EEE 686
Homework 5 -Modifications

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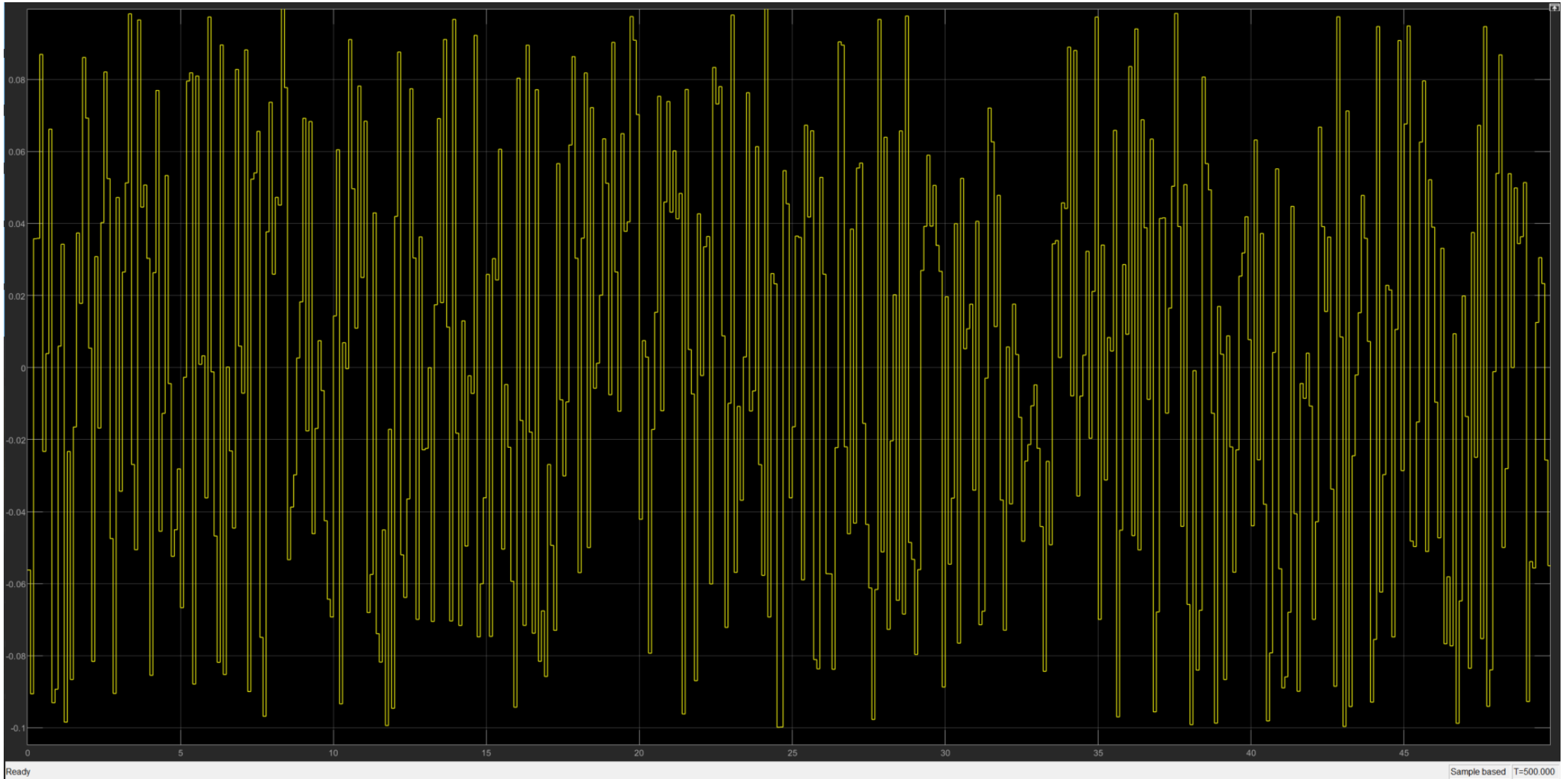
Control objectives

- Implement the modifications:
  - Deadzone
  - Sigma
  - Projection
- Tested with step input / pulse train with excitation

Professor’s note: You should not increase the dead-zone too much. Then you will be admitting very poor controllers. Similar for sigma. Your projection does not work. Once you hit it, there is no way back.

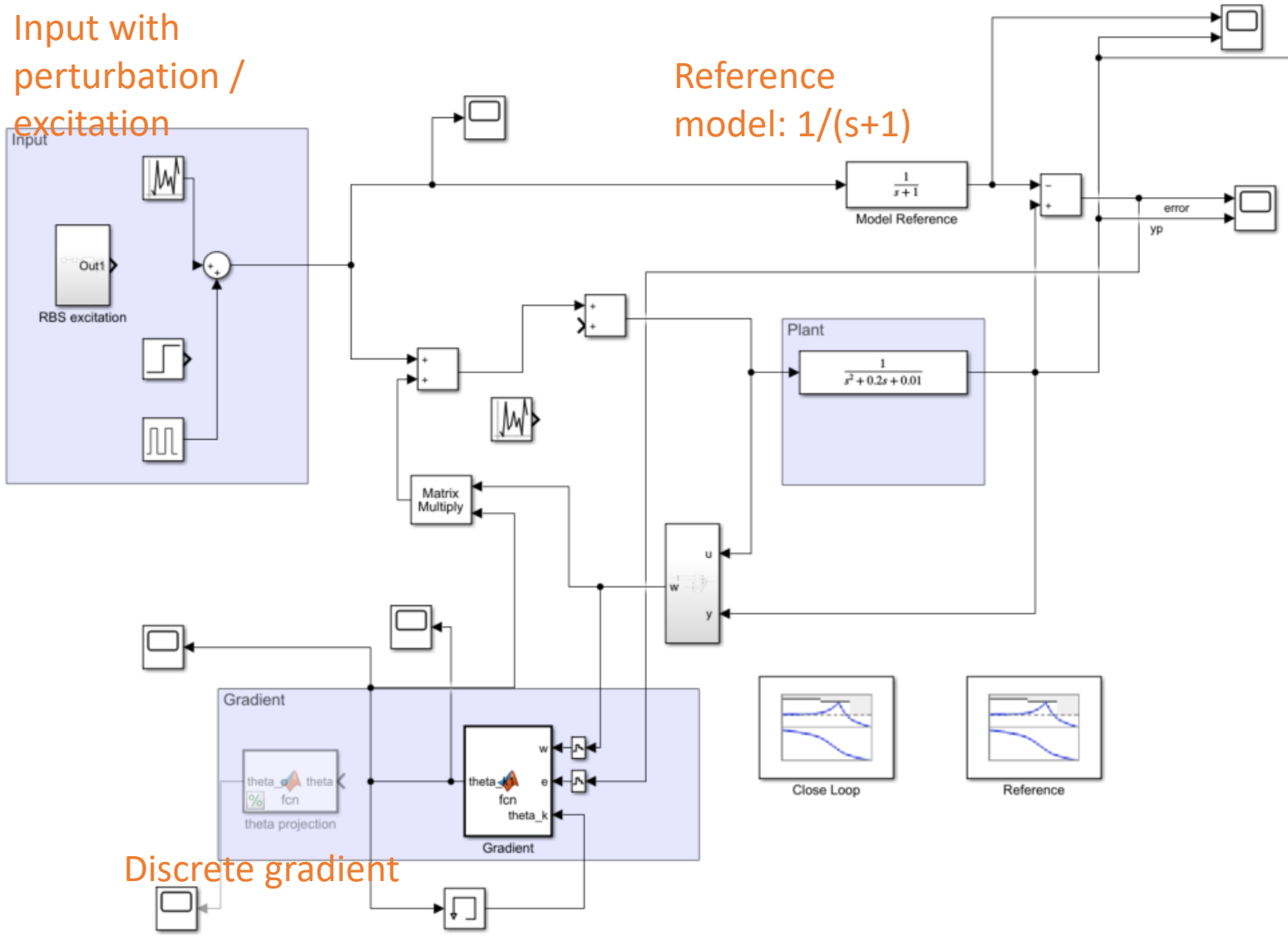
Input Perturbation

- Max: 0.1, Min: -0.1, Sampling time: 0.1s



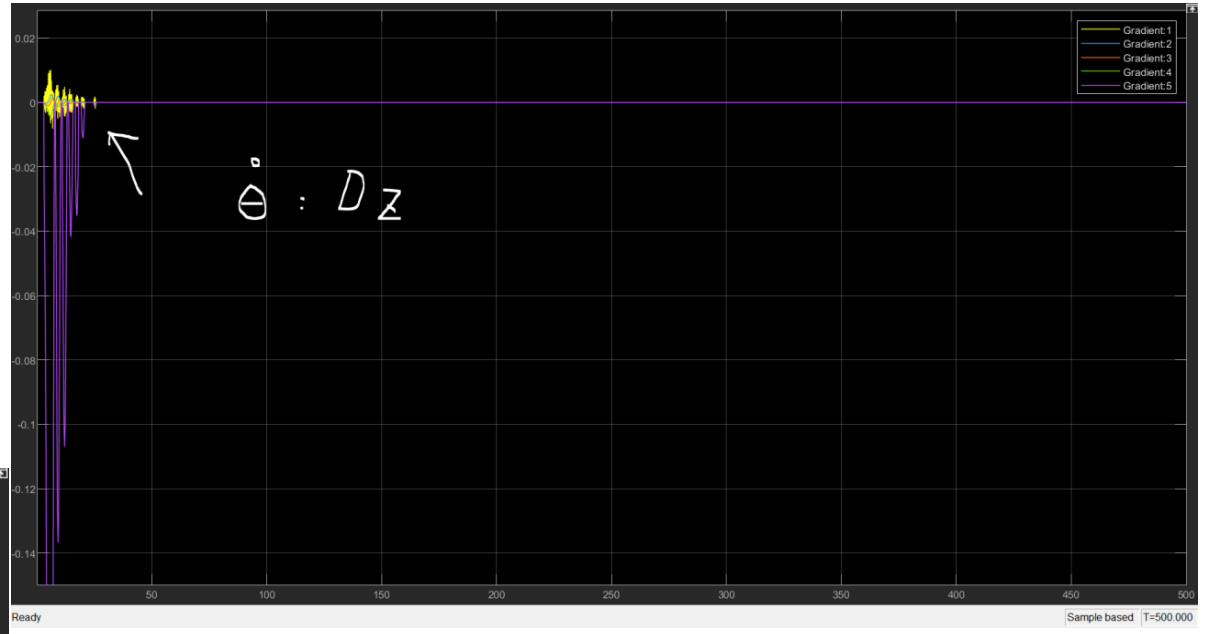
MRAC -System setup

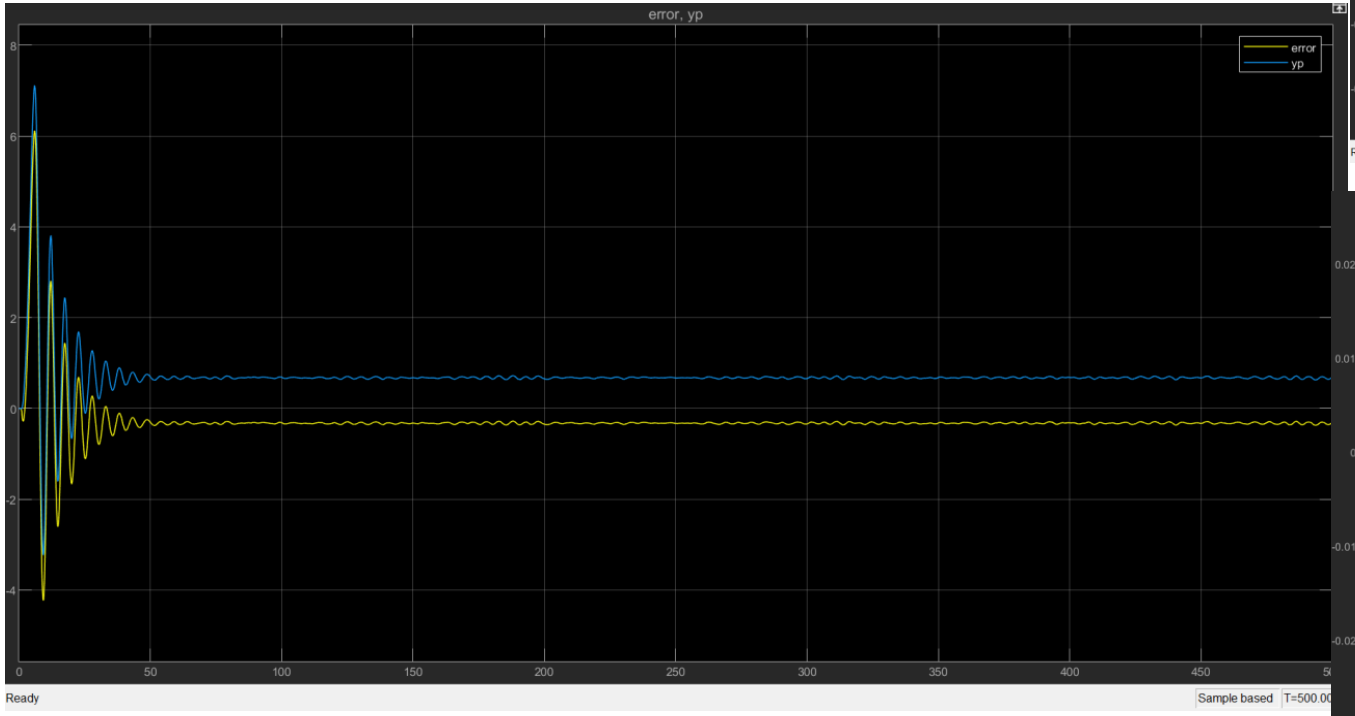
- We are modifying gradient algorithm in this homework.
- We use a pulse train input to see how well the plant converges to reference model.

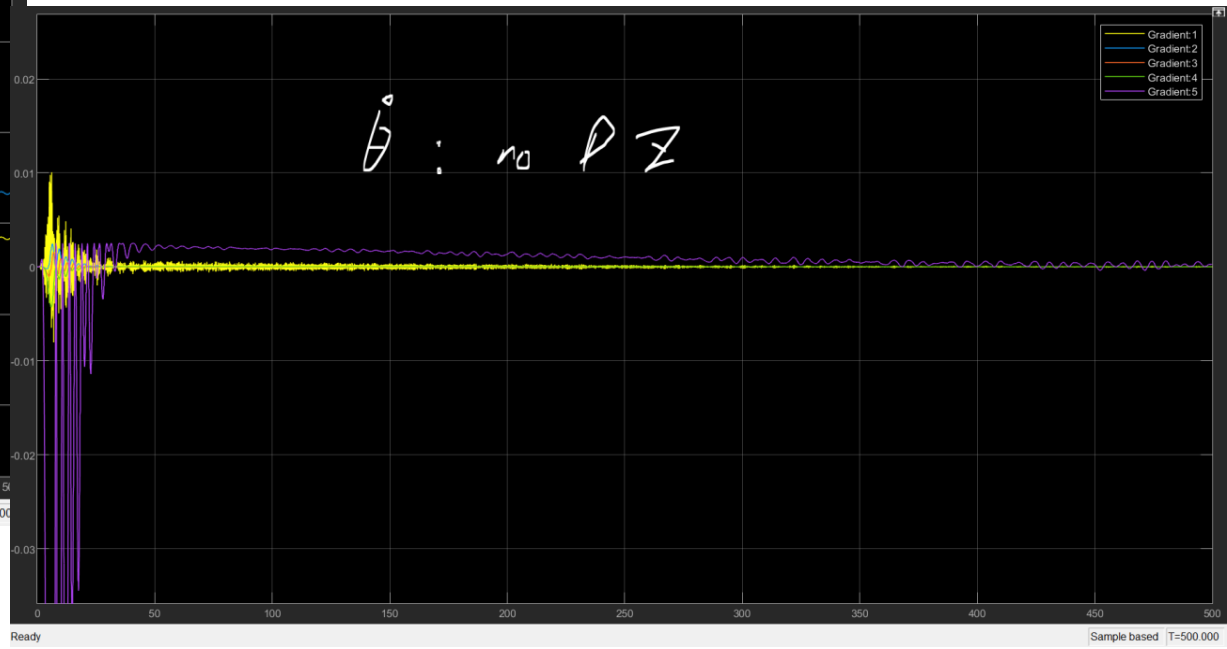


MRAC –P1 -Deadzone

- Deadzone: delta = 0.1

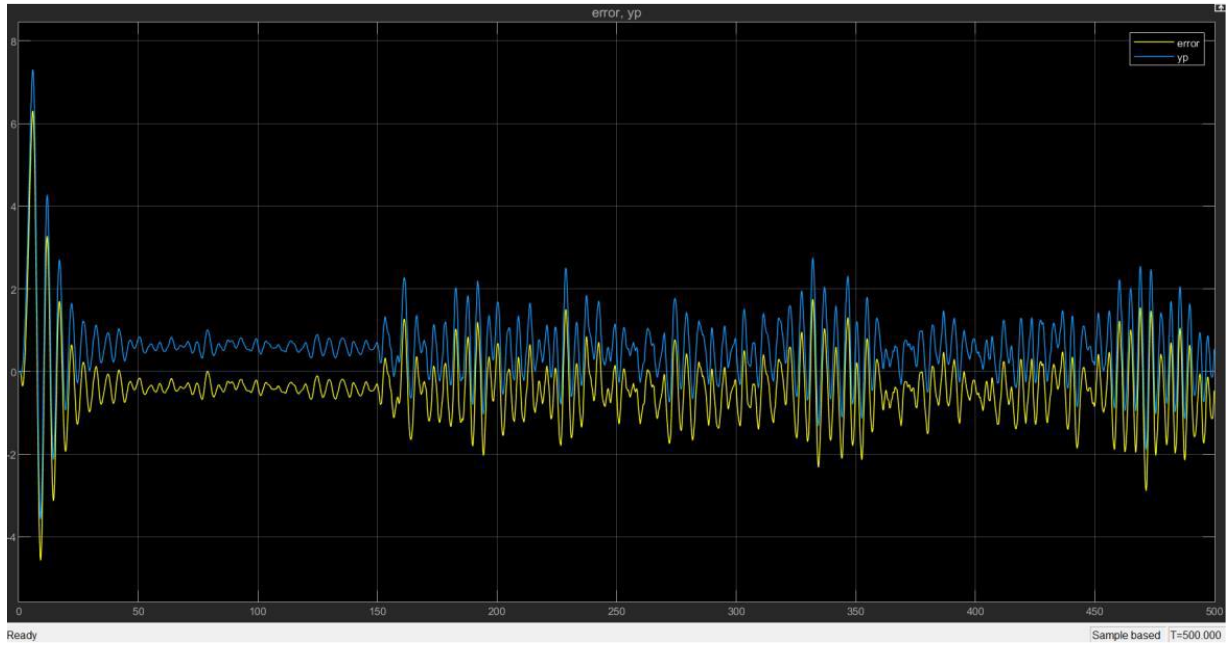


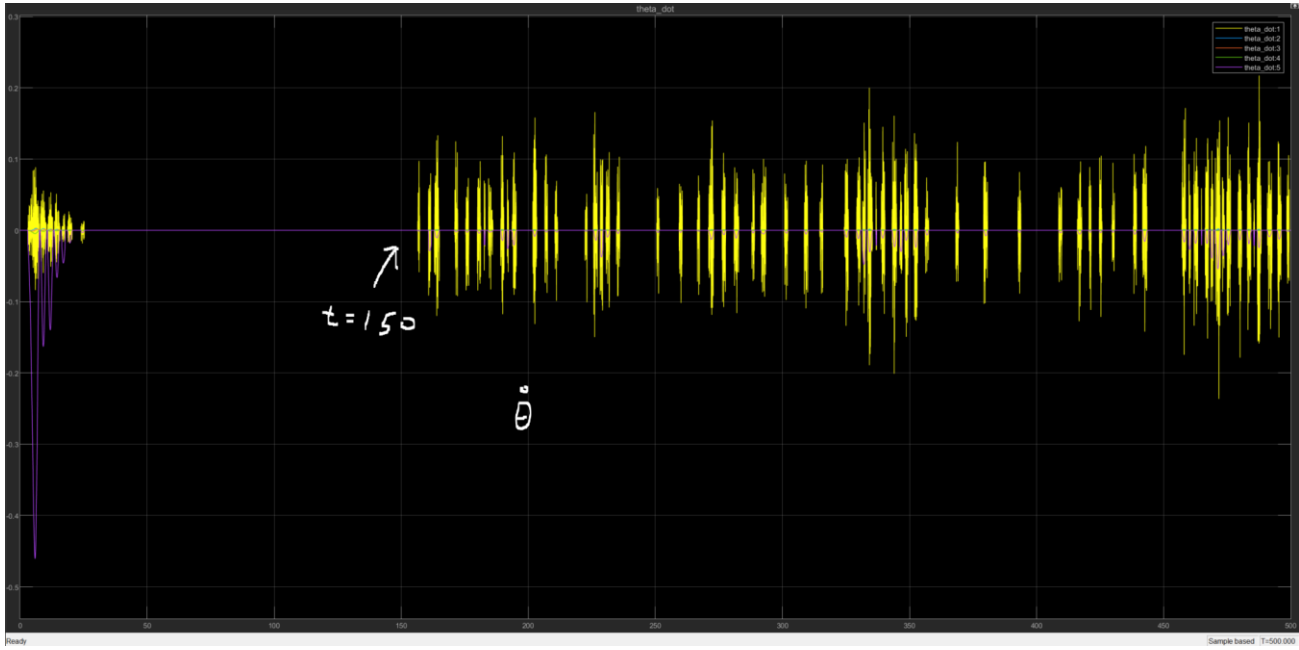




MRAC –P1 –Deadzone–More perturbation

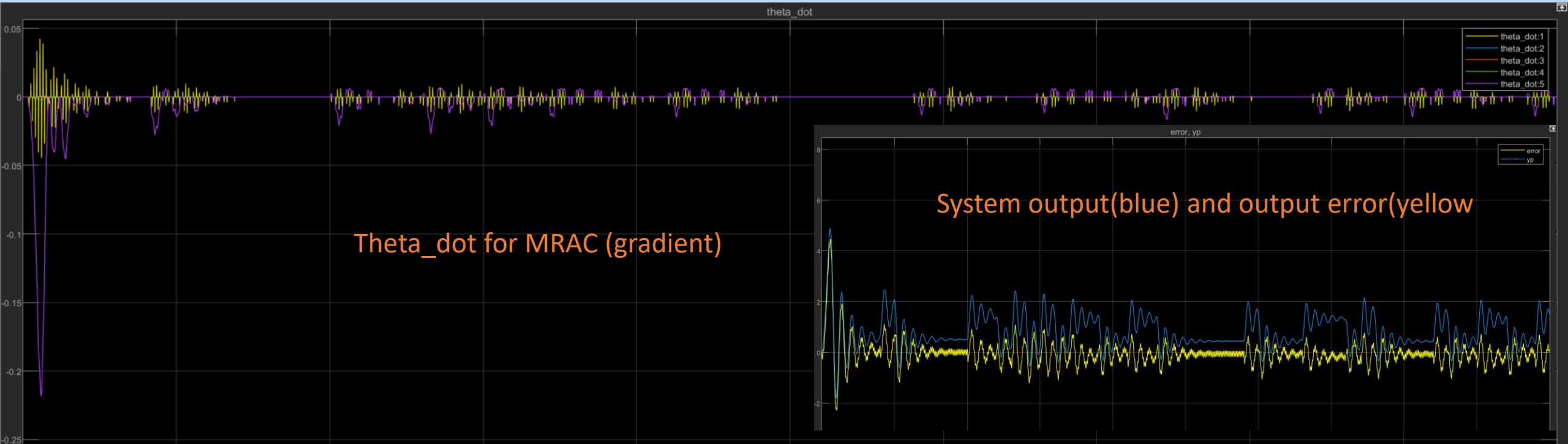
- Introduce a bigger perturbation [-5, 5] at t=150s



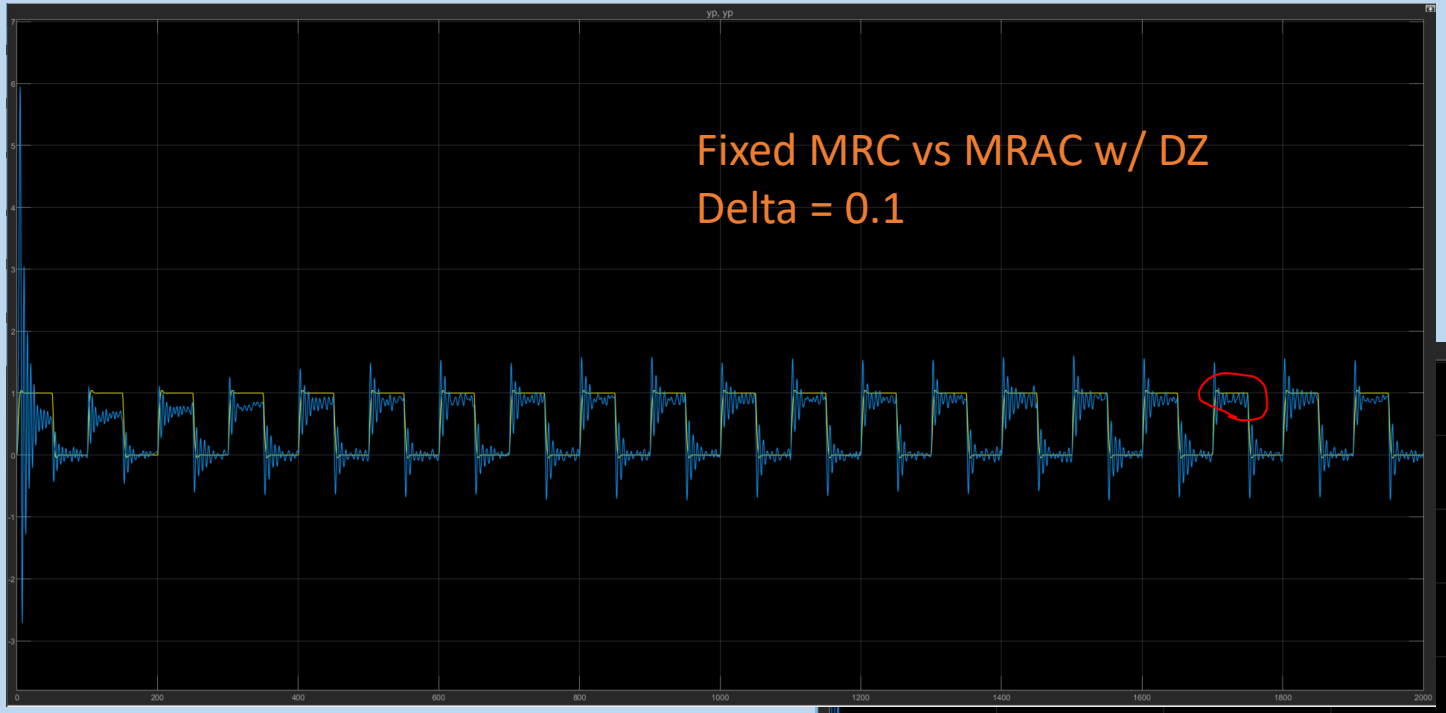


MRAC –P1 –Deadzone–signal disturbances

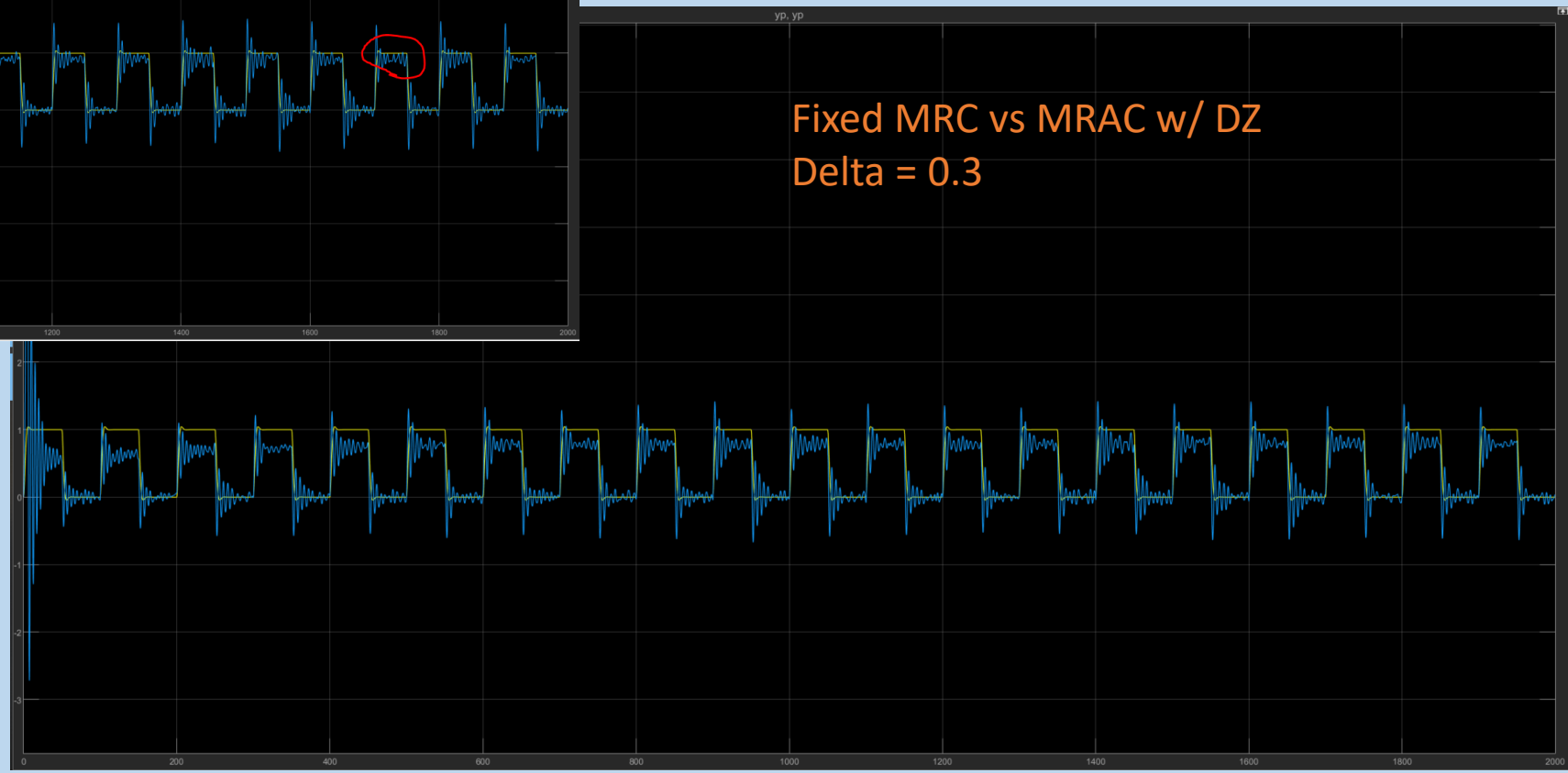
- In this trial we included RBS signal excitation
- Delta is set to 0.3
- We can see the deadzone in action from theta dot graph
- Input is a pulse train signal + excitation



Comparing different DZ settings (delta)

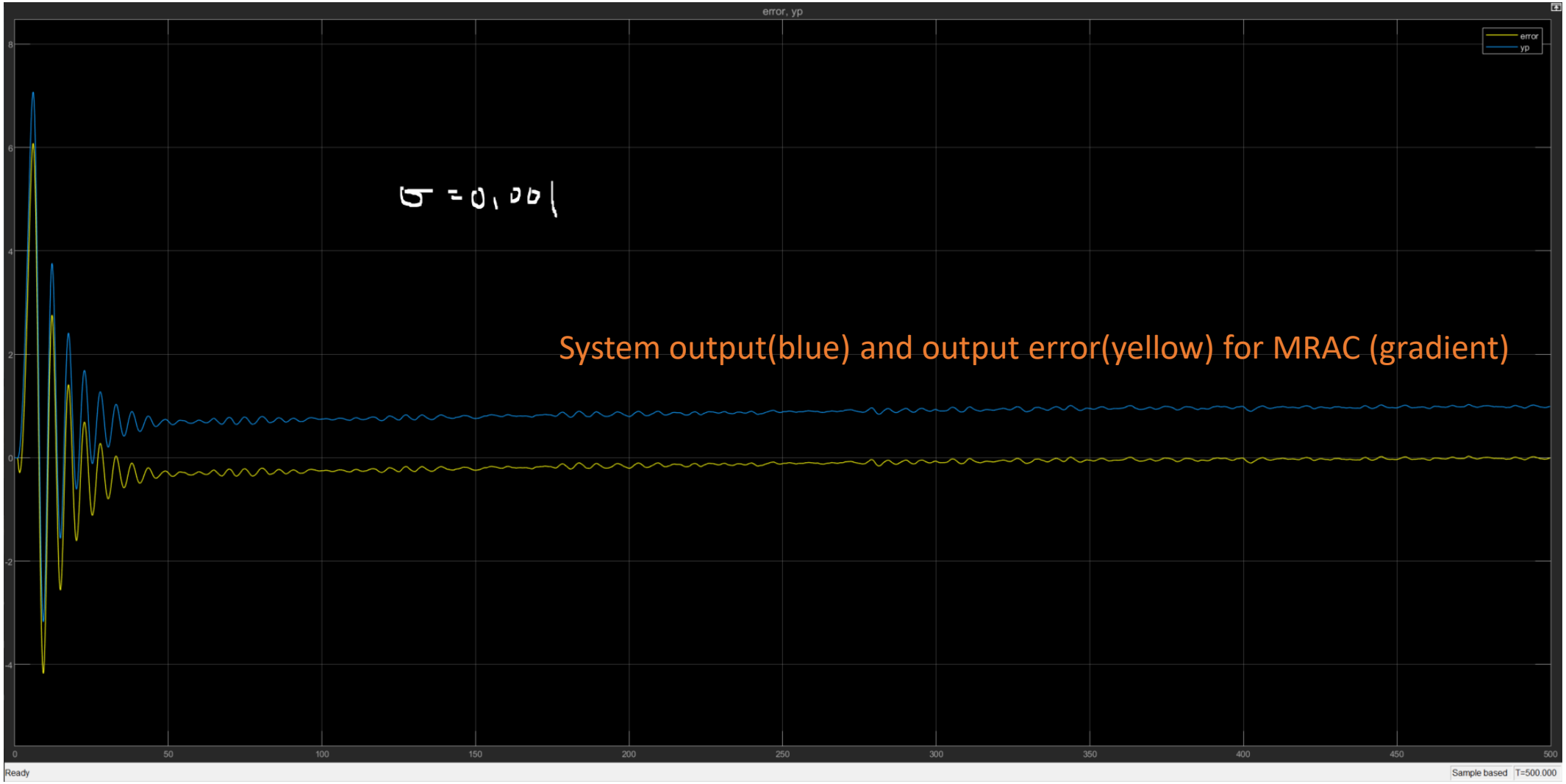


← We can see that the error is reduced as the delta is reduced such that the deadzone kicks in later.



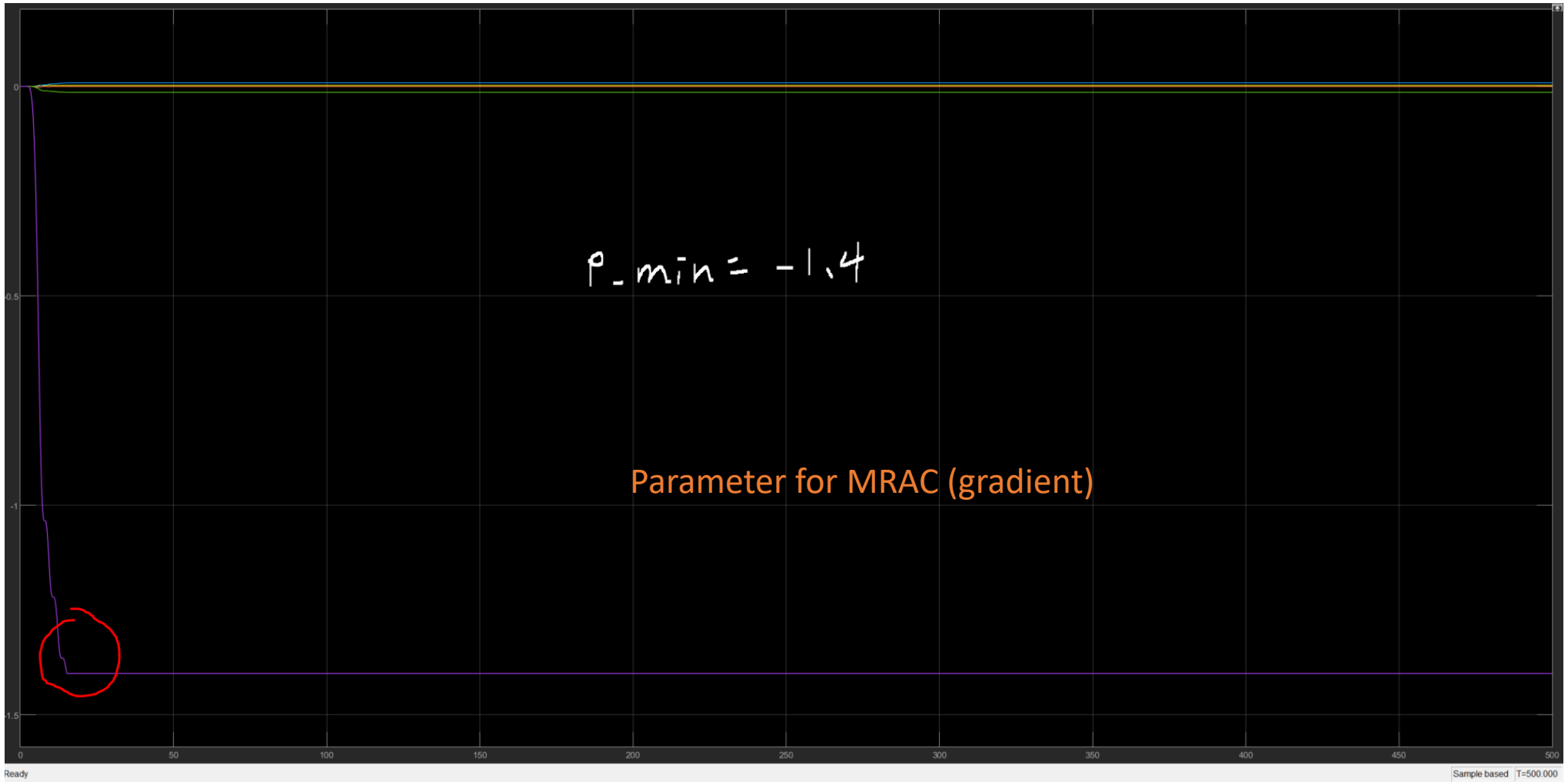
What I wanted to see here is that how much difference would the delta make in terms of system output compared to the ideal system.

MRAC –P1 –Sigma



MRAC –P1 –Projection – first attempt

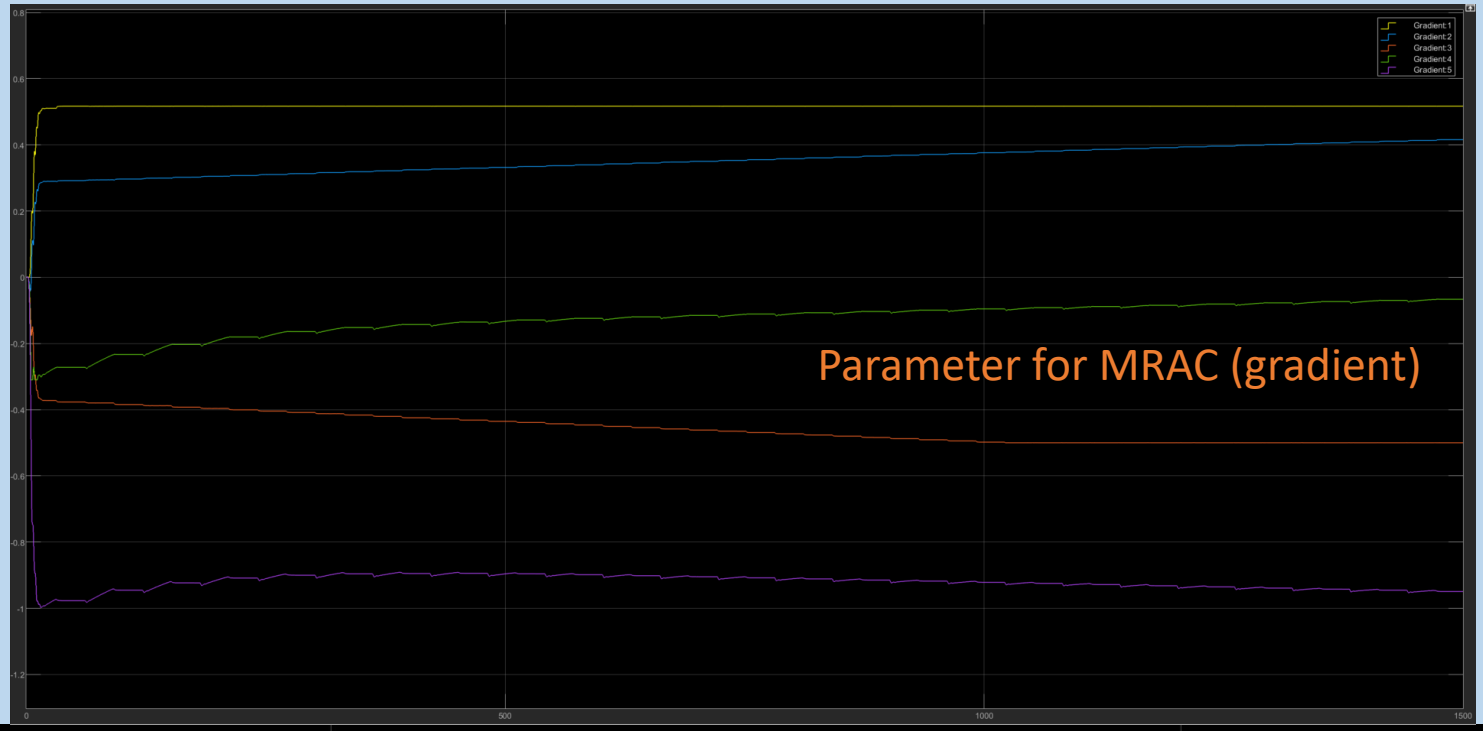
- My attempt: if theta is over a threshold, then stop updating theta dot.



Updated Projection Modification

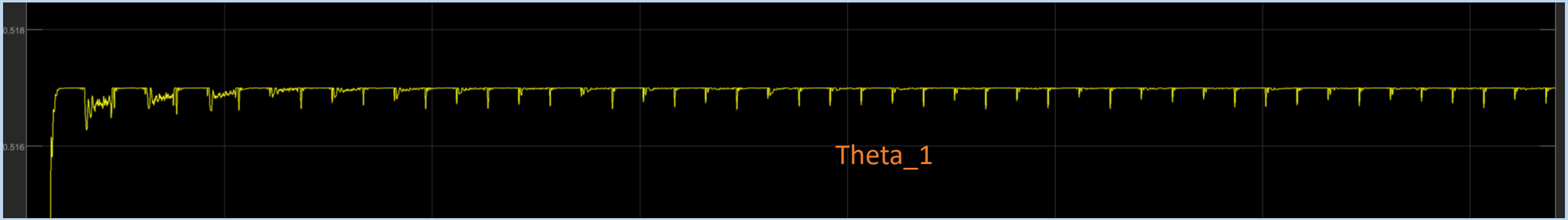
- Instead of previously using continuous time where I modify the theta_dot when the parameters are outside of a boundary, I used discrete system in this case so that we have direct access to the theta for projection.

Parameters are projected individually if they go outside of the boundary set. They are projected to the closest boundary, i.e. theta_max if they exceeds the max value.



Updated projection - continued

- Theta_star: [0.017 0.078 0 -0.01 -1]
- Theta_min: [-0.1 -0.1 -0.5 -0.31 -1.8]
- Theta_max: [0.517 0.778 0.1 0.09 2]
- Below is the enlarged view of the bounded parameter (theta 1)
- We can see that the perturbation in input causes the parameter to spike a little then become bounded again.



Summary

- The modifications are meant for improving robustness when input perturbation is present.
- Sigma modification seems to create an offset compare to the deadzone.
- Selecting appropriate parameter set to project onto is important as poor design could disrupt the transient response of the system.