University of Westminster

IIT Sri Lanka

Robotic Principles

5ELEN018W

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INDIVIDUAL COURSEWORK

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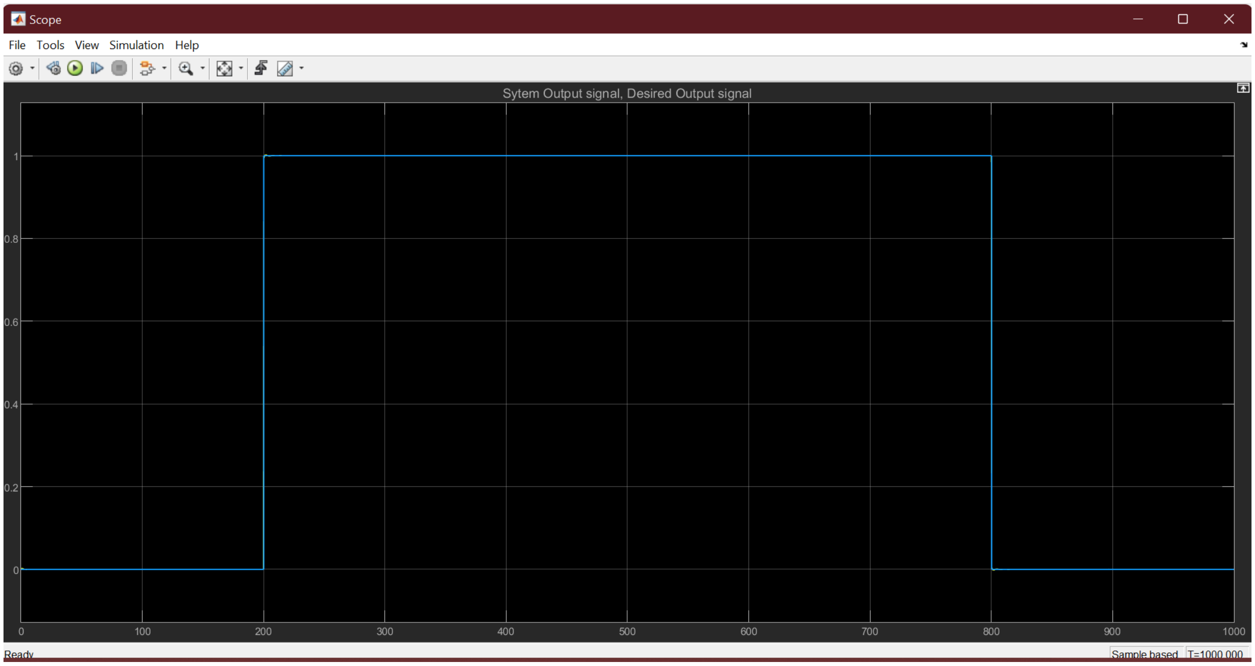
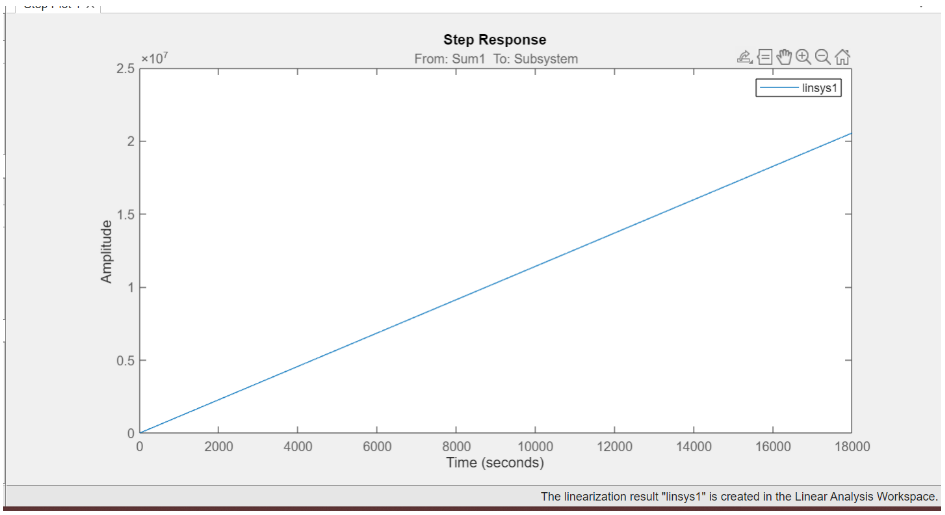
PID Controller implementation

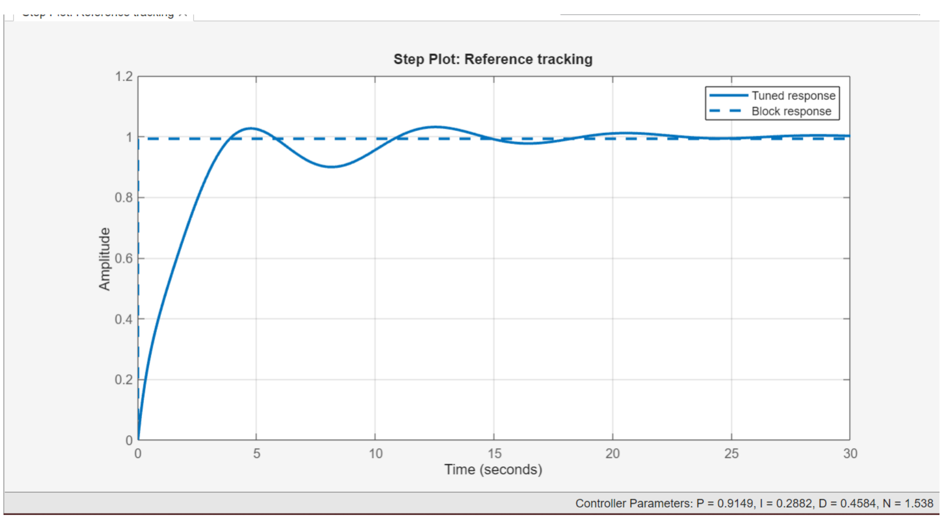


In my project, I have successfully implemented a PID controller with specific tuning parameters. The proportional gain (P) that I tune to 560, determines the reaction to the current error. The integral gain (I) also set it to 560, which accumulates past errors. The derivative gain (D) that I used is 250, predicting future errors based on the current rate of change. The filter coefficient (N) that I set is 250, which influences the weight of previous errors in the control action.

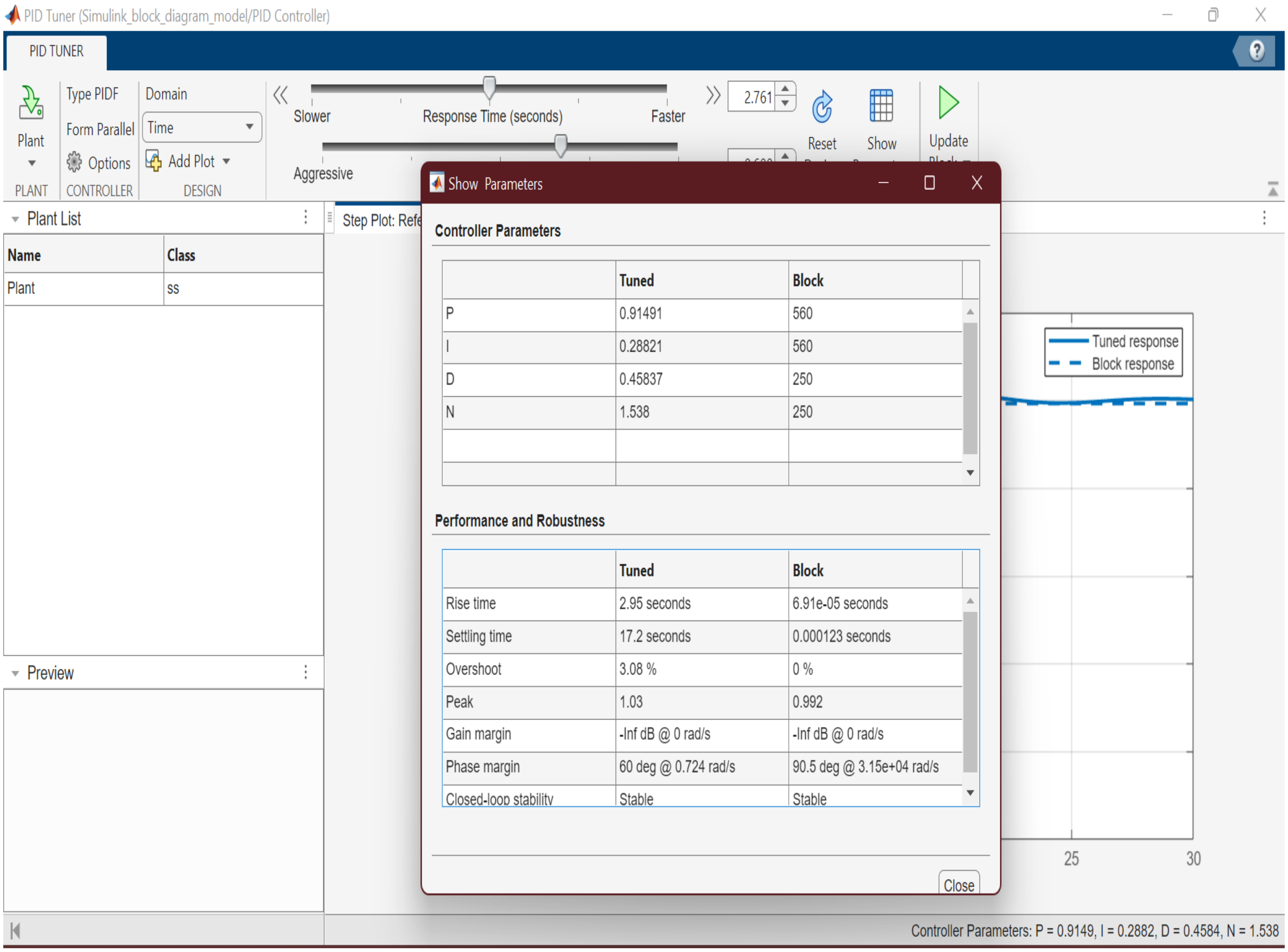
Importantly, the system that I designed exhibits stability, a critical aspect ensuring that it can effectively handle changes in input and maintain consistent performance over time.

Step Response



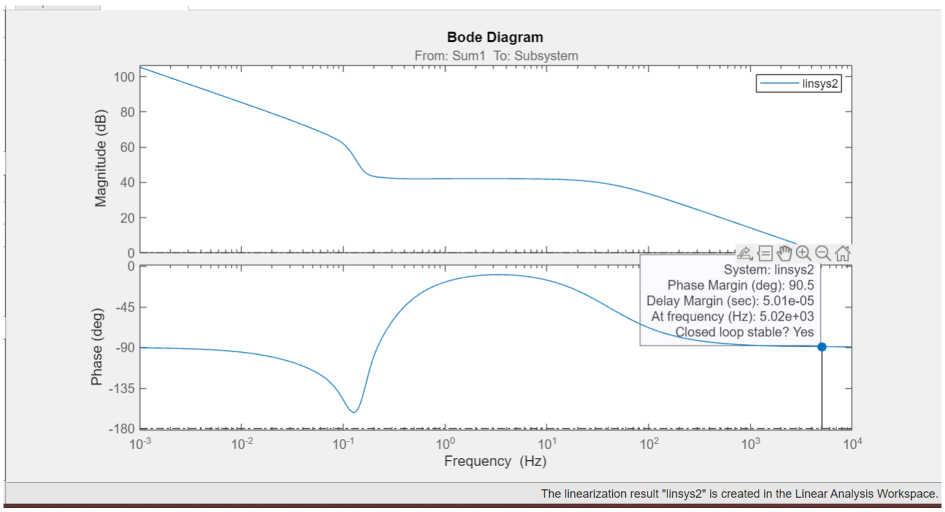


- Less overshoot is observed in the graph as the response has a slow settling time.
- The system's output and the desired output as time approaches show steadyness/ decrease of steady-state error.



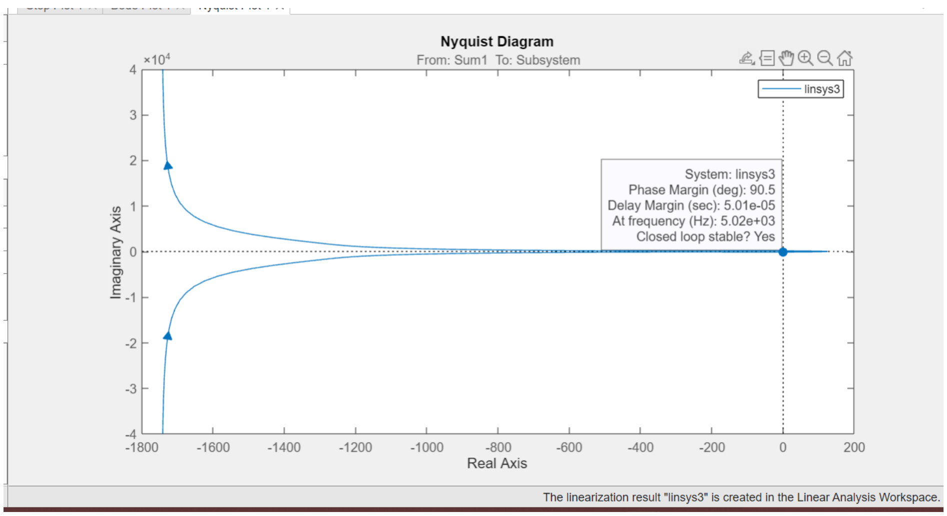
- This graph shows the PID parameters as well as the performance and robustness with factors like rise time, settling time, and overshoot.
- Finally, this analysis justifies the stableness of the control system.

Bode Diagram



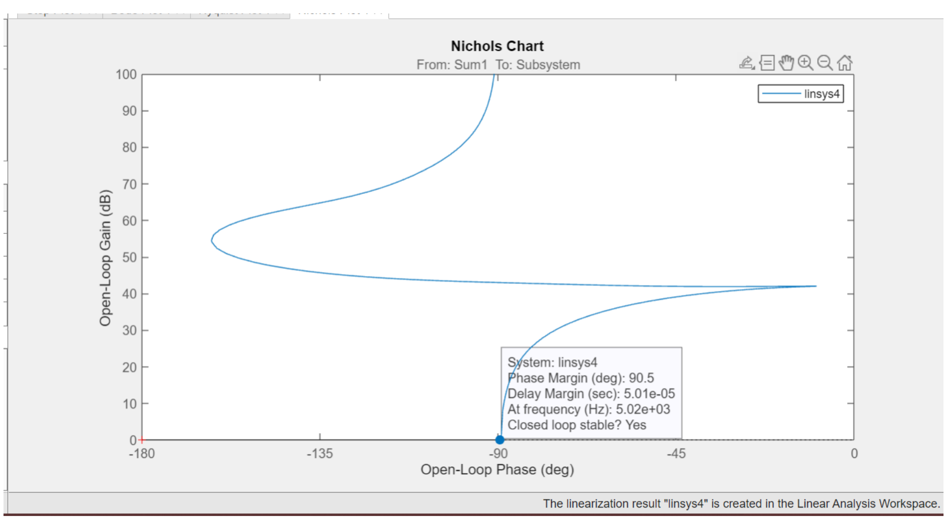
- In this graph, the magnitude decreases as the frequency increases, which is typical for many control systems. The phase decreases as the frequency increases and stabilizes around (-135) degrees.
- The stability of the system can be assessed using these plots. One common method is to look at the phase margin, which is the difference between the phase of the system's frequency response and (-180) degrees at the frequency where the magnitude is 0 dB.
- In this case, the phase margin is 90.5 degrees, which suggests that the system is stable (a phase margin of greater than 0 degrees indicates stability).
- The Bode plot also confirms that the closed-loop system is stable.

Nichols Chart



- This graph provides details of Nichols chart which is a stable close loop system.
- In this specific chart, the phase margin is 90.5 degrees.

Nyquist Diagram



- The diagram plots the system's response as the frequency varies from low to high. The real part of the response is plotted on the x-axis and the imaginary part on the y-axis.
- If the plot encircles the point (-1, j0) in the clockwise direction as many times as the number of right-half plane poles of the open-loop system, then the closed-loop system is stable.