

Faculty of Engineering

Computer and Systems Engineering Department

**CSE 371: Control Systems (1)**

Instructor: Prof. Wahied Gharieb Ali

Micro-Project

**PID Controller**

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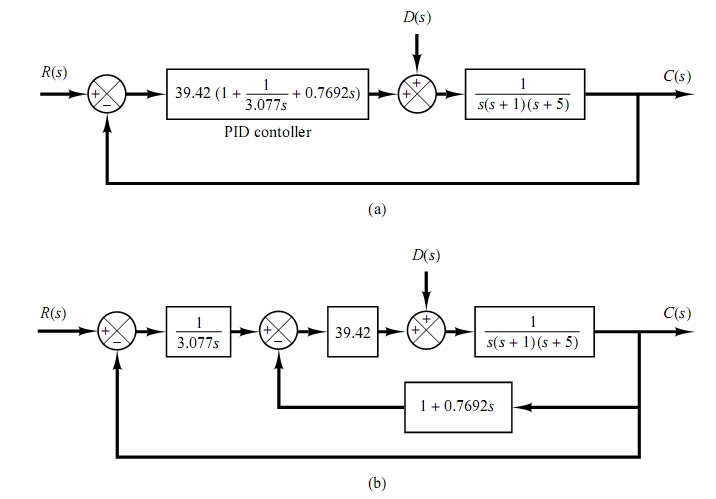
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# PROBLEM FORMULATION

For the given system,



1. Simulate the closed loop system using the MATLAB/SIMULINK for a unit step input u(t)
2. Explain, which parameter in the PID block has to be modified to decrease the settling time.
3. Study the effect of a constant disturbance input = ±0.1u(t) on the system response.
4. Compute the gain margin and phase margin for the open loop without PID controller and closed loop system with PID controller.

# Background

The PID is the most popular feedback controller algorithm used. It is a robust easily understood algorithm that can provide excellent control performance despite the varied dynamic characteristics of processes.

The PID algorithm consists of three basic modes: the Proportional mode, the Integral mode & the Derivative mode.

In the *s*-domain, the PID controller may be represented as:

In the time domain:

u(t): The PID output

e(t): The Error between the output and the set point.

Kp: Proportional Gain

Ki: Integral Gain

Kd: Derivative Gain

# Analysis

# Simulation

## Closed Loop System Simulation

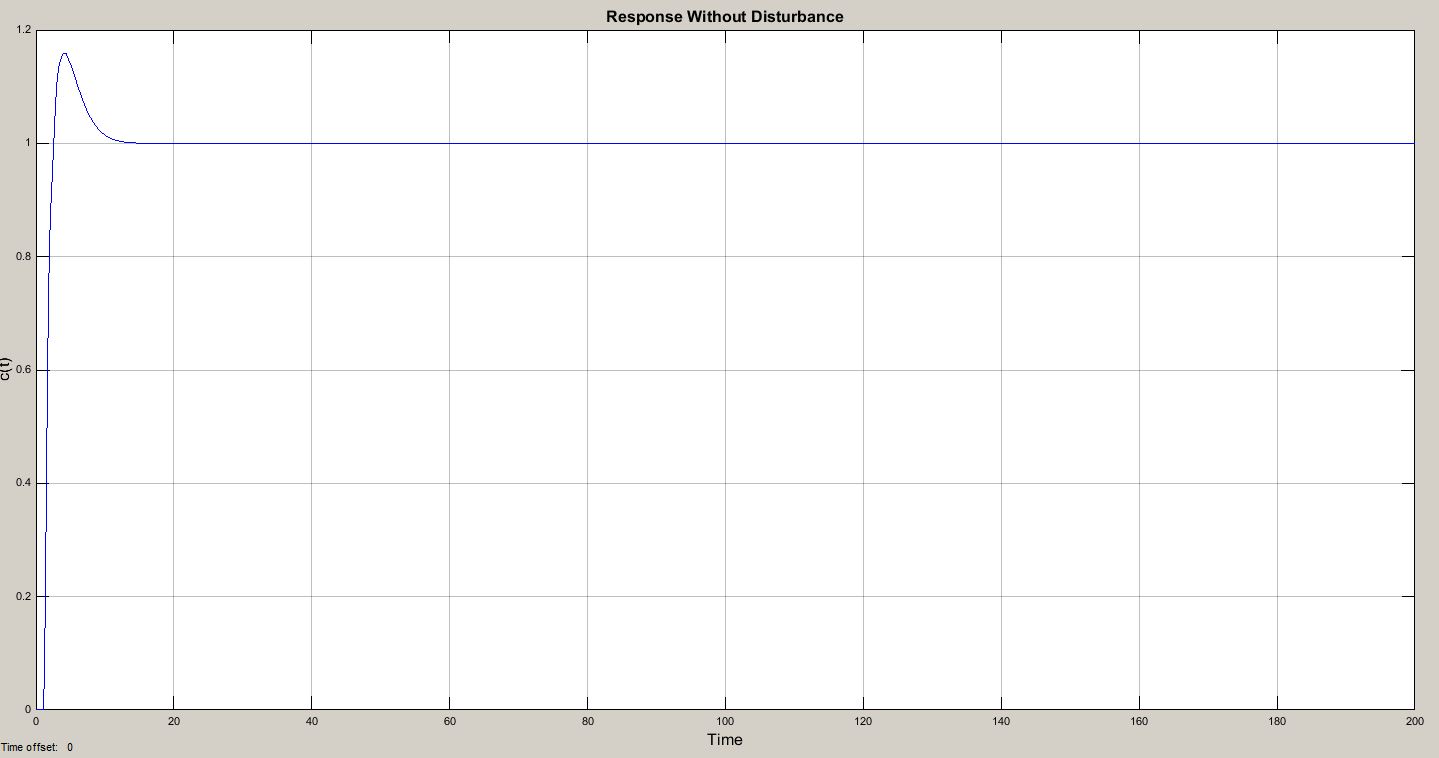


Figure 1 Closed loop system response

## Disturbance Effect on The System

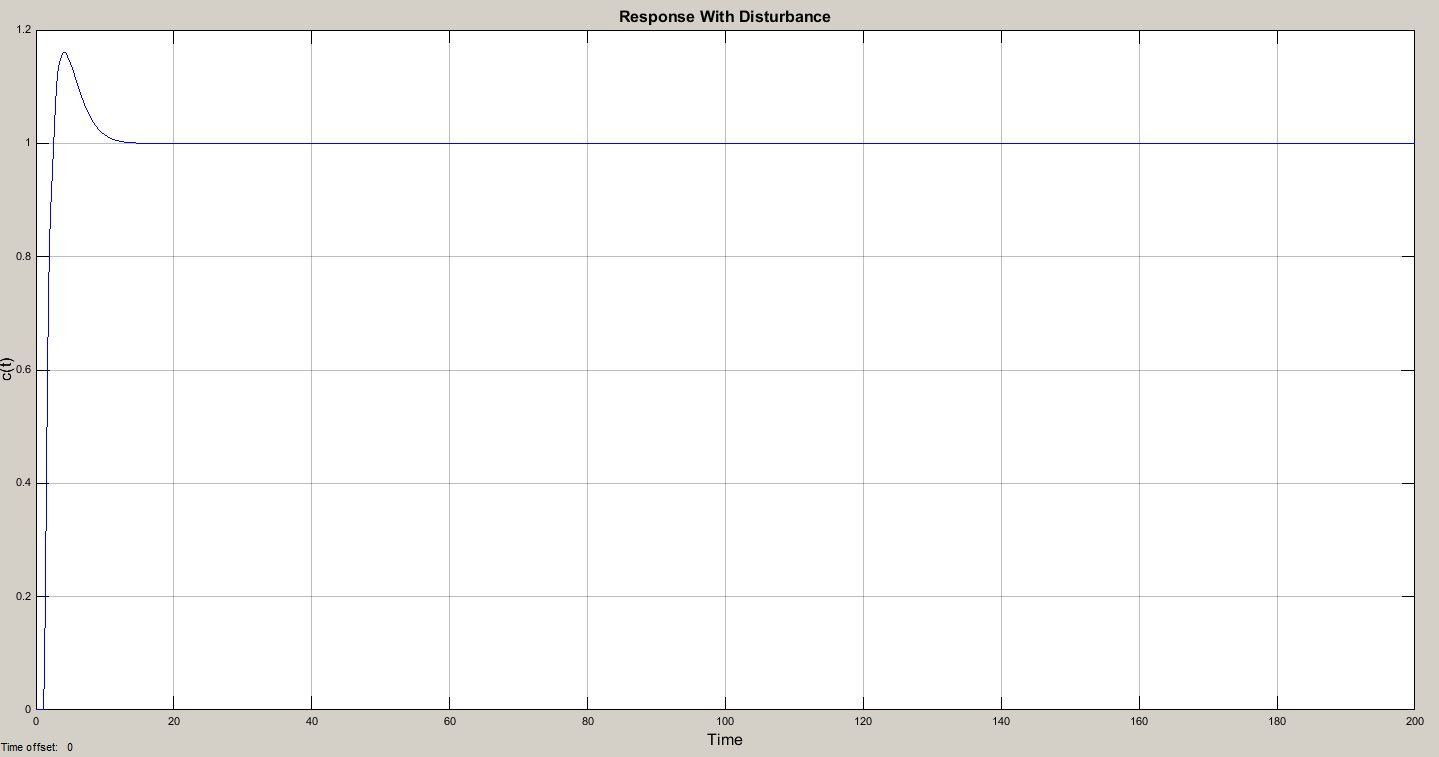


Figure 2 Closed loop system response with disturbance

## Phase and Gain Margin for Open Loop System

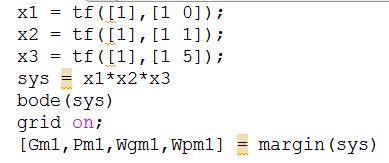


Figure 3 Using Matlab to calculate Pm and Gm of the open loop system

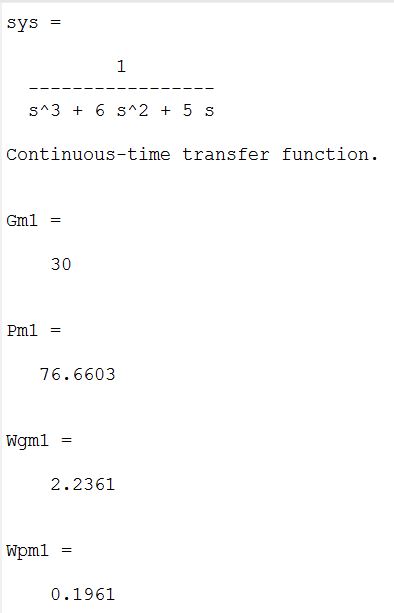


Figure 4 Matlab results of the open loop system

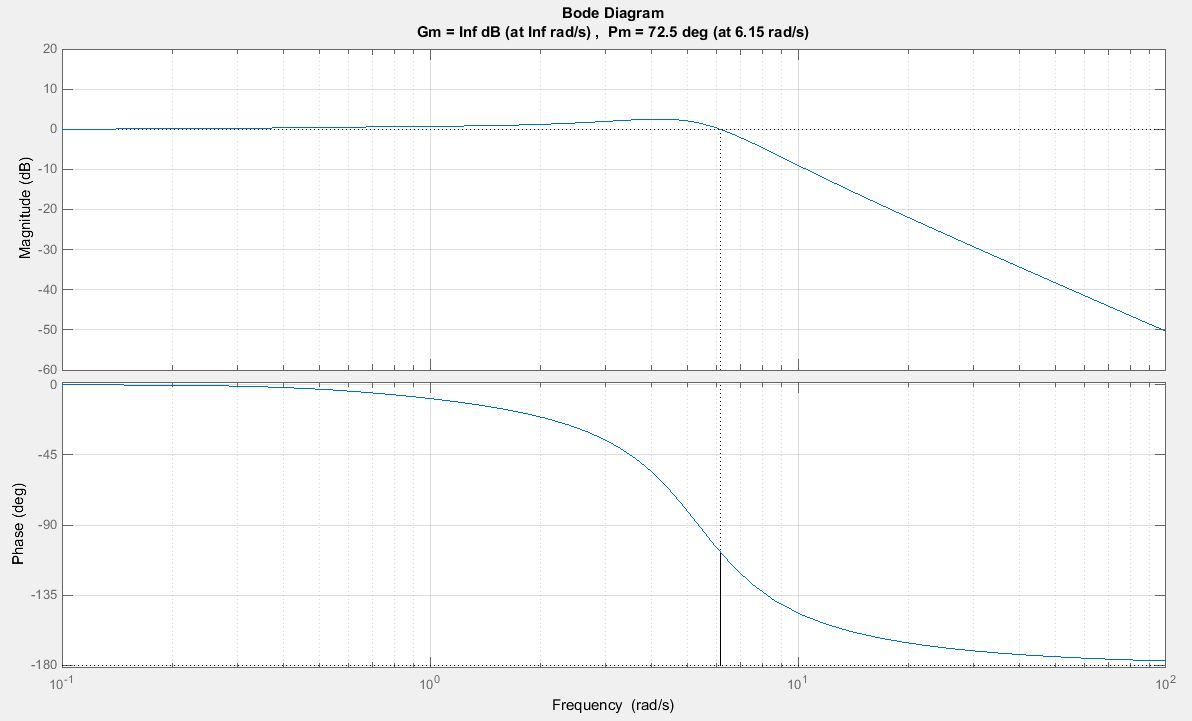


Figure 5 Bode plot of the open loop system

## Phase and Gain Margin for Closed Loop System

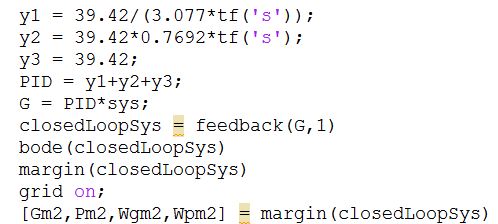


Figure 6 Using Matlab to calculate Pm and Gm of the closed loop system

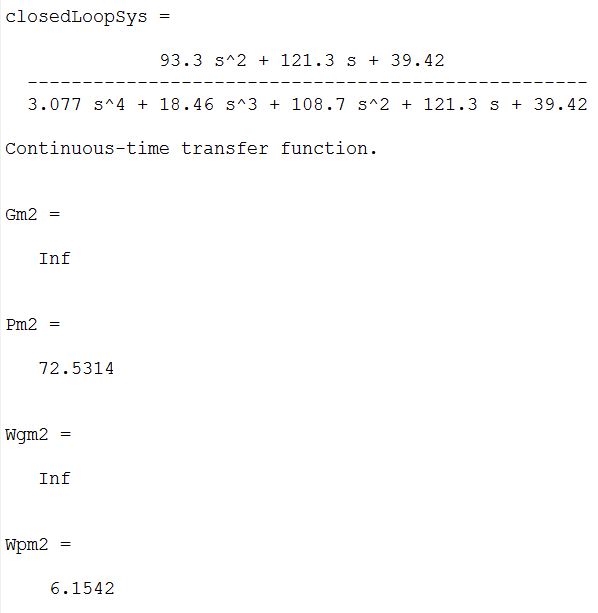


Figure 7 Matlab results of the closed loop system

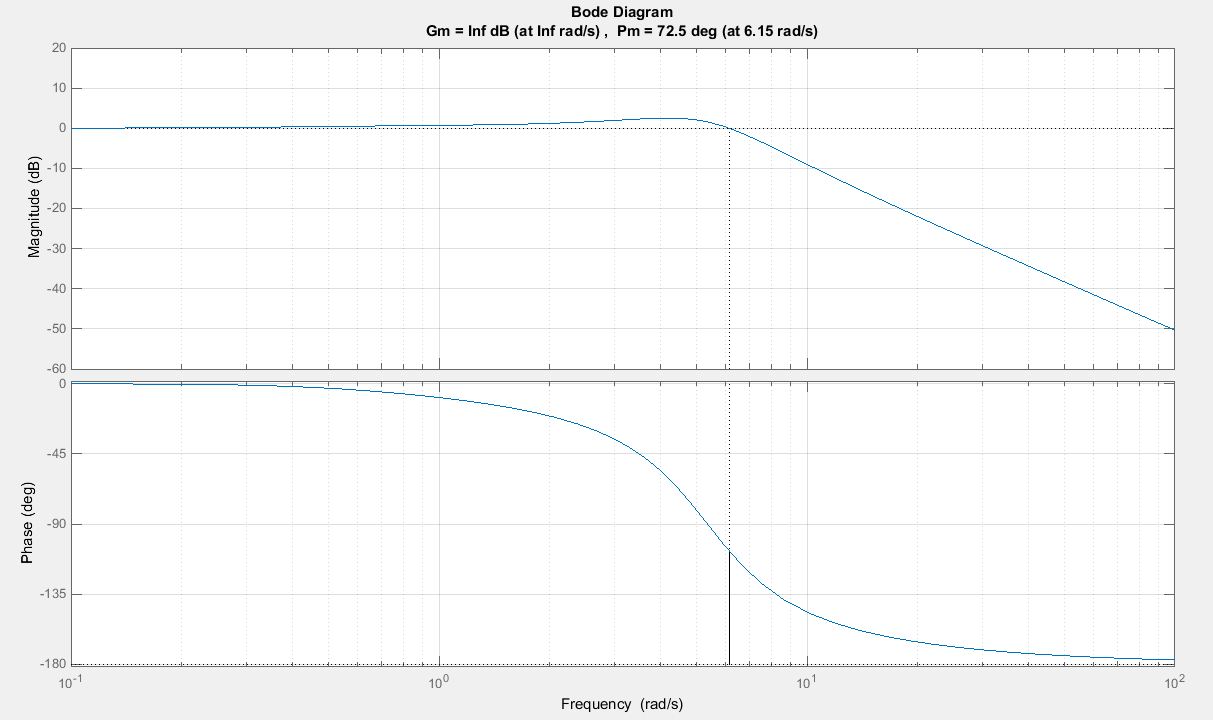


Figure 8 Bode plot of the closed loop system

# Conclusion

# REferences

[1] “Modern Control Engineering”, 5th edition, Katsuhiko Ogata.

[2] Lecture Slides: “Topic#11 PID Controller Design”, Dr. Wahid Gharib, 2015.