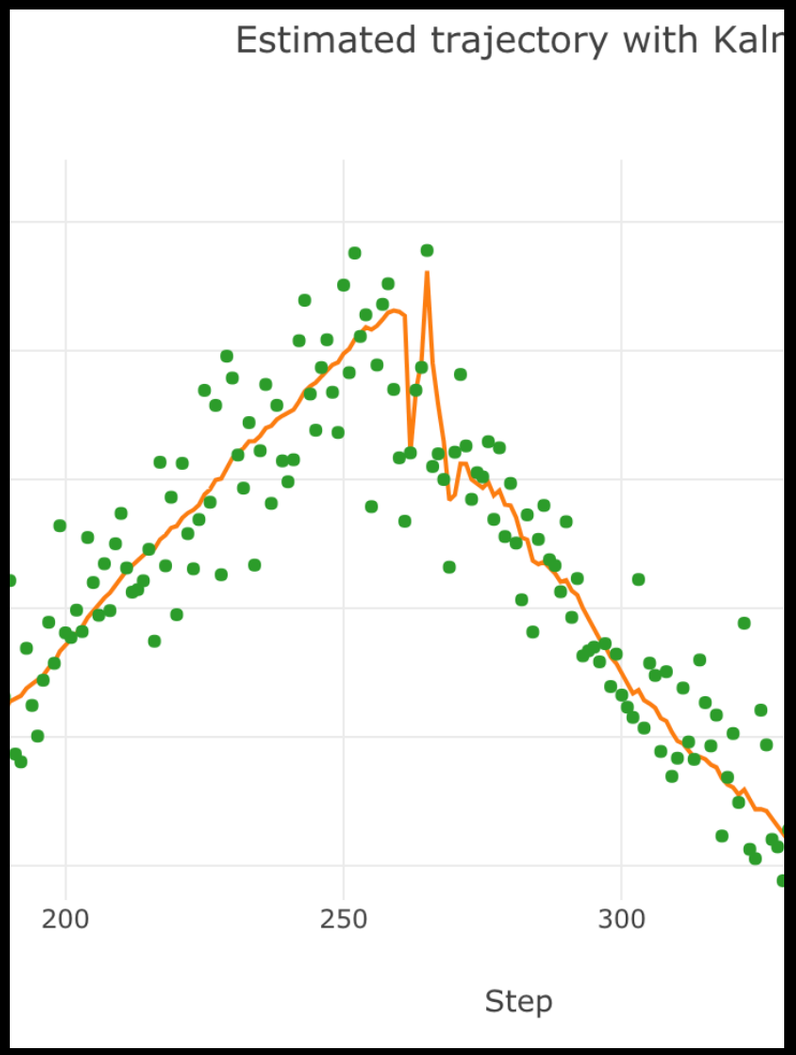


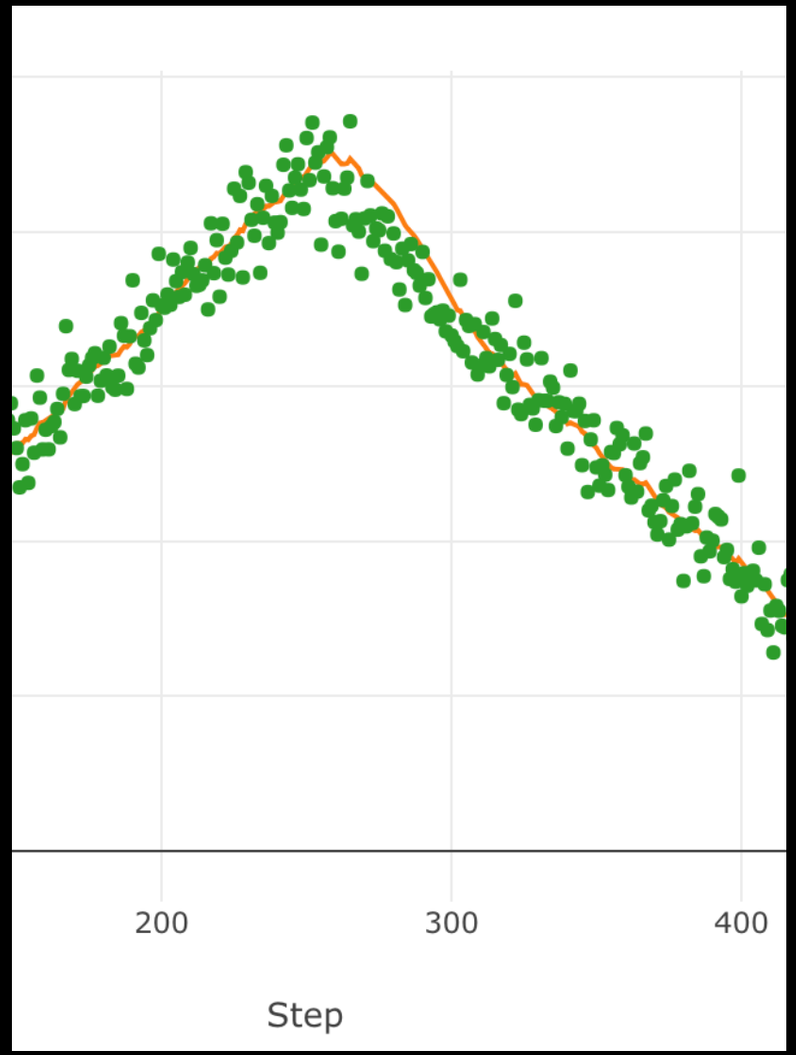
Filtered Y-trajectory



0.01^2 reset-P 0.03^2

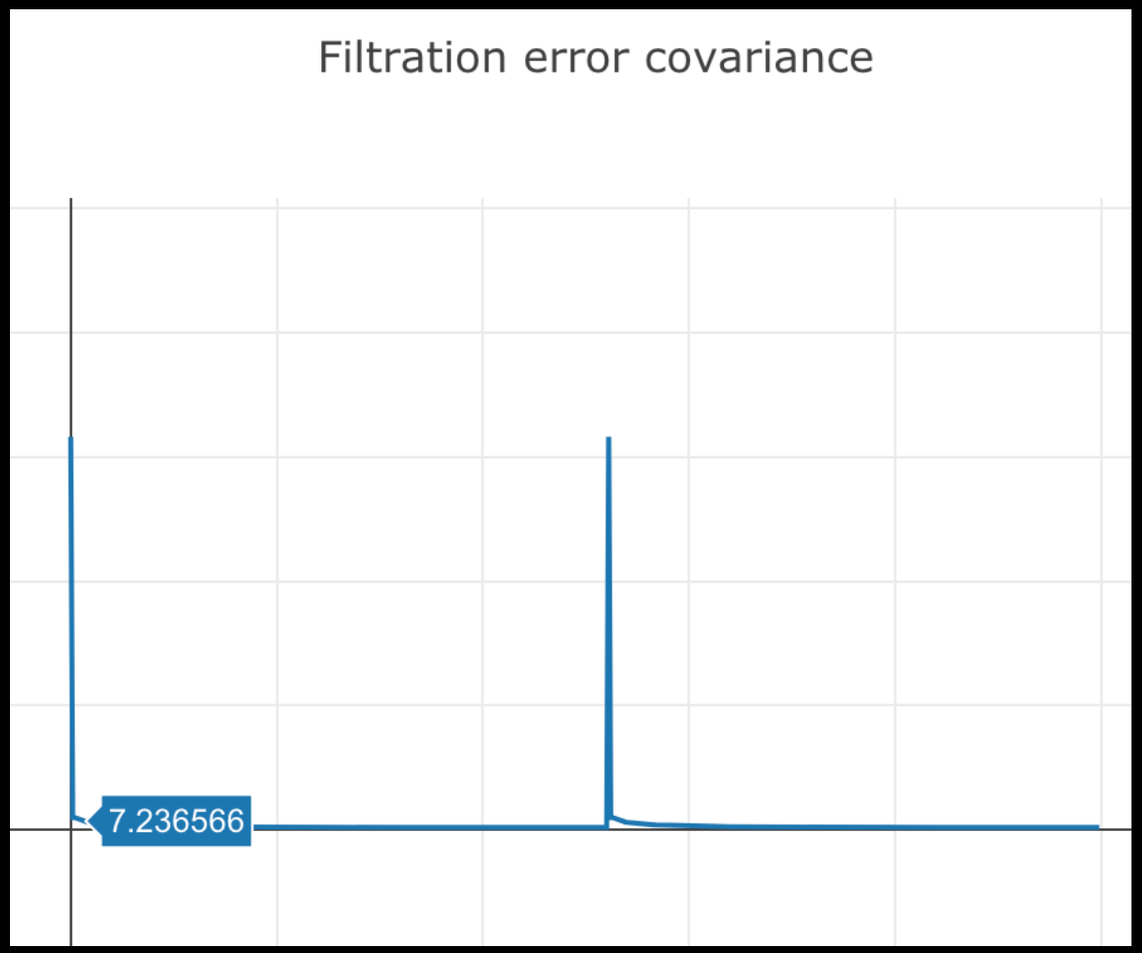


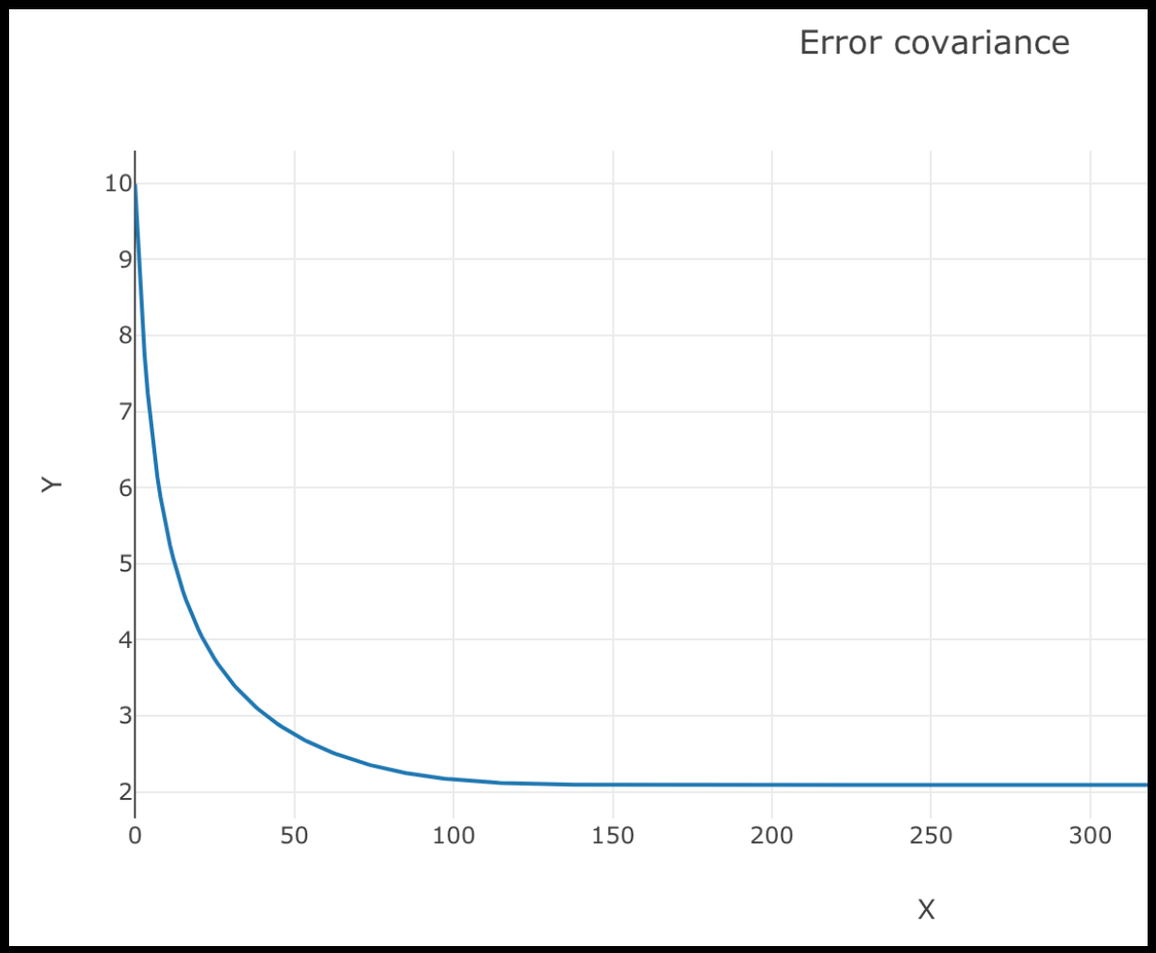




reset-P

0.03^2

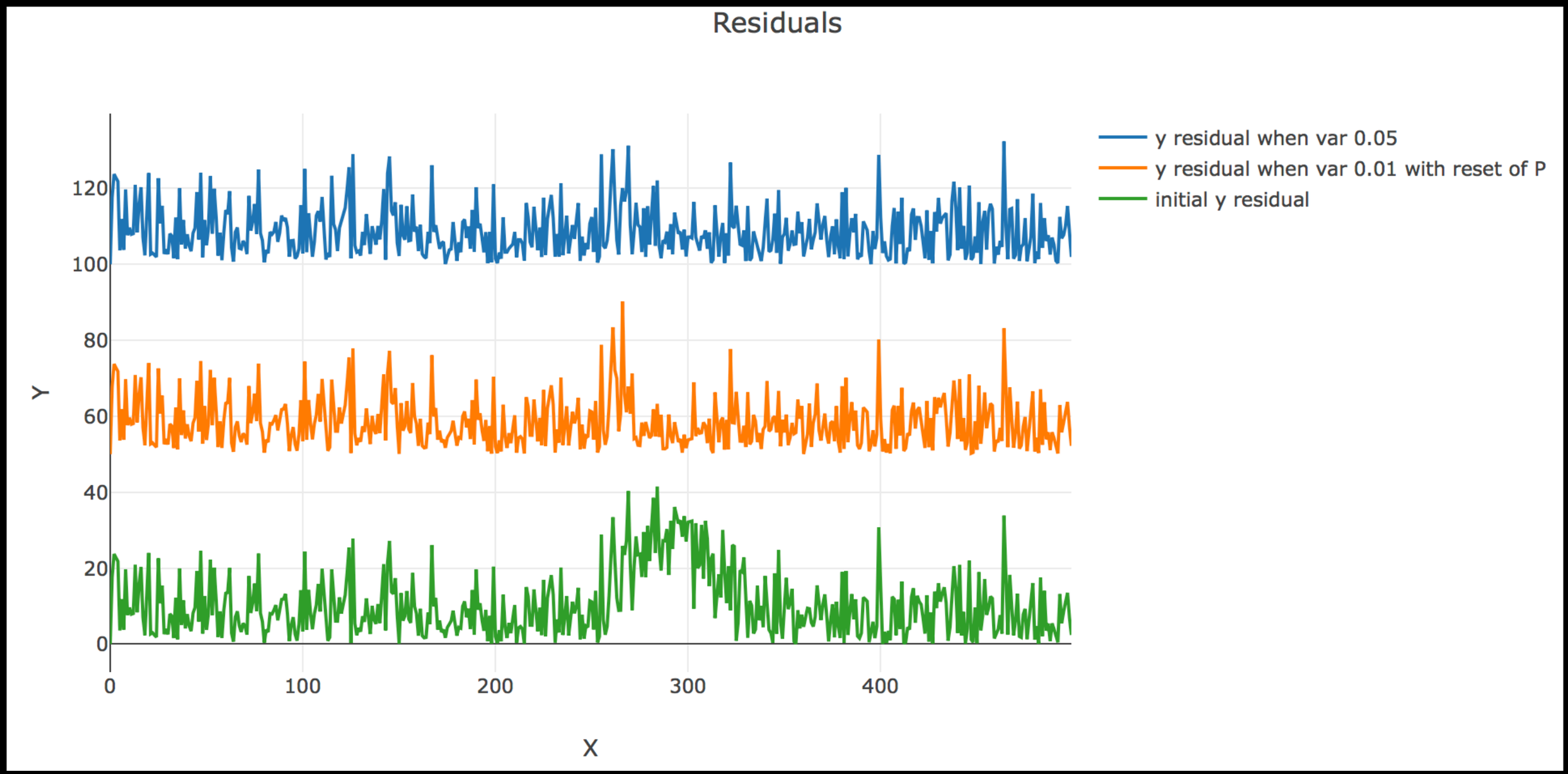

Filtration error covariance
7.236566


Error covariance
10
9
8
7
6
5
4
3
2
Y
0
50
100
150
200
250
300
X

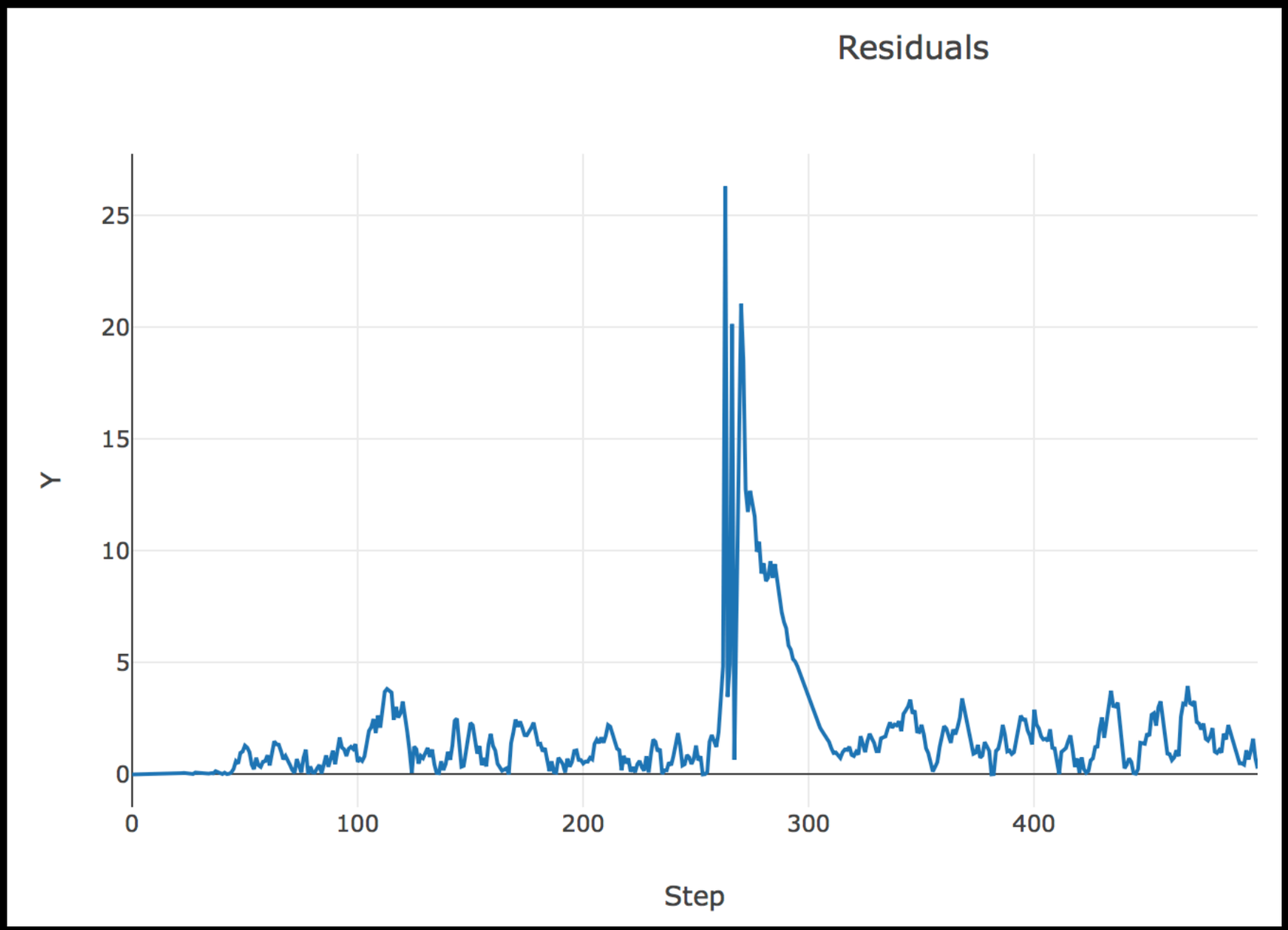
0.01^2 init

0.01^2 reset-P

0.05^2 only



delta between (0.01 + resetP) and 0.05



General conclusions about the efficiency of method

Two approaches:

1. Reset P to huge values when residuals > 2.5 σ-noise
   - faced big spikes in the beginning of turn
2. Change variance of random acceleration from 0.01^2 —> 0.03^2
   - reduced residuals

As we see, the second approach gives better results especially when we have data with not so large amount of huge residuals for X and Y simultaniously.