University of Westminster

Module:5ELEN018W - Robotic Principles

Level 5 (Computer Science)

Assignment: Individual Report

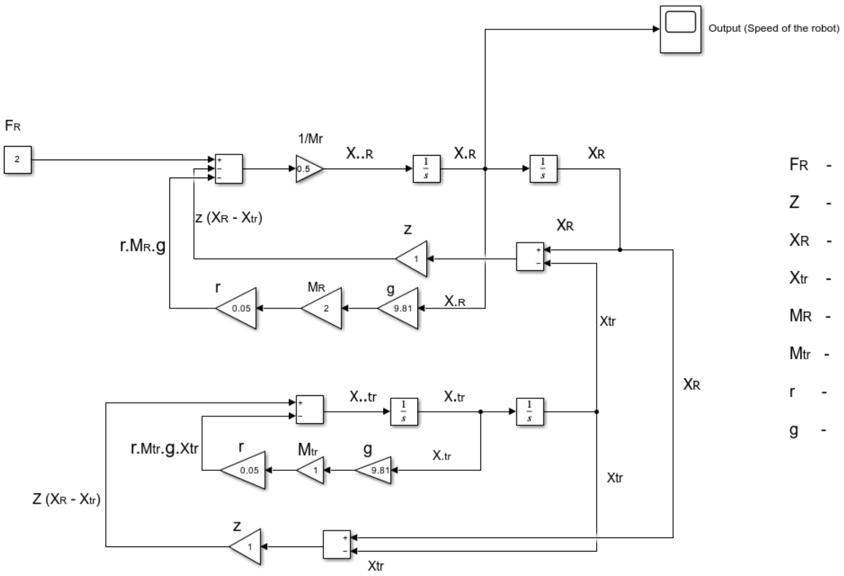
Name – K.G.N.S.Dhatmapriya

IIT ID – 20221623

UoW ID – w2001507

Table of Contents

Part 01 – Model



FR - Robot's force

Z - the connection of robots hand and trolly

XR - Displacement of the robot

Xtr - Displacement of the trolly

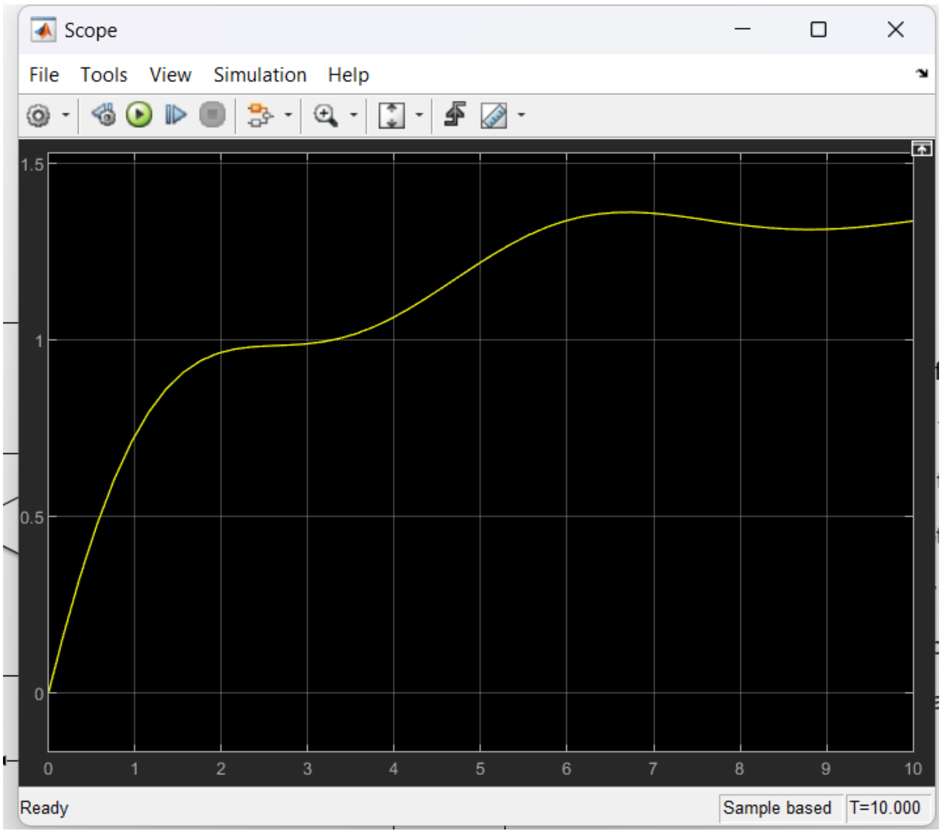
MR - Mass of the robot

Mtr - Mass of the trolly

r - rollig friction cofficient

g - Gravitation constant

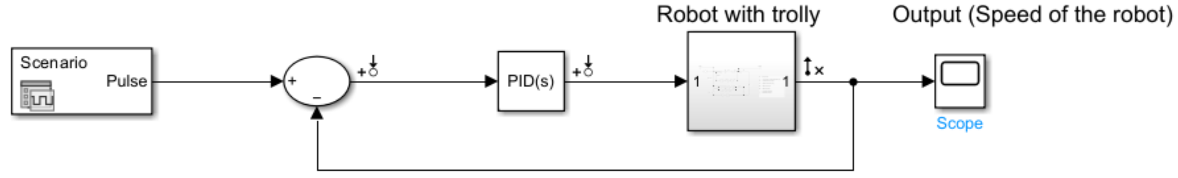
Scope (Speed of robot)



Using the given equations and values, I assembled the system. Upon implementing the parameters, a graph was produced. From the parameters, we derived X..R, indicating the robot’s speed.

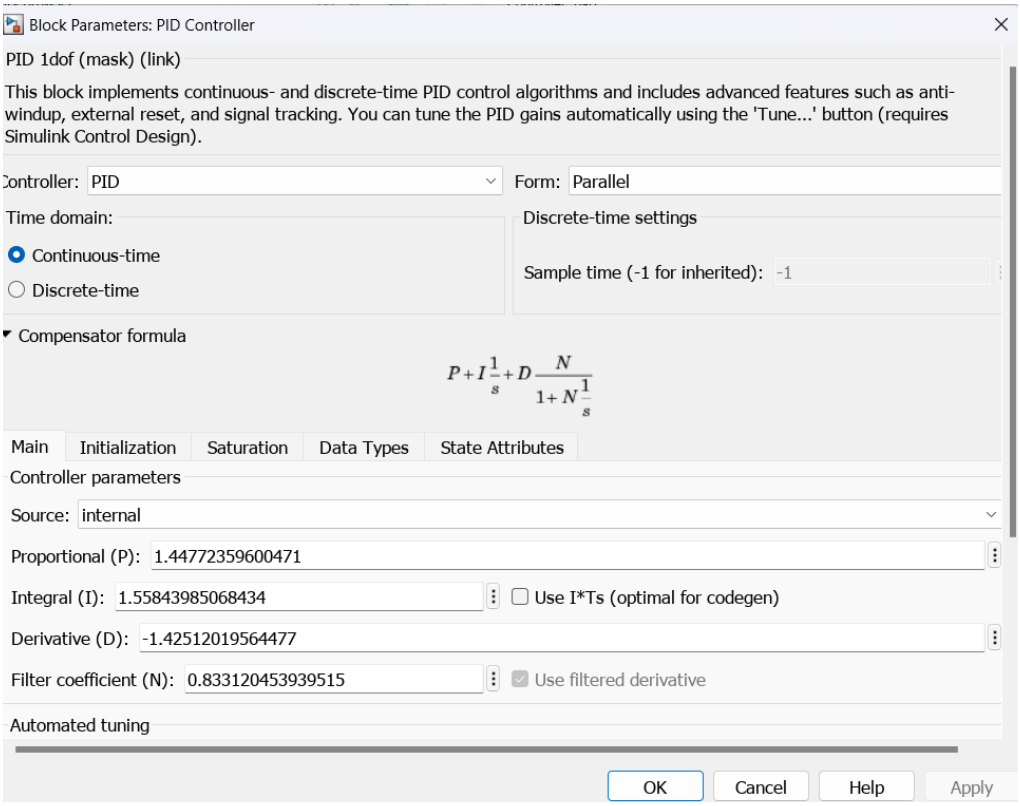
Part 02 – Controller part

Closed loop system with PID



PID

In this scenario, we will input the intended output, which signifies the robot's speed, and compare it with the present output of the subsystem. When the difference between the desired and current outputs is zero, the system operates flawlessly, showcasing the optimal performance of the robot model controller. To attain this, precise values must be assigned to the PID parameters and the filter coefficient. When the parameters are set, and the scope is executed, it is beneficial for the current output to match the desired output. The specific values manually chosen for the parameters are listed as follows:



Proportional (P)
The proportional component magnifies the existing error to compute the control output. A greater P value implies a more assertive response of the system to the error. A value of 1.44772359600471 indicates a substantial focus on the present error, signaling a preference for a robust and prompt reaction to deviations from the desired output.

Integral (I)

The integral component integrates the error across time, aiming to diminish any remaining steady-state error by consistently adapting the control signal. A value of 1.55843985068434 reflects a well-balanced strategy, permitting the system to slowly rectify persistent differences between the desired and actual outputs without excessively forceful corrections.

Derivative (D)

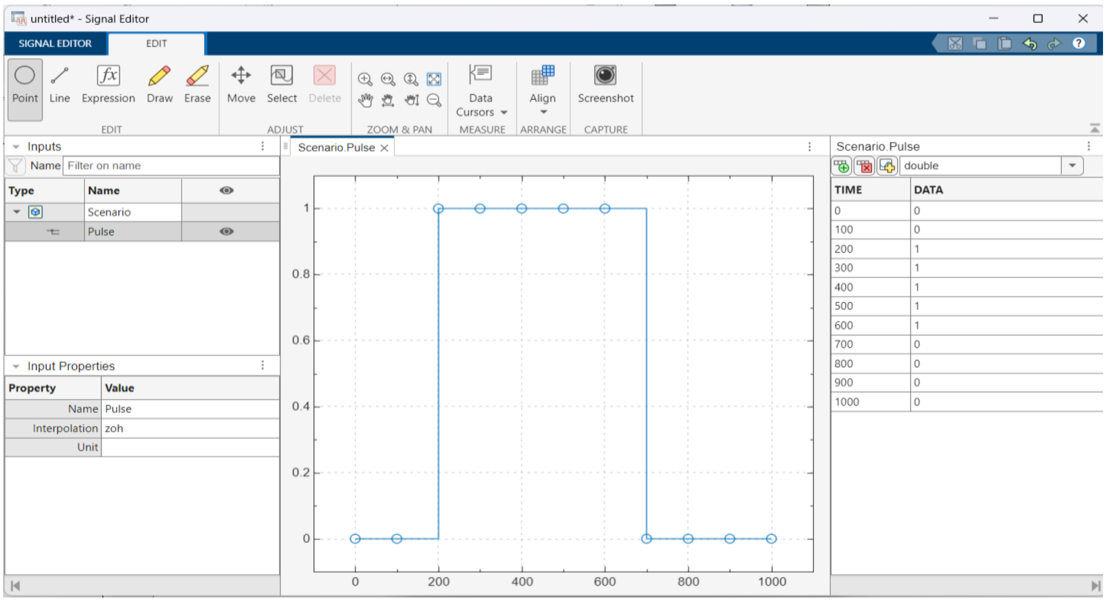
The derivative element takes into account the error's rate of change, enabling it to predict system behavior and dampen oscillations. A value of -1.42512019564477 indicates a deliberate choice to exclude the consideration of the current rate of change, possibly signifying confidence in the system's stability or a preference for a more straightforward control strategy.

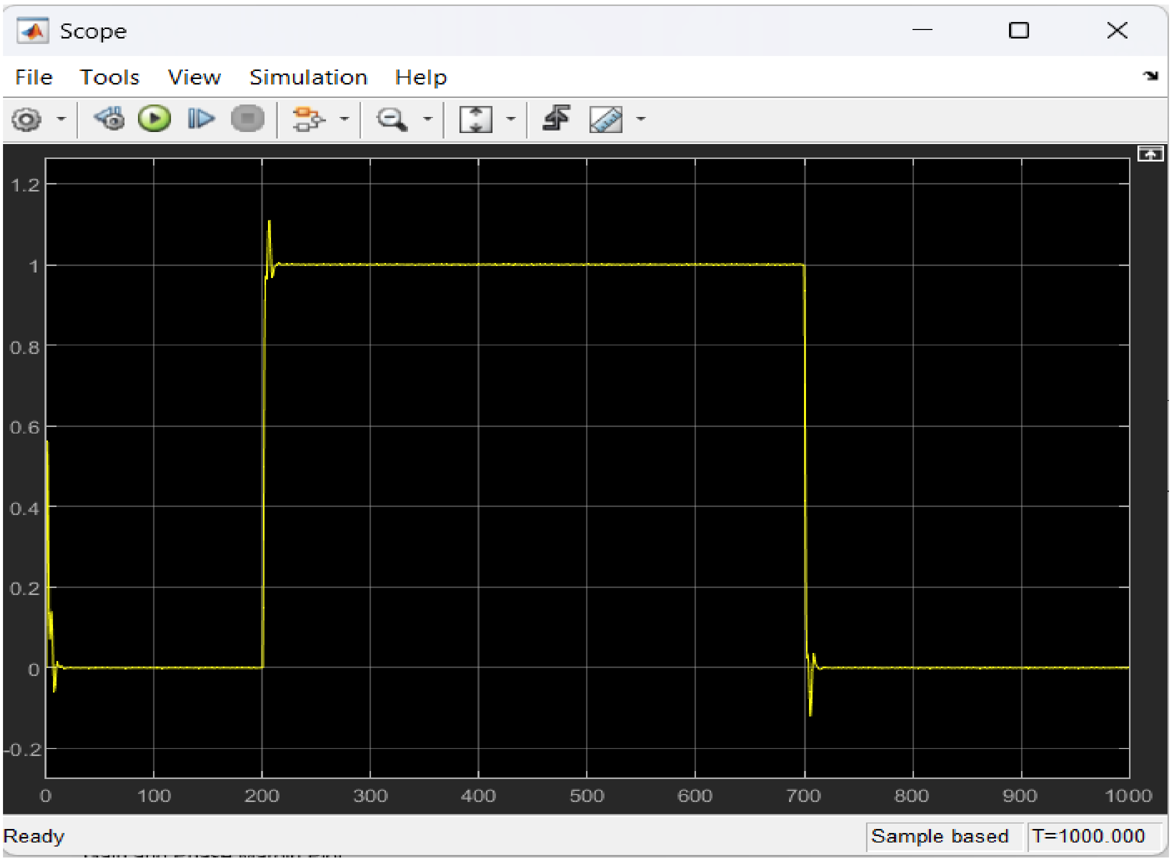
Filter Coefficient (N)

The filter coefficient dictates the impact of the filter on the control signal. Filters are capable of mitigating noise or sudden shifts in the system's behavior. A value of 0.833120453939515 indicates a moderate smoothing effect, serving to ensure that the control signal remains relatively stable and doesn't overly react to minor, transient fluctuations in the system.

Comparison of the reference signal given (desired output) and the actual response of the system

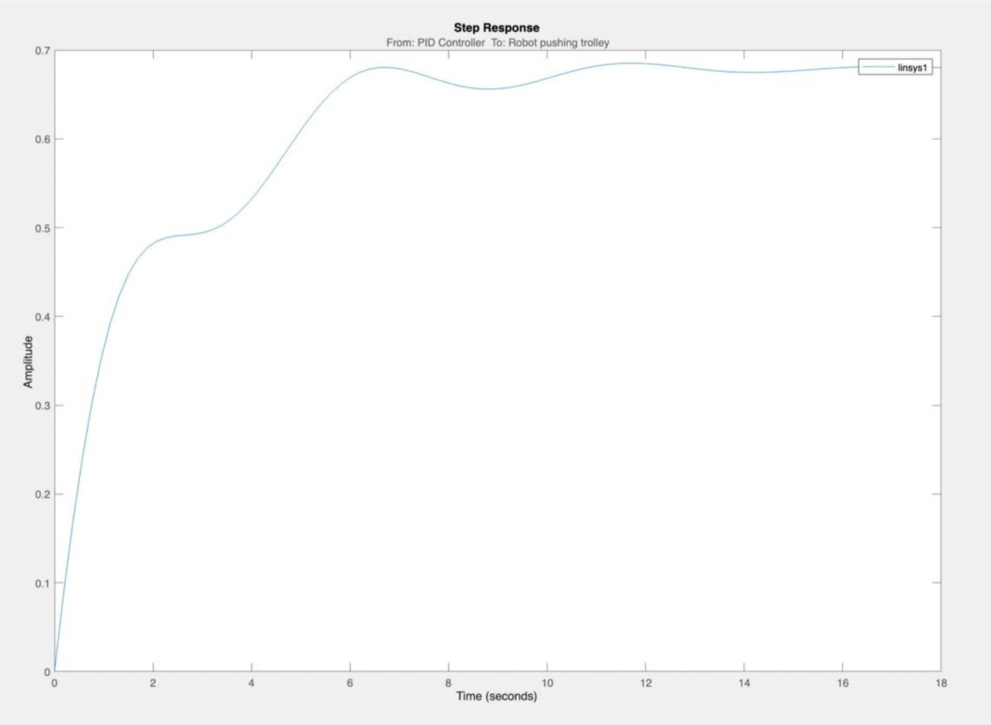
The reference signal serves as the target speed for the robot, guiding the controller in its efforts to steer the system toward this specified speed. After that the actual system response for the robot's speed


untitled* - Signal Editor
SIGNAL EDITOR
EDIT
Point
Line
Expression
Draw
Erase
Move
Select
Delete
Data Cursors
Align
Screenshot
EDIT
ADJUST
ZOOM & PAN
MEASURE
ARRANGE
CAPTURE
Inputs
Name
Filter on name
Type
Name
Scenario
Pulse
Input Properties
Property
Value
Name
Pulse
Interpolation
zoh
Unit
Scenario.Pulse
double
TIME
DATA
0 0
100 0
200 1
300 1
400 1
500 1
600 1
700 0
800 0
900 0
1000 0
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
1000


Scope
File
Tools
View
Simulation
Help
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
100
200
300
400
500
600
700
800
900
1000
Ready
Sample based
T=1000.000

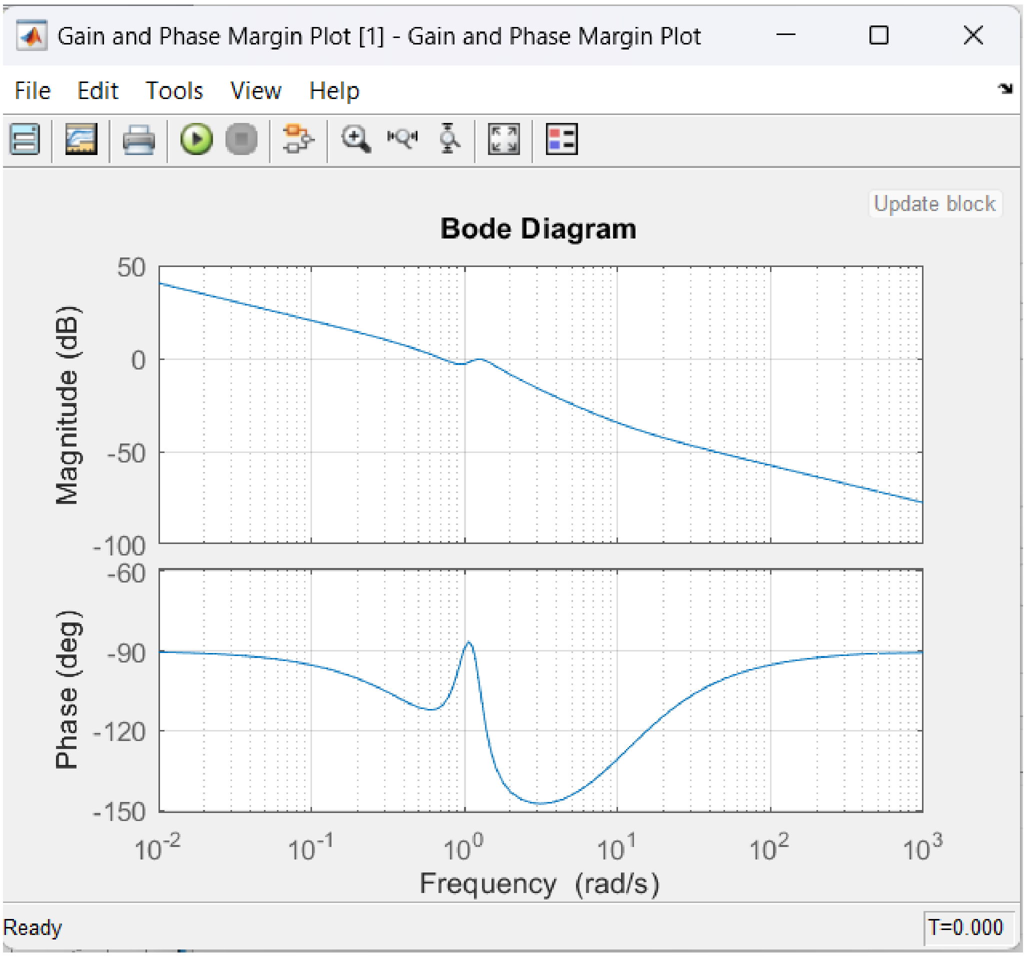
Response Diagrams

1. **Step Response**



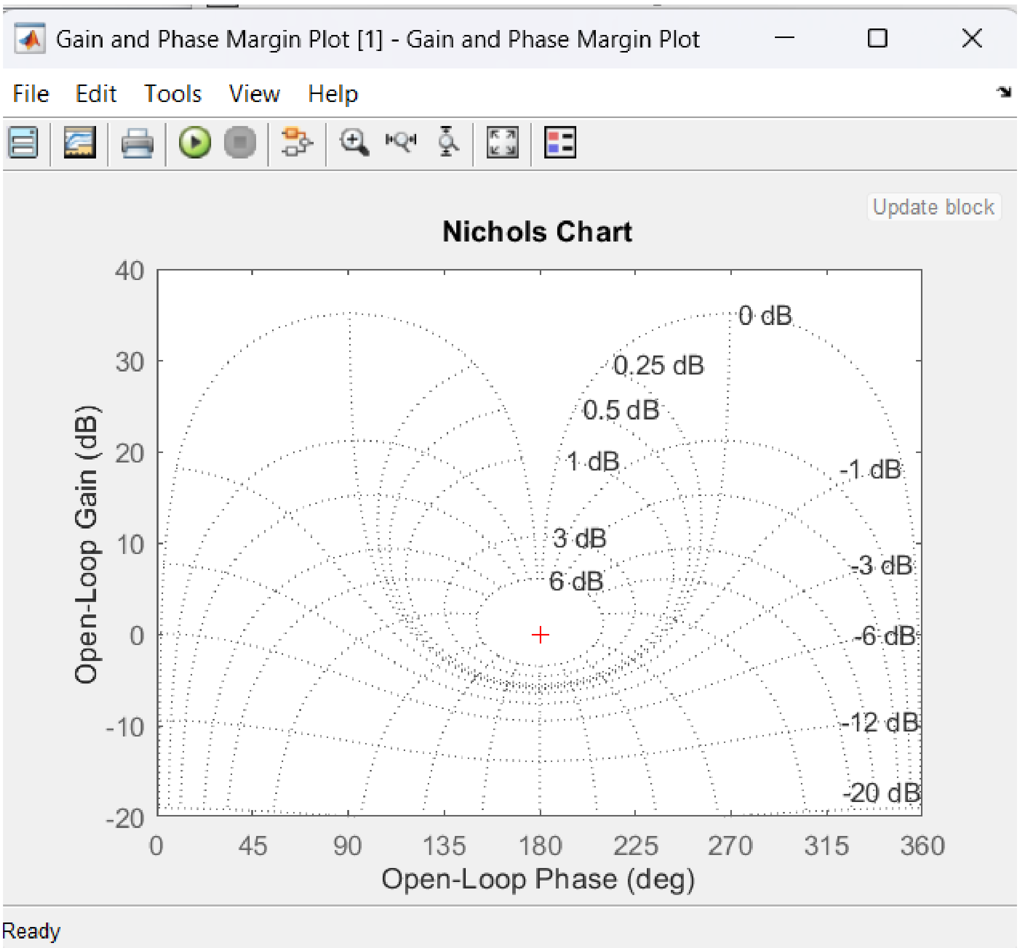
This diagram illustrates the system's reaction when exposed to a step input, aiding in comprehending the speed and precision with which the system attains its steady-state following an abrupt alteration in the reference input.

2. Bode Plot



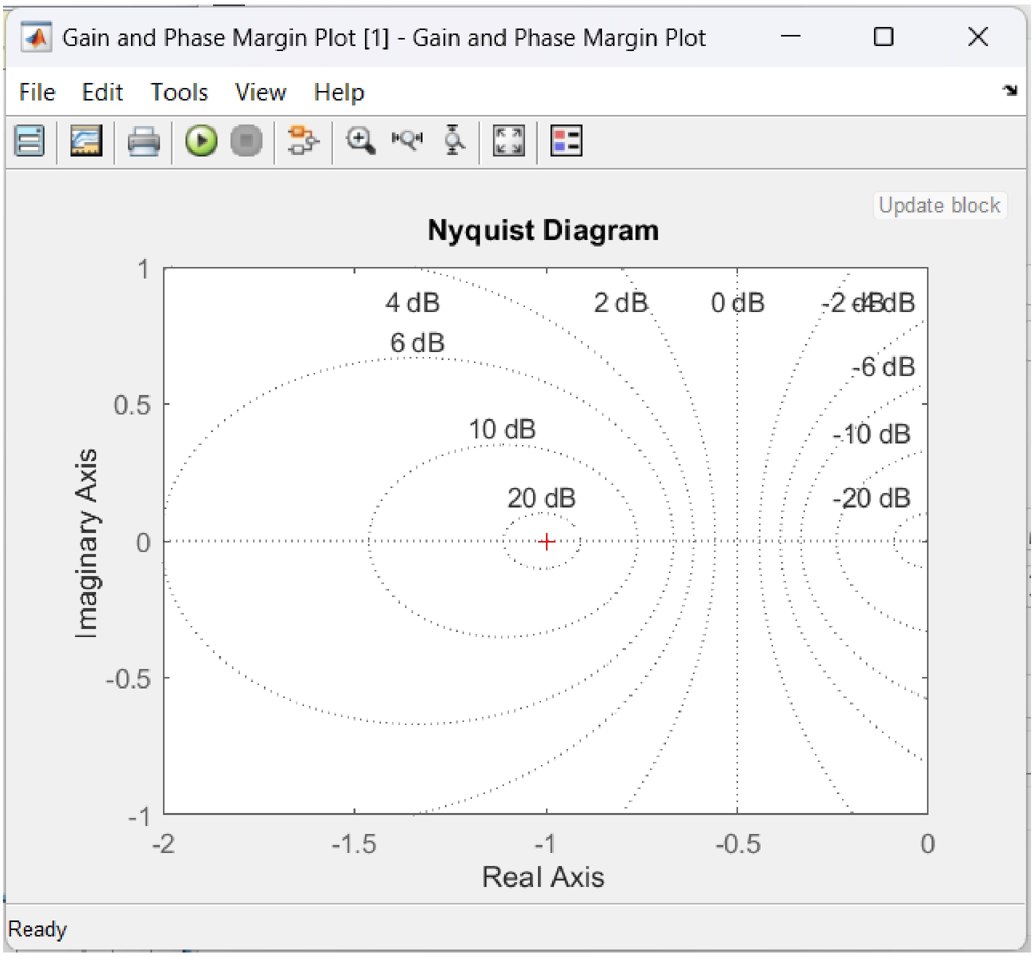
The Bode plot illustrates the frequency response of the system, presenting both magnitude and phase in relation to frequency. This visualization offers valuable insights into system stability, resonance frequencies, and phase margin, all of which play a pivotal role in guaranteeing the robustness of the system.

3. Nichols Plot



A Nickols plot, attributed to engineer John E. Nickols, is a graphical tool primarily employed for the analysis and tuning of PID (Proportional-Integral-Derivative) controllers. This plot offers a visual representation of the ultimate gain and phase margins within a closed-loop control system, aiding in the assessment and optimization of controller performance.

4. Nyquist Plot



The Nyquist diagram serves as an additional tool for analyzing the frequency response of a system. It graphs the imaginary part against the real part of the system's transfer function as the frequency changes. This visualization is particularly valuable for gaining insights into system stability and assessing gain/phase margins.

.

.

The stability of closed loop