- **I noticed that some of the parameters are negative, but the D estimates are all positive which is good. The magnitude for u is very small and it will be sensitive to noise and inaccuracies on the left side. Could you take a look at the magnitude of tao and f (especially tao) and explain why the magnitude for u is very small?**

The units of the input are N and N.m with the chamber pressure we put in and the “small”area of contact the amplitude should be small.

- **Now back to the accuracy for the left side, have you figured out a way to evaluate it? I noticed that you planned to try a quasi-static case which can be the starting point, and if the coefficients a and k are still positive, then we need to check the equation to see if we miss anything. However, this does not solve the issue for dynamic cases so you need to think about how to verify the q_dot and q_dot_dot measurements. Keep in mind, the q and q_dot also impacts the right side of the equation.**

From the symbolic equation, I am confident that the values on left side are correct. I also applied 10 points moving average filters for both q_dot and q_ddot before calculate the left side.

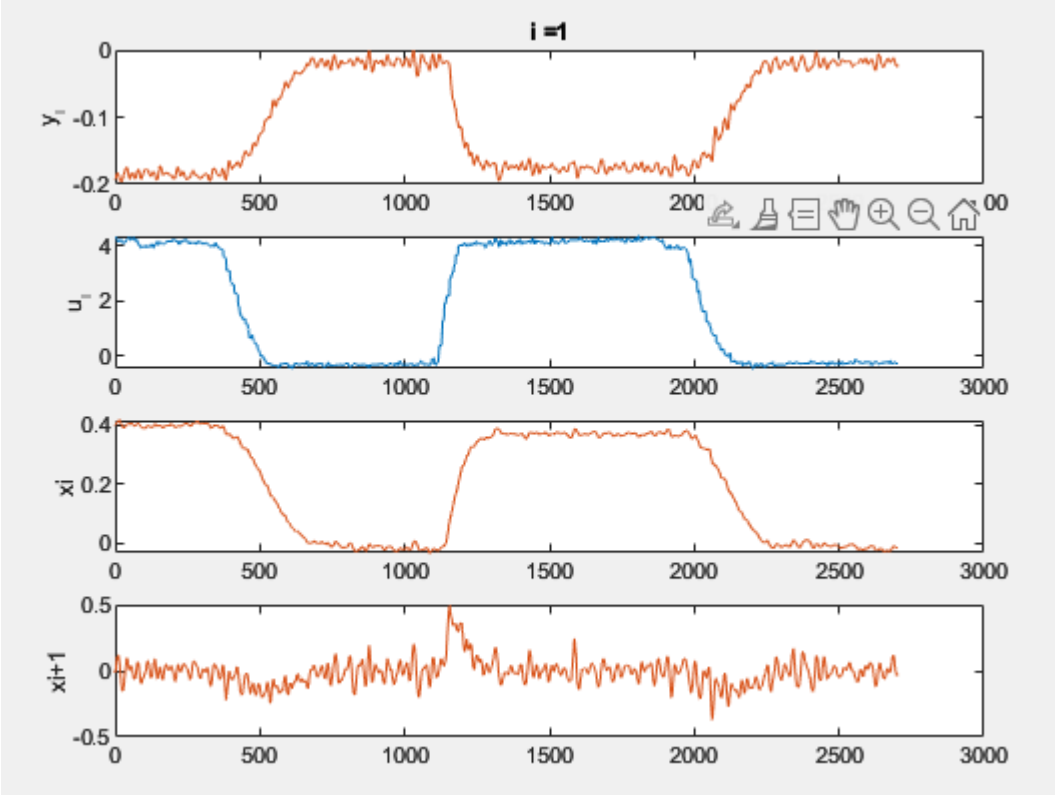
- **Can you explain how you compute tao and f? It seems you were using p_m but why the torque is just the pressure difference?**

Since the actuator is symmetrically placed, the level arm is the same. The only missing part is the coefficient for tau (level arm x contact area) and f (contact area)

$$\tau_{yi} = (pm_{i1} - pm_{i2}) * Area * levelarm, f_{zi} = (pm_{i1} + pm_{i2} + 2 * pm_{i3}) * Area$$

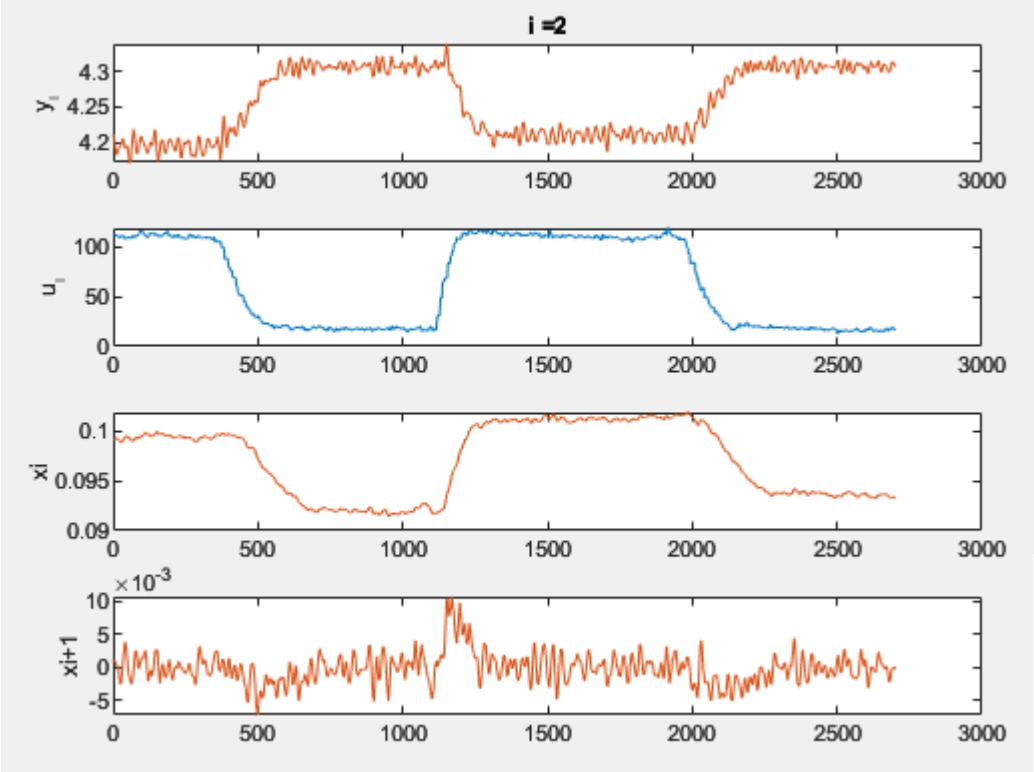
- **I think for the velocity estimate, one reason why you got negative a is because of the noise since k and d are both positive. Is there a way you can further clean up the velocity measurements?**

Following results are 10th order mv for pos, vel and acc, i = 1,2,3,4 represents theta_1, l_1, theta_2, l_2, level arm is set to 0.048m, Area is 0.0015



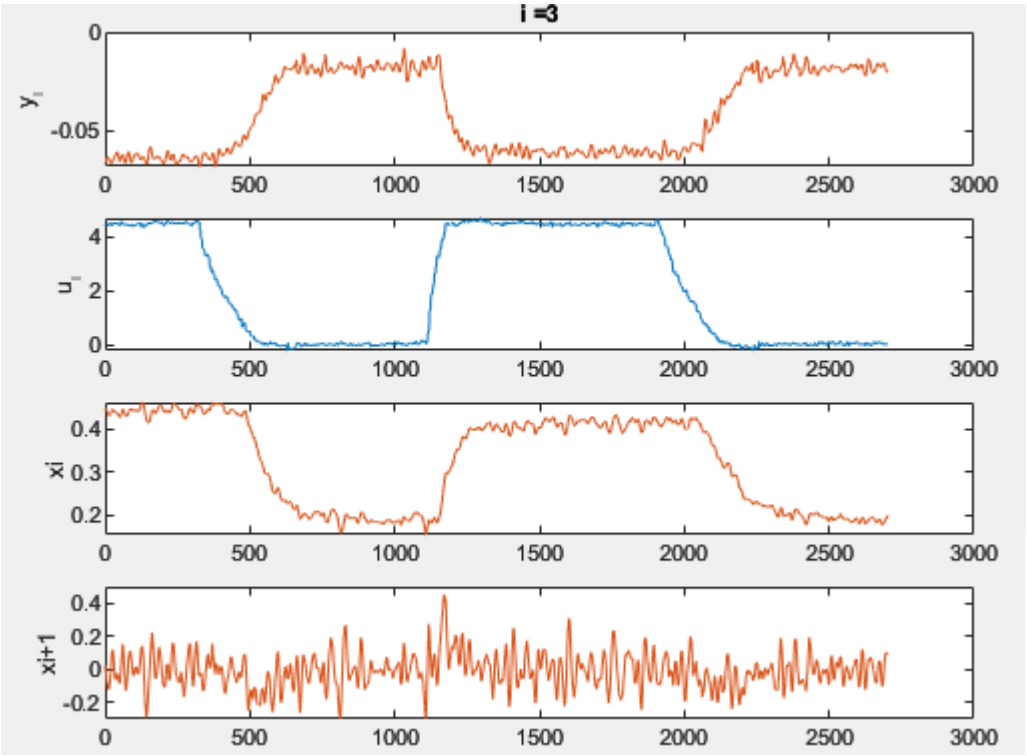

```
lg1 =

    0.0031
   -0.5082
    0.0430
```



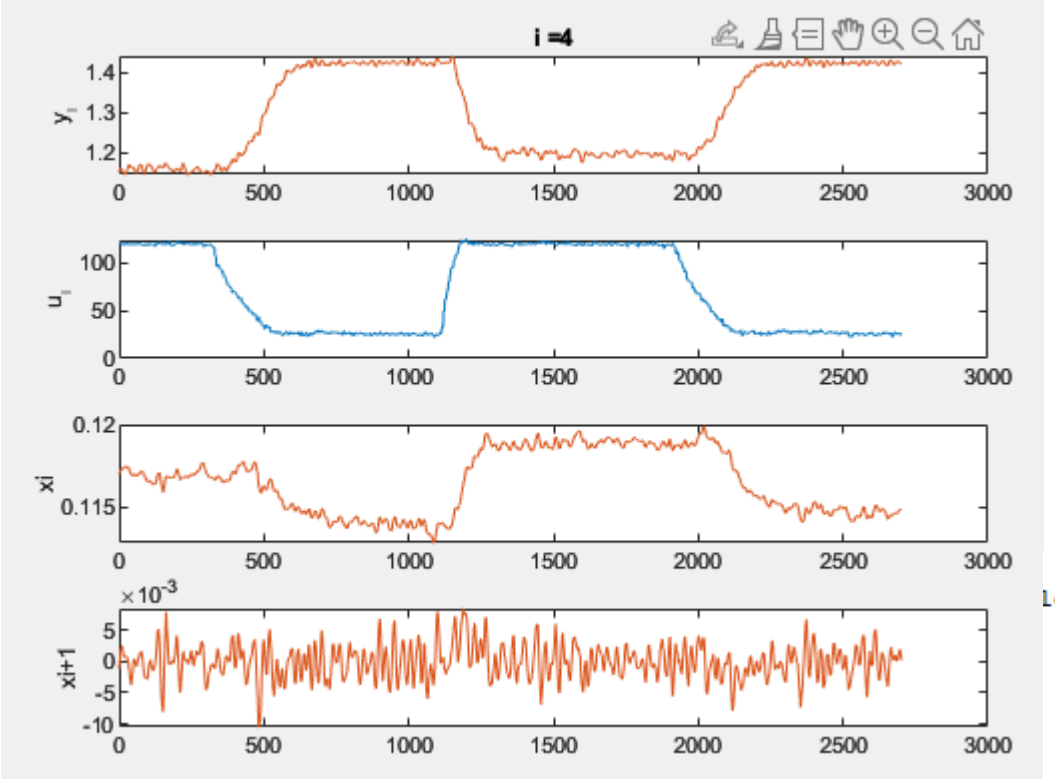

```
lg2 =

   -0.0047
   46.9630
   20.1006
```




```
lg3 =

   -0.0040
   -0.1054
    0.0150
```

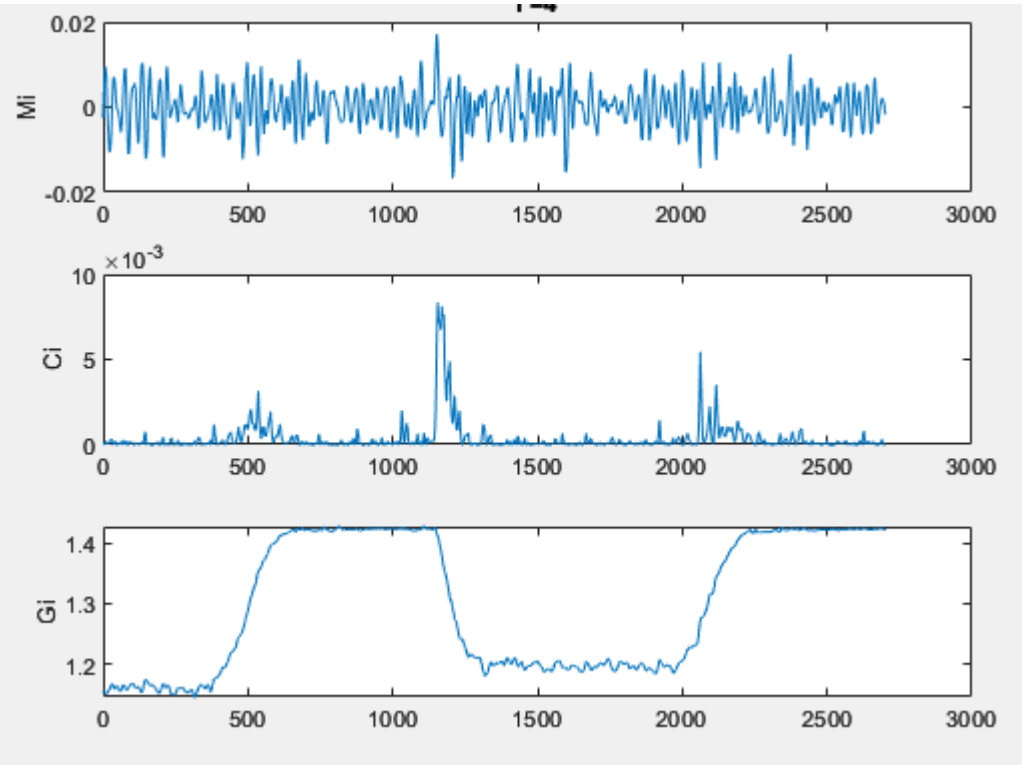



```
lg4 =

   -0.0027
   12.7925
    4.3929
```

Things might work:

- Ignoring M term since acc is noise.
- Considering the friction effect


Mi
0.02
0
-0.02
0
500
1000
1500
2000
2500
3000
Ci
×10^-3
10
5
0
Gi
1.4
1.3
1.2