Homework 3 – Controller design

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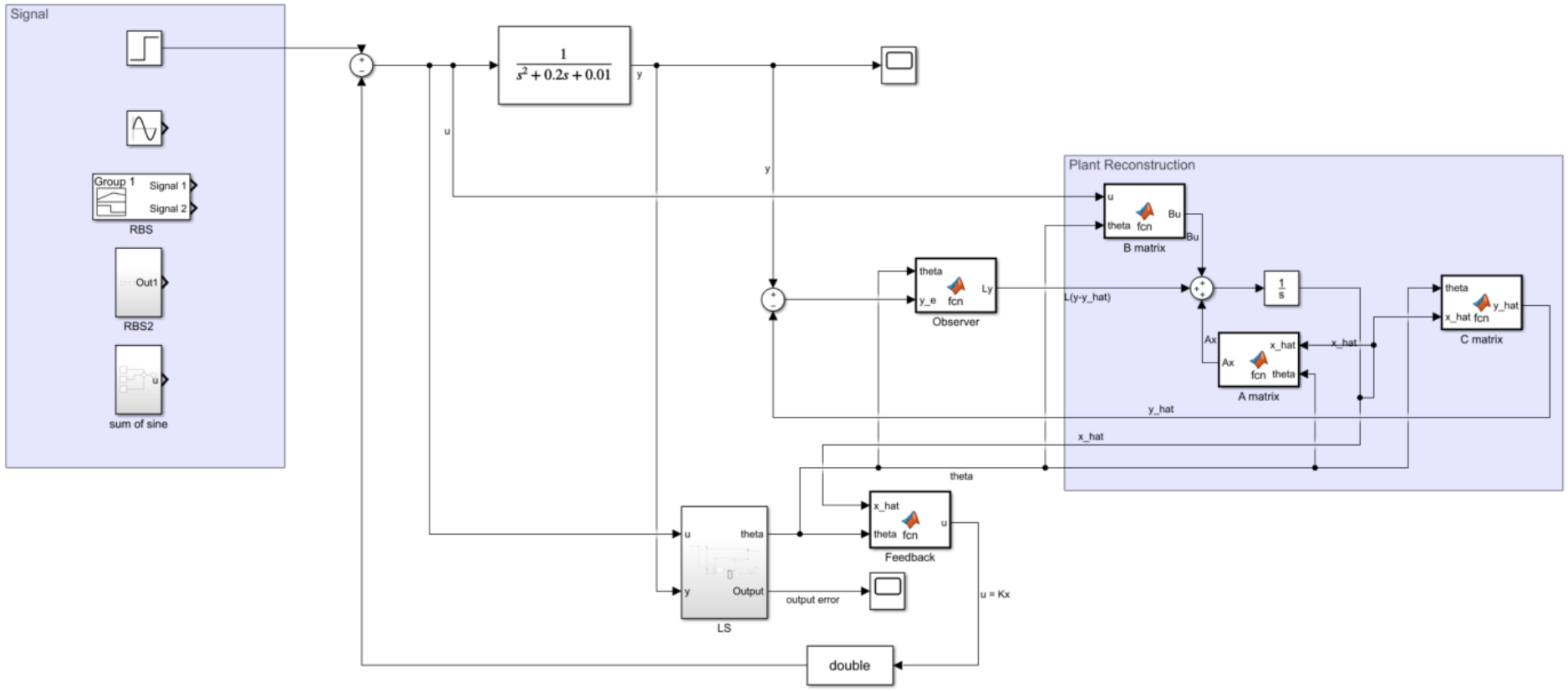
Overview

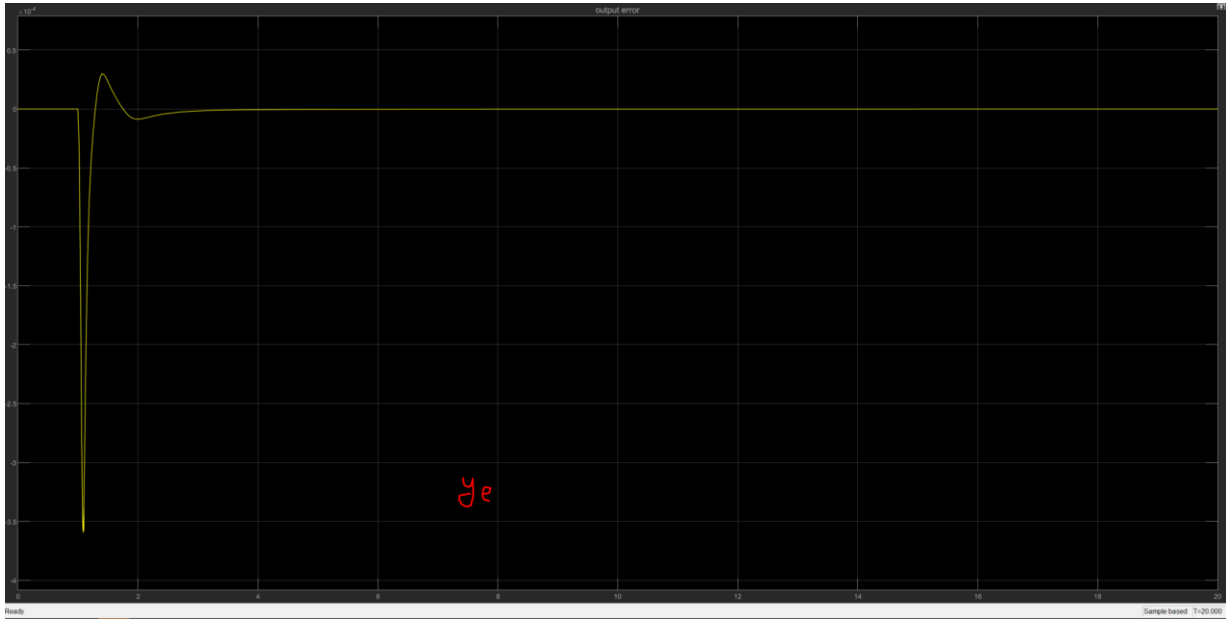
- PPC
  - System setup
  - System response
  - Frequency response
- LQG
- MRC

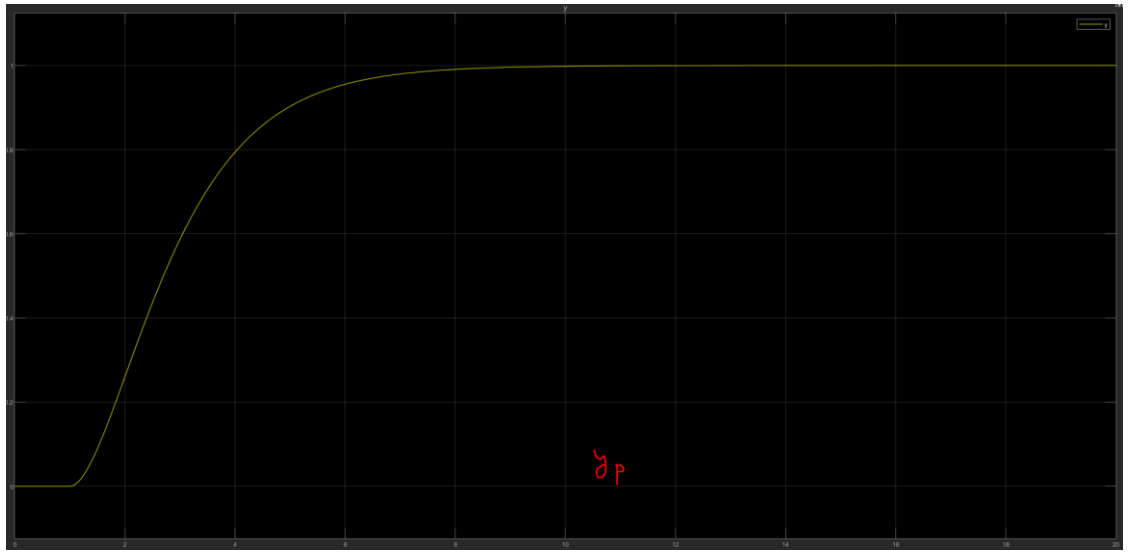
PPC - setup


Signal
Group 1
Signal 1
Signal 2
RBS
Out1
RBS2
u
sum of sine
$\frac{1}{s^2+0.2s+0.01}$
y
u
y
Plant Reconstruction
u
theta
fcn
Bu
B matrix
theta
y_e
fcn
Ly
Observer
L(y-y_hat)
1/s
Ax
x_hat
fcn
theta
A matrix
x_hat
theta
x_hat
fcn
y_hat
C matrix
y_hat
x_hat
theta
x_hat
theta
fcn
u
Feedback
u
theta
y
Output
output error
LS
u = Kx
double

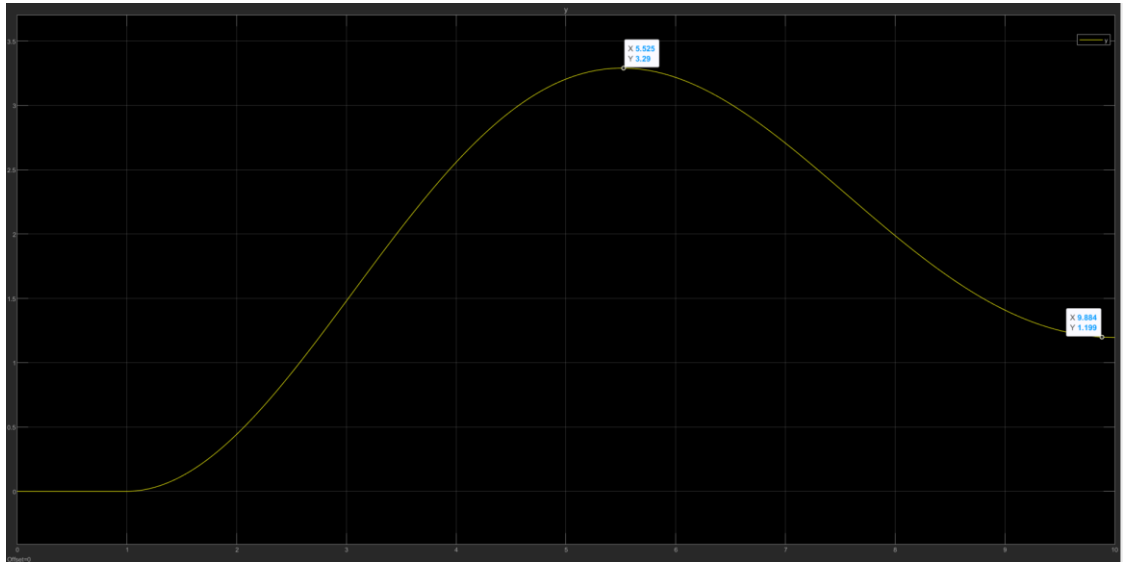
PPC – P1 – System response

Pole = 10 times to the left from open loop pole→



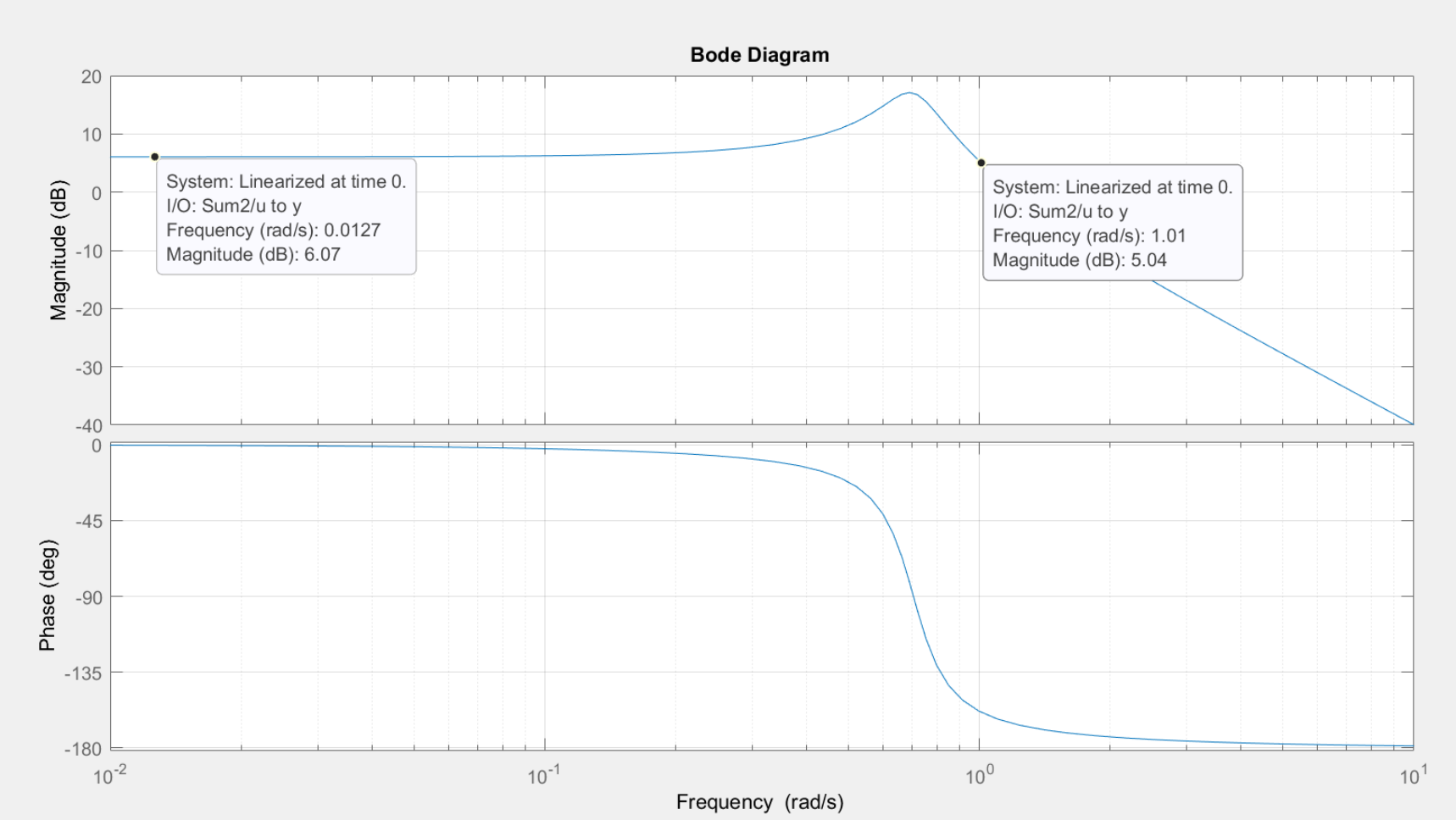


When assigned desired pole →

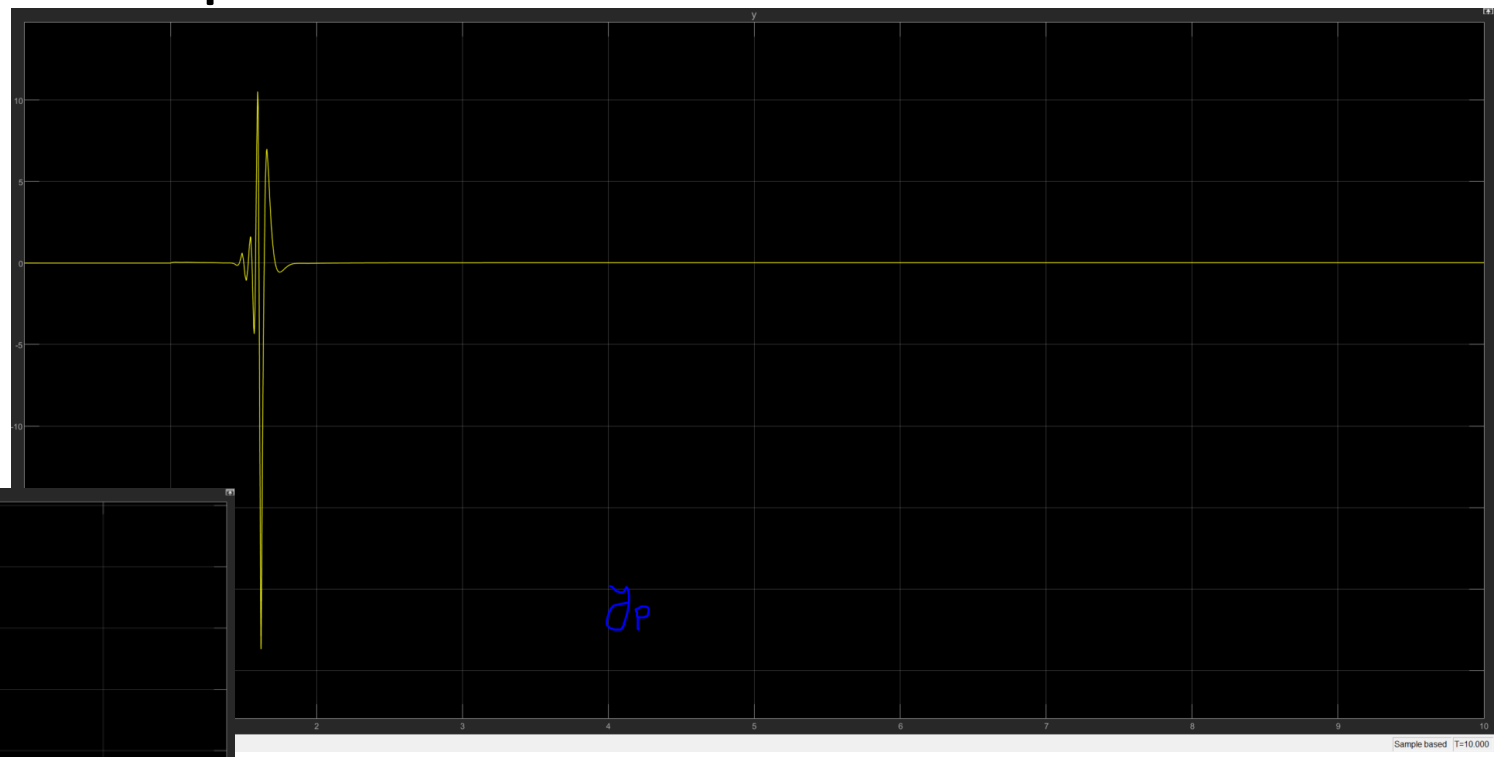


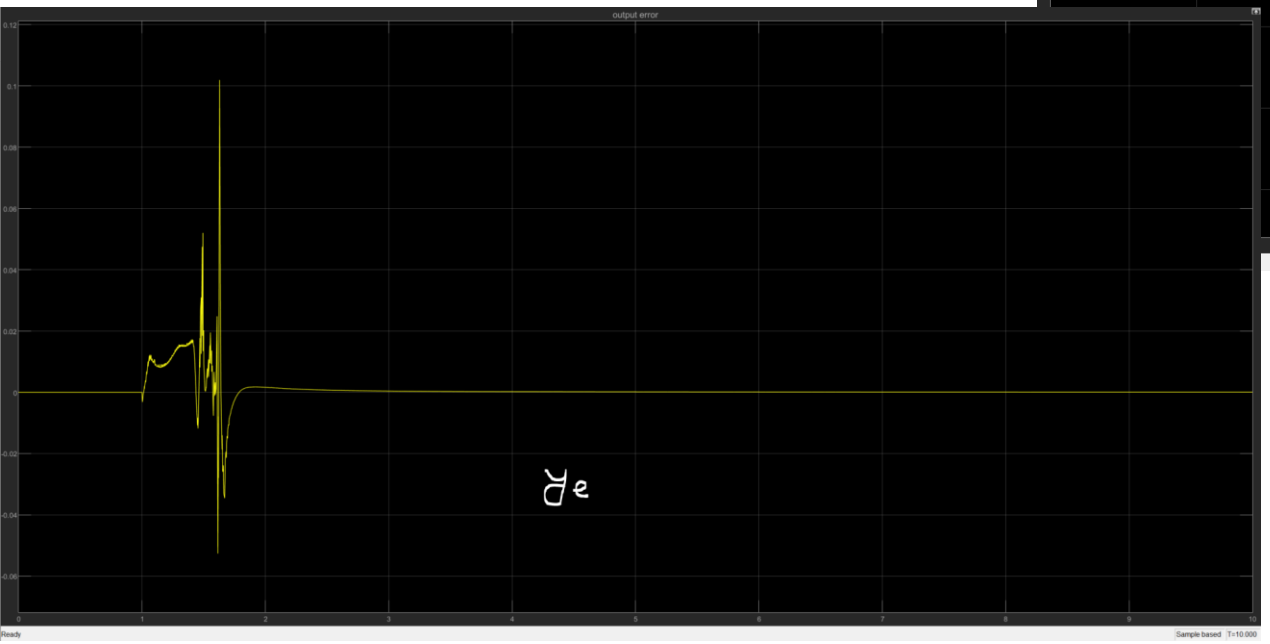
PPC – P1 – Frequency response

- With K designed having pole = -.1+0.69805i & -.1-0.69805i



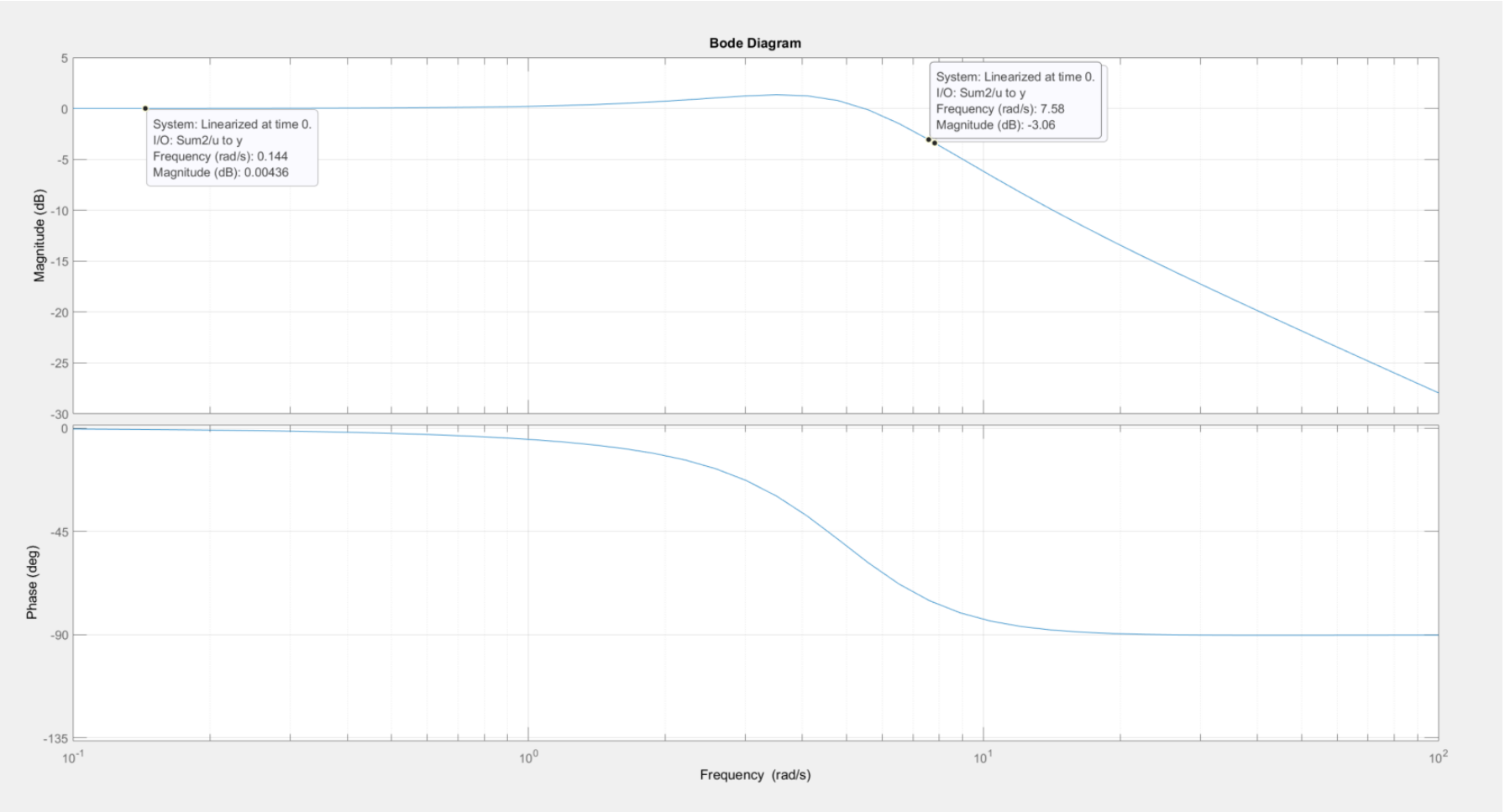
PPC – P2 – System response





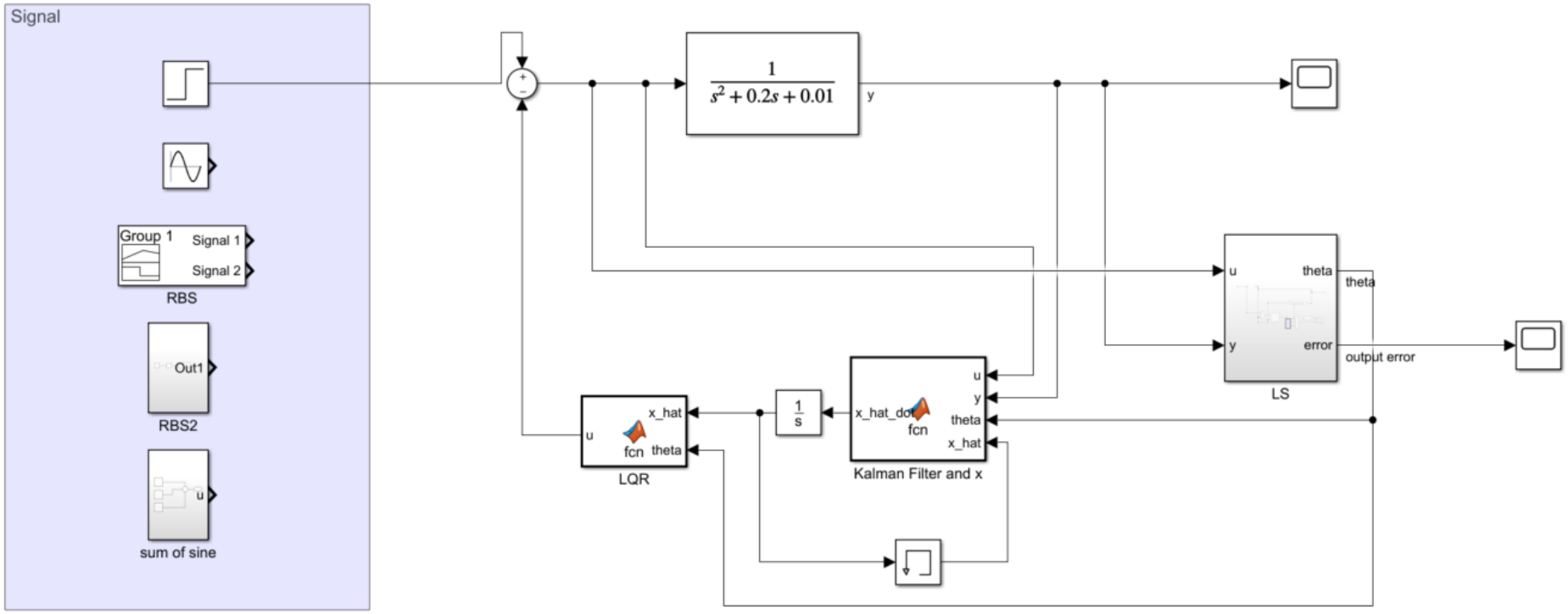
PPC – P2 – Frequency response

- Bandwidth of O.L. = 7.5408

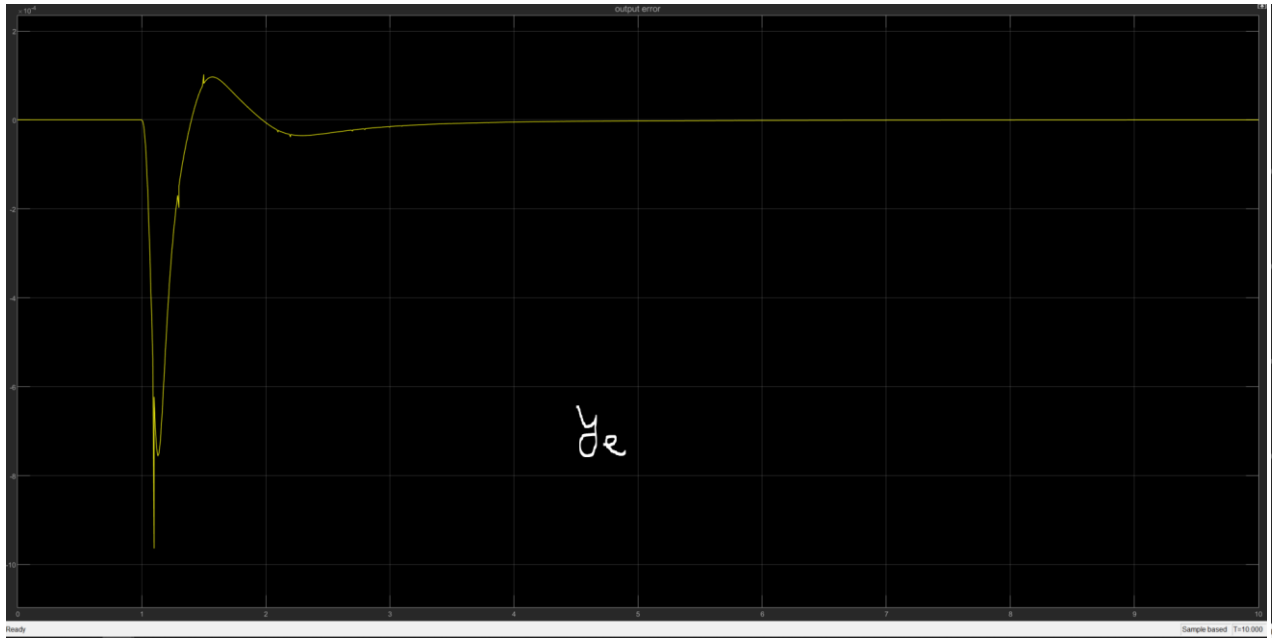


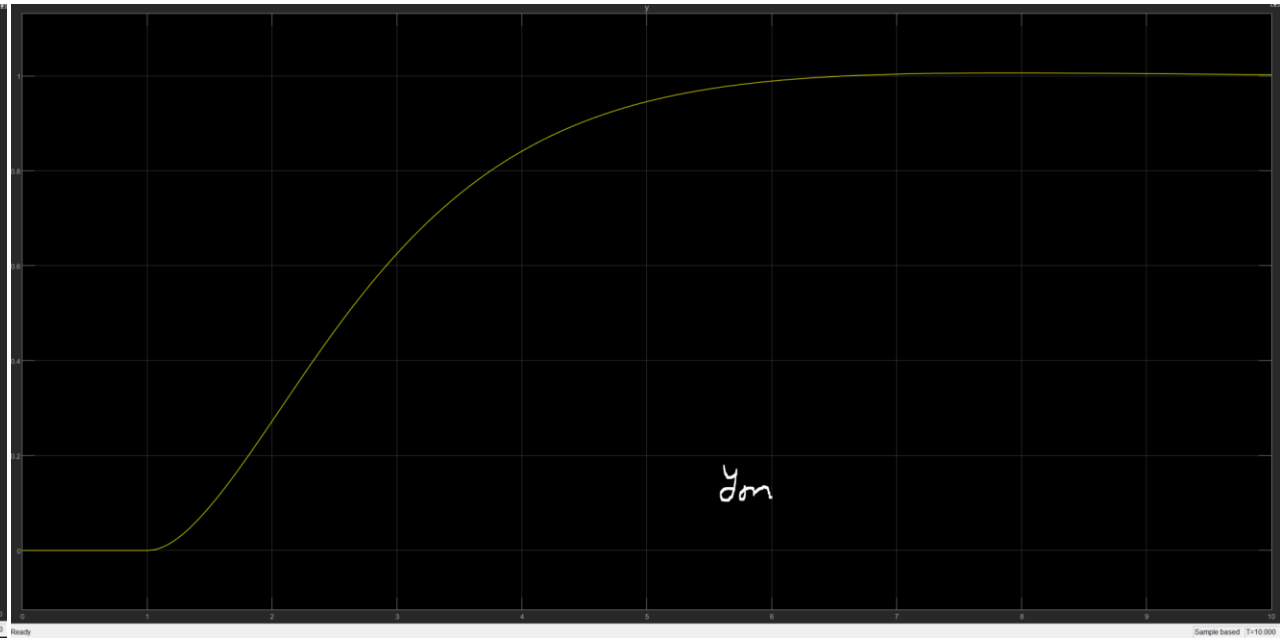
LQG – P1 – system setup

- Sampling time: 0.005 s, Q = R = 1 for lqr, Q = R = 0.1 for Kalman.



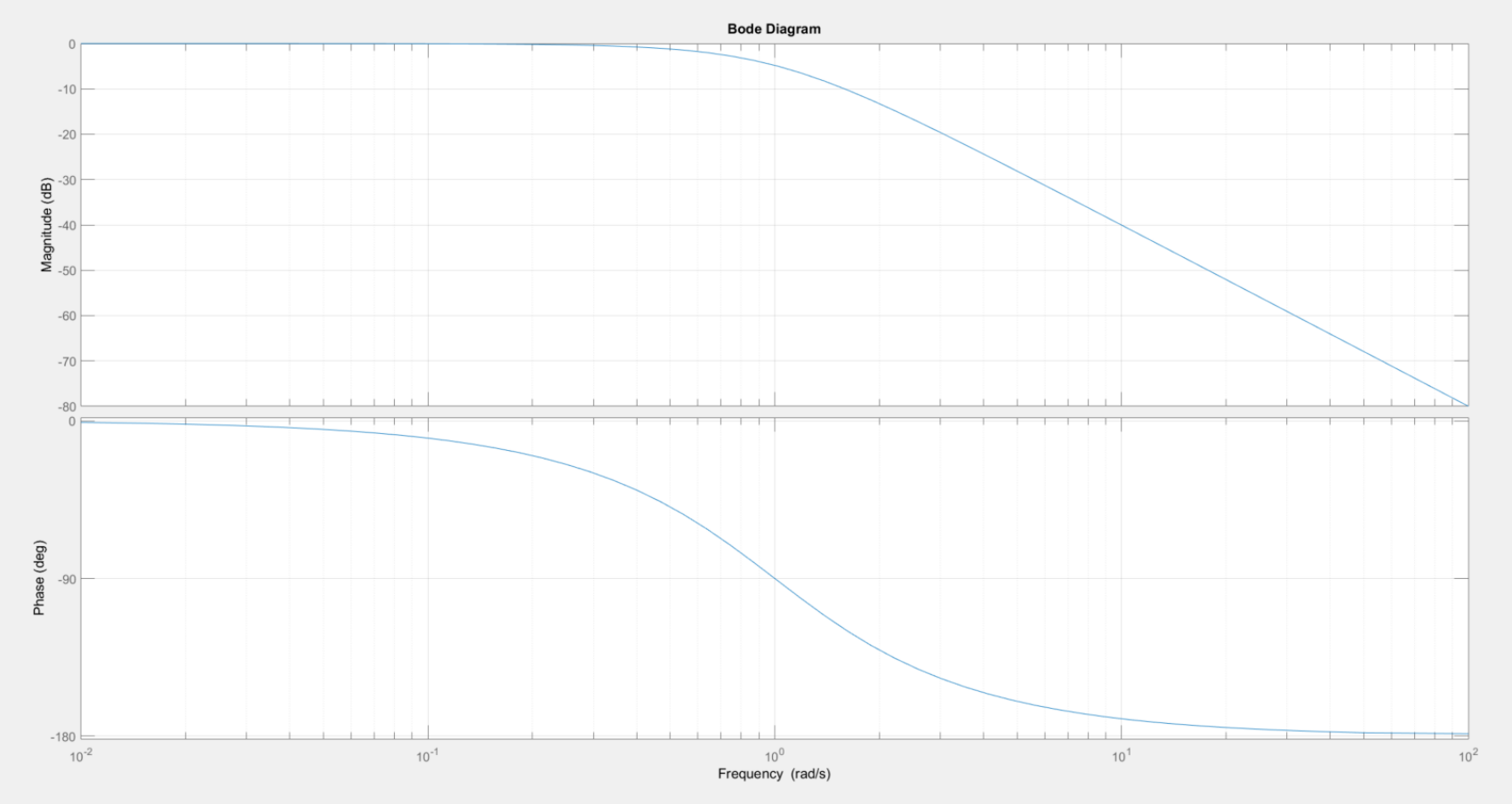
LQG – P1 – system response



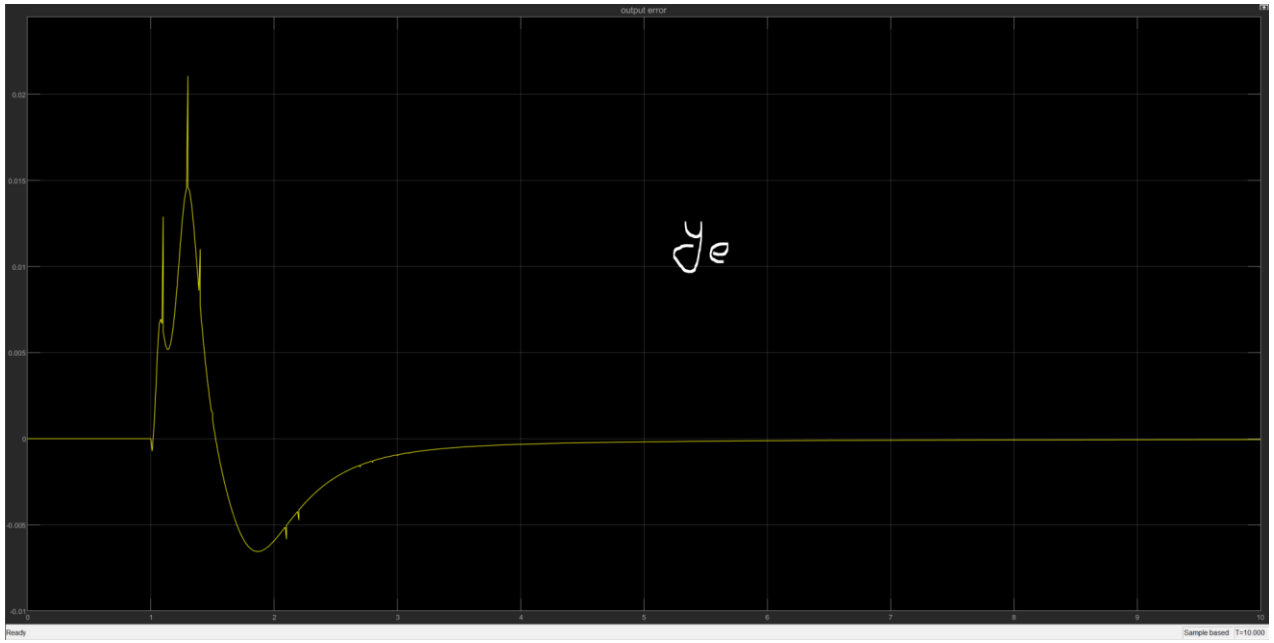


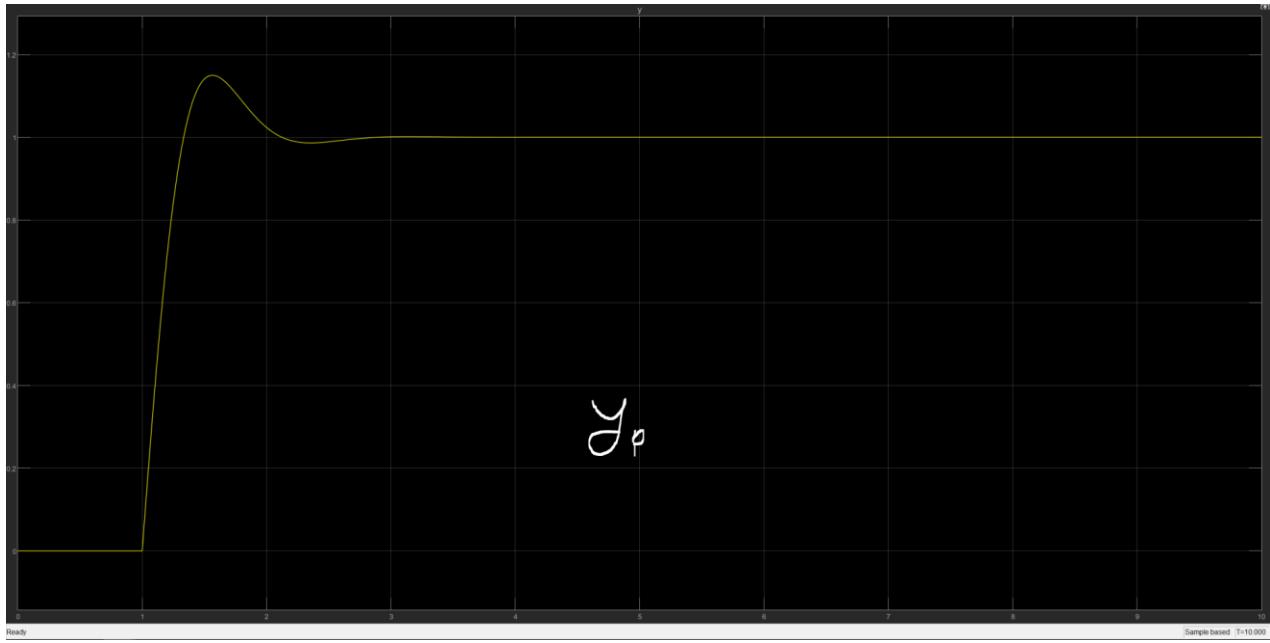
LQG – P1 – Frequency response

- Desired bandwidth: 1 rad/s



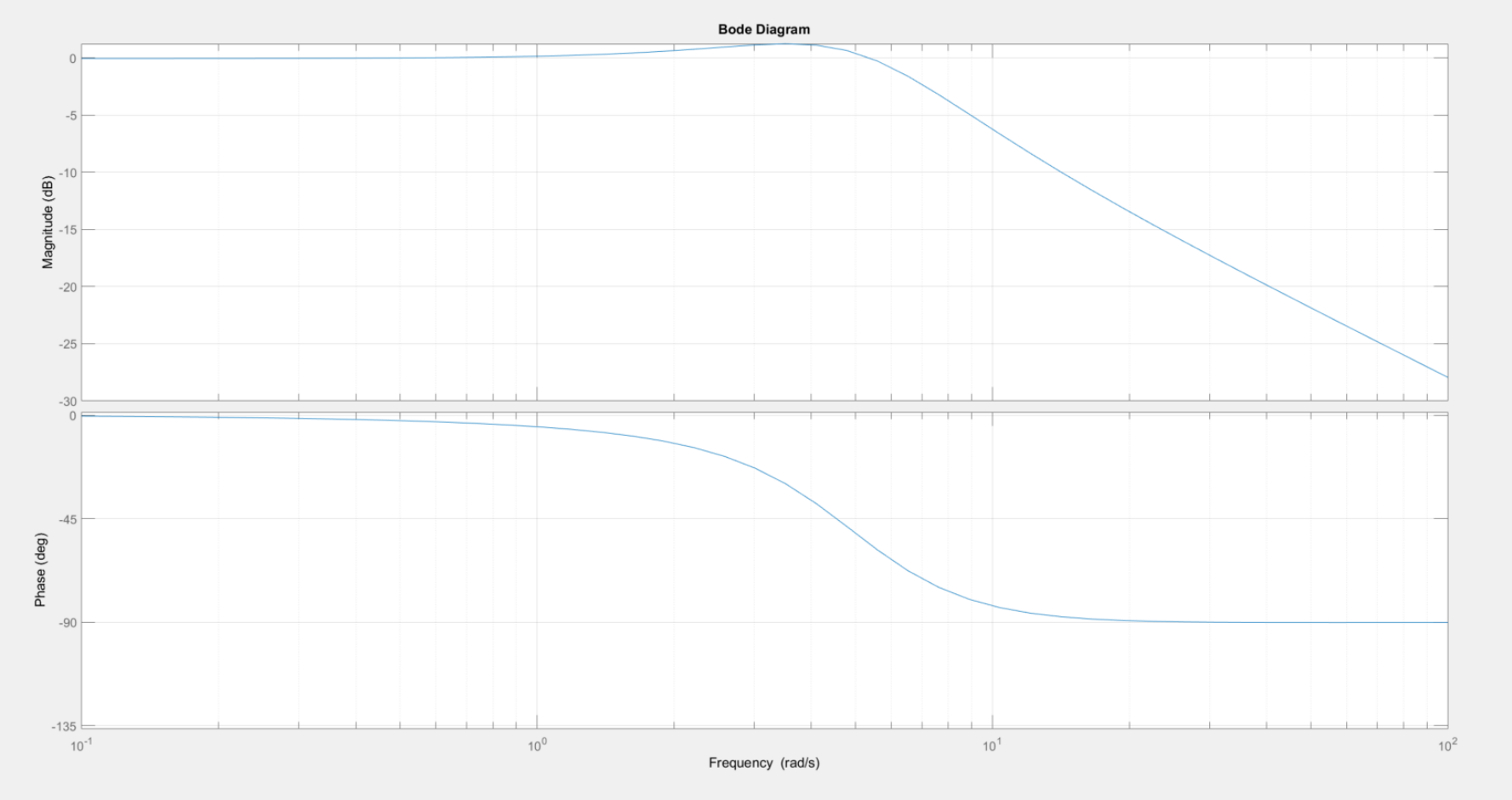
LQG – P2 – system response



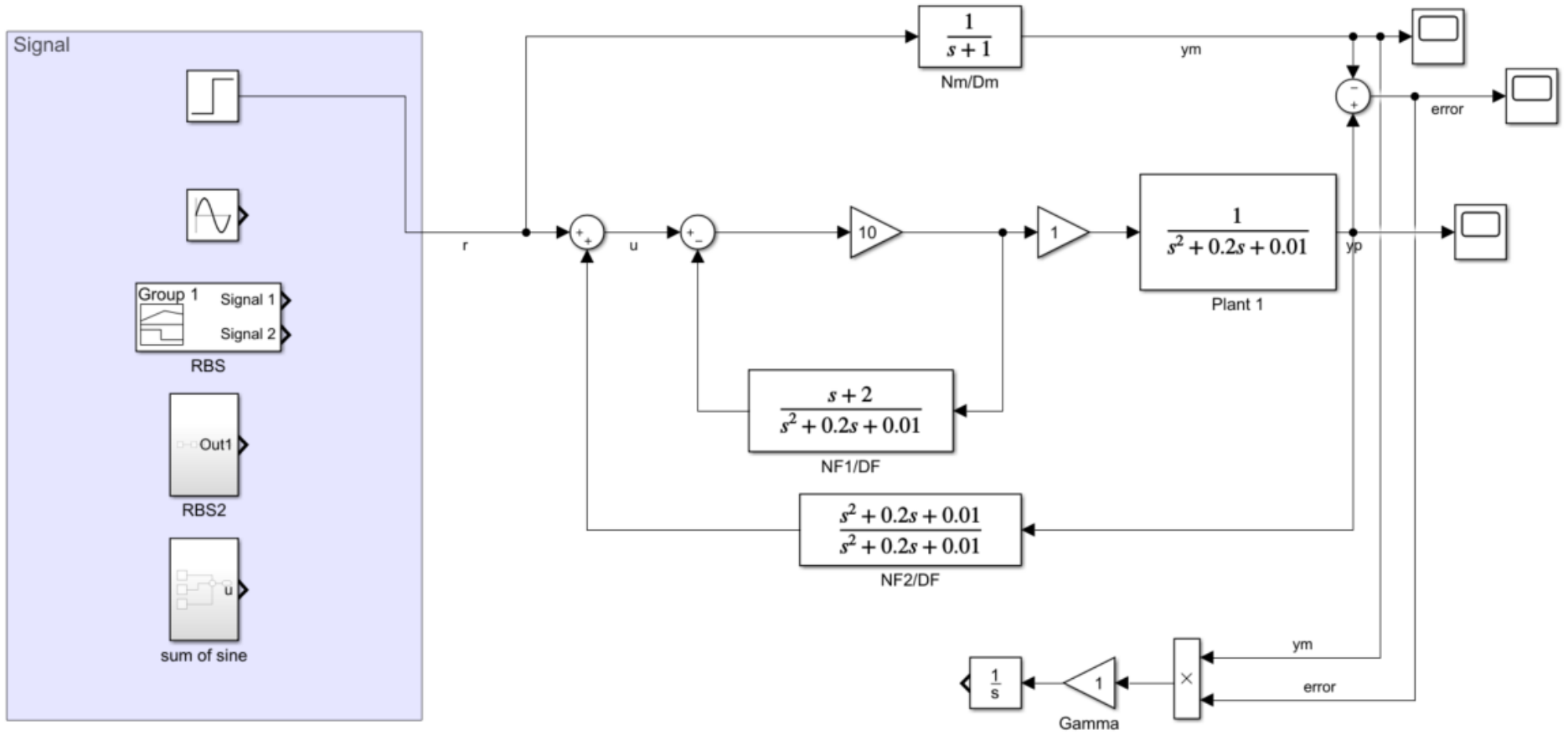


LQG – P2 – Frequency response

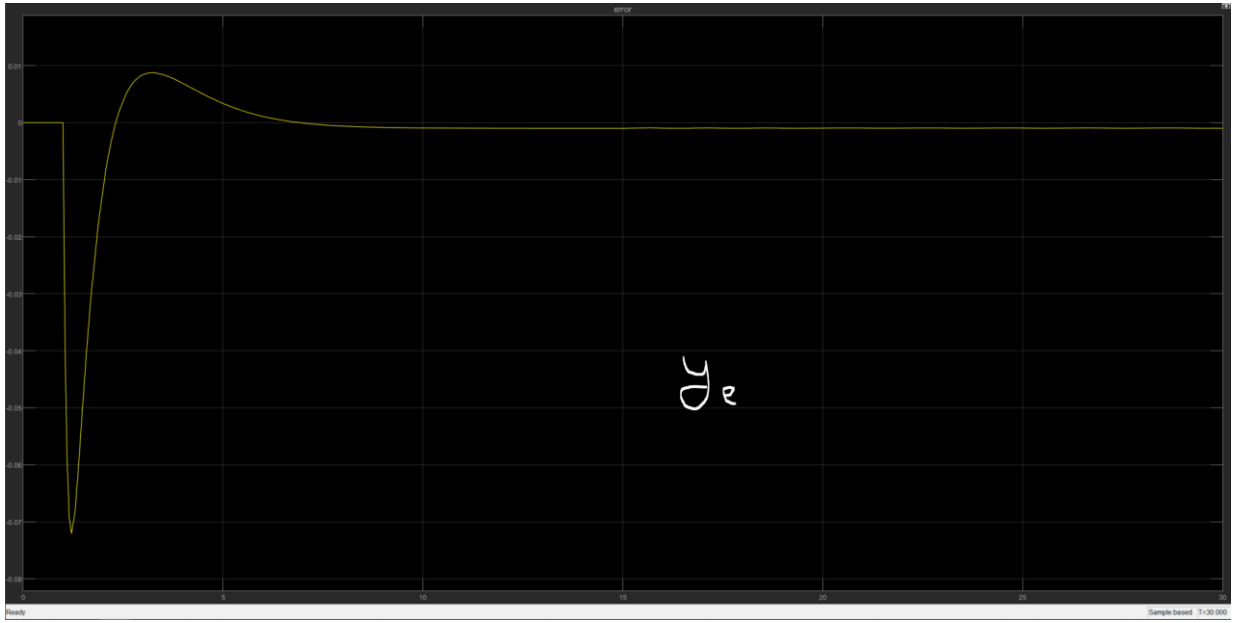
- Bandwidth of O.L. = 7.5408



MRC – system setup

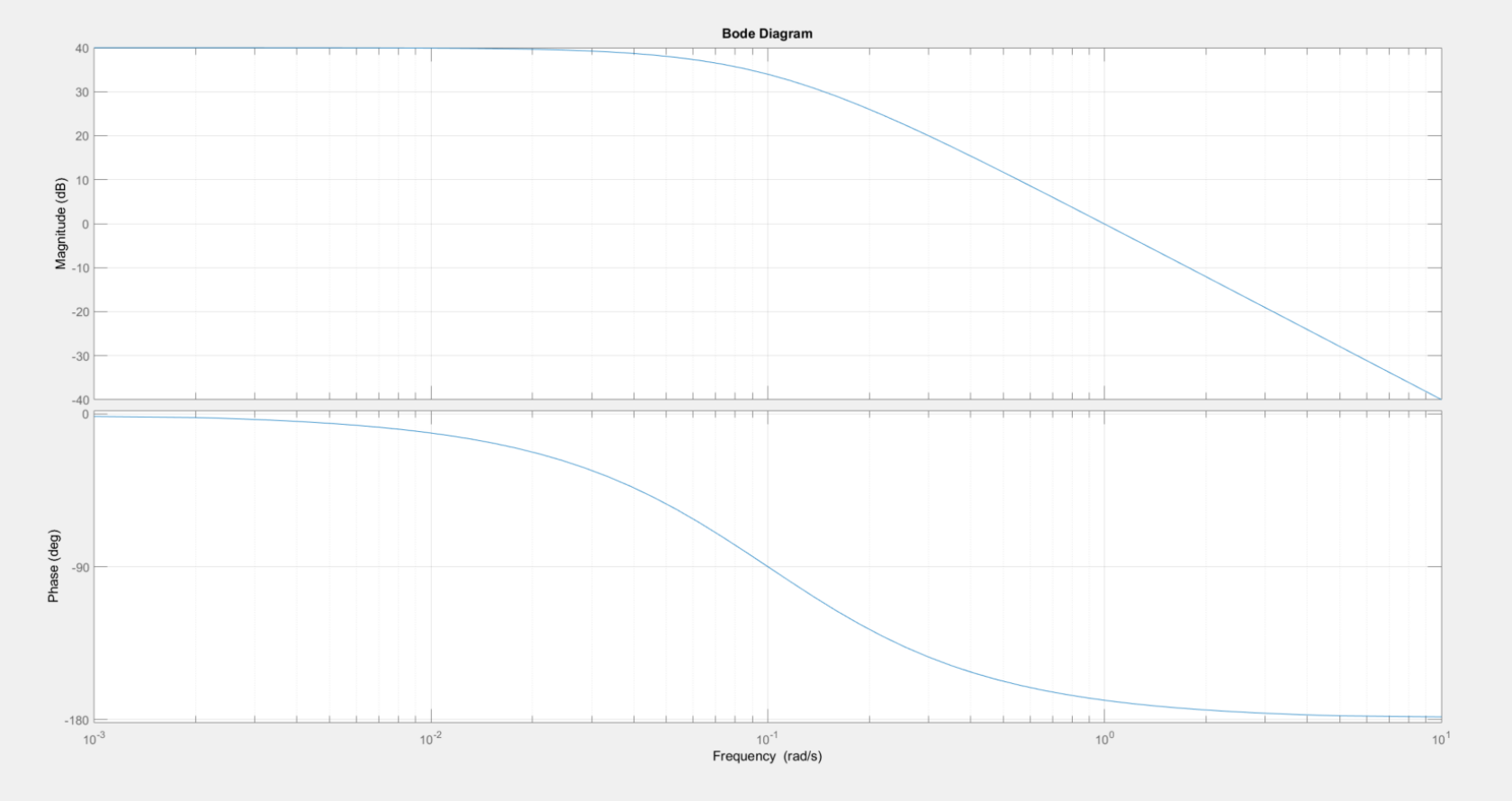


MRC – P1 – System response

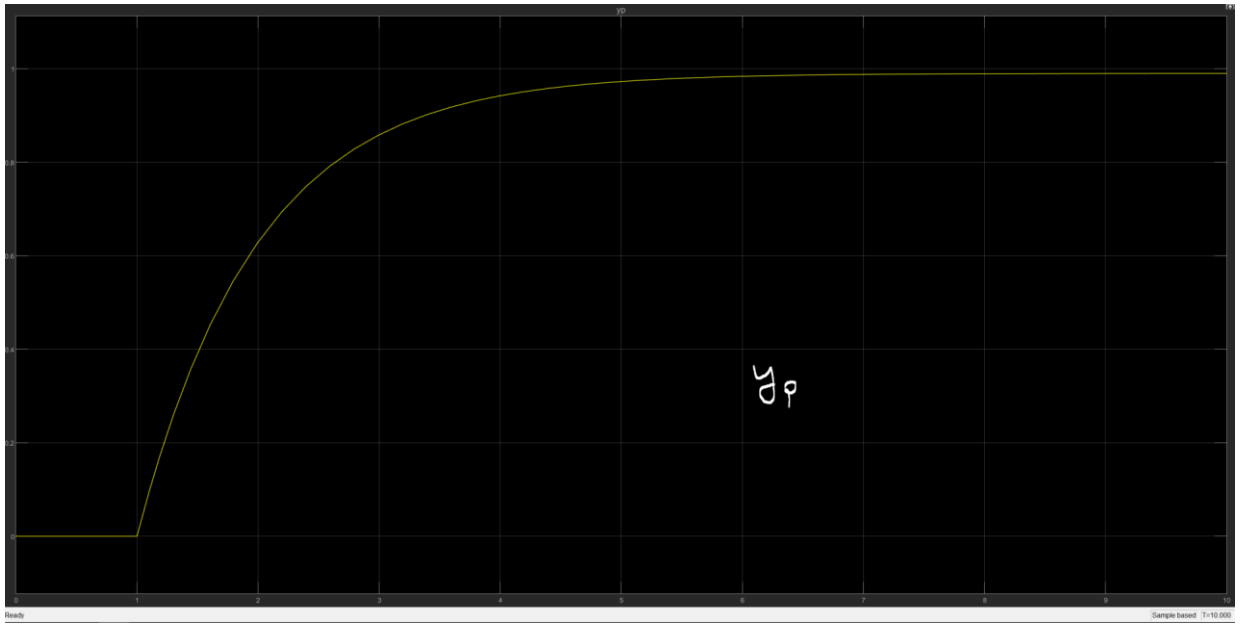


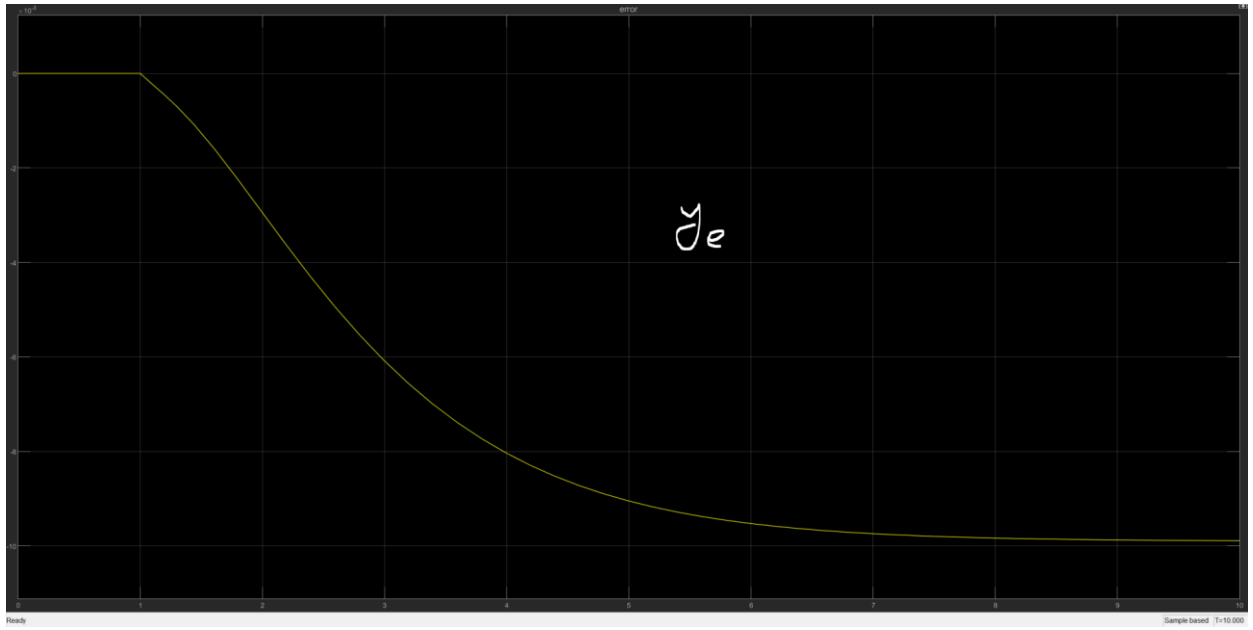
MRC – P1 – Frequency response

- Desired bandwidth: 1 rad/s



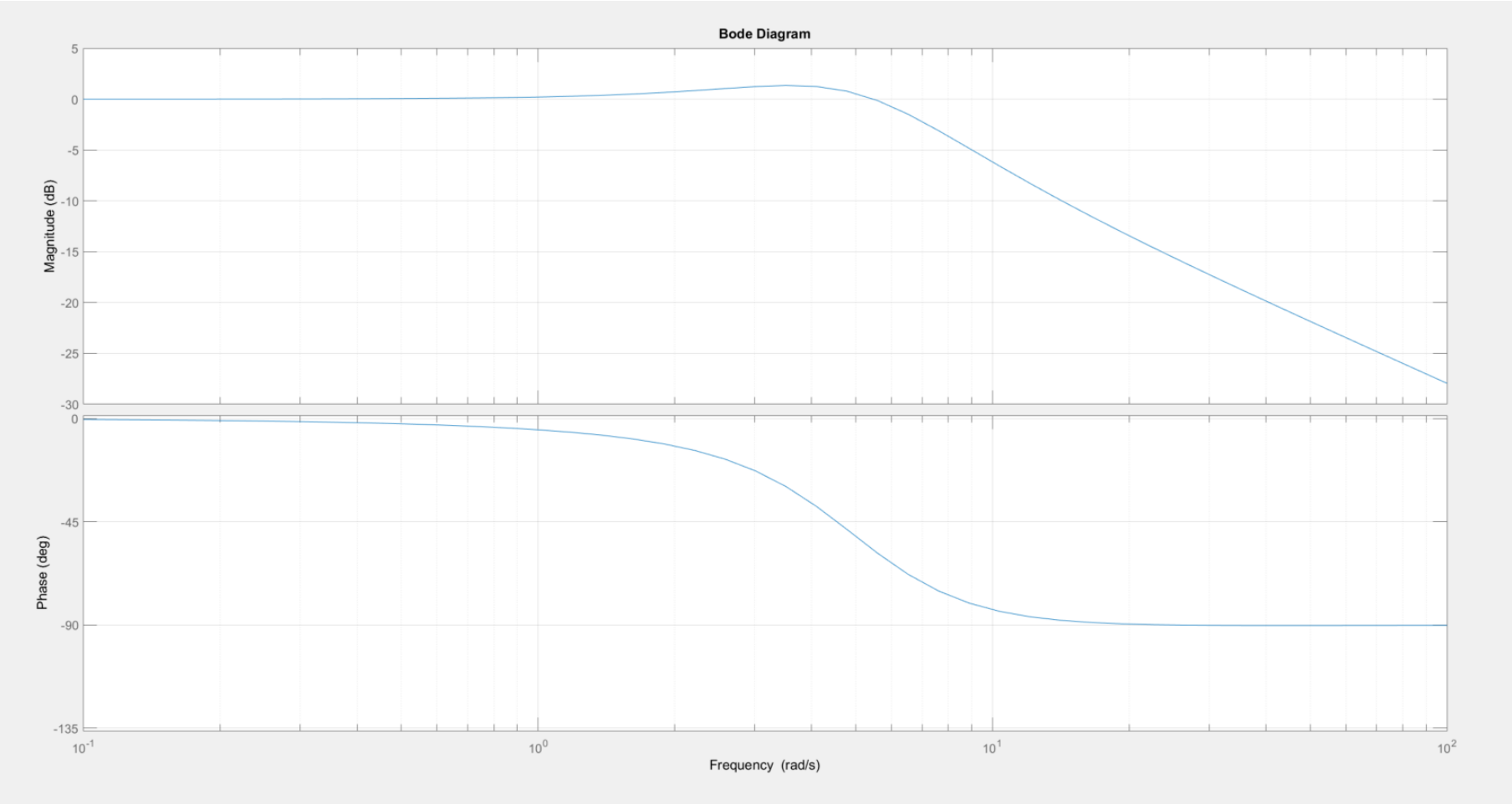
MRC – P2 – System response





MRC – P2 – Frequency response

- Bandwidth of O.L. = 7.5408



Summary

- LS parameter convergence is somewhat stable for output, but not for parameters
- Real time calculation is starting to get expensive as the time to finish each time step is longer.
- PPC is relatively harder to obtain a desired response, since we'd need to calculate the desired pole first for the desired system performance.