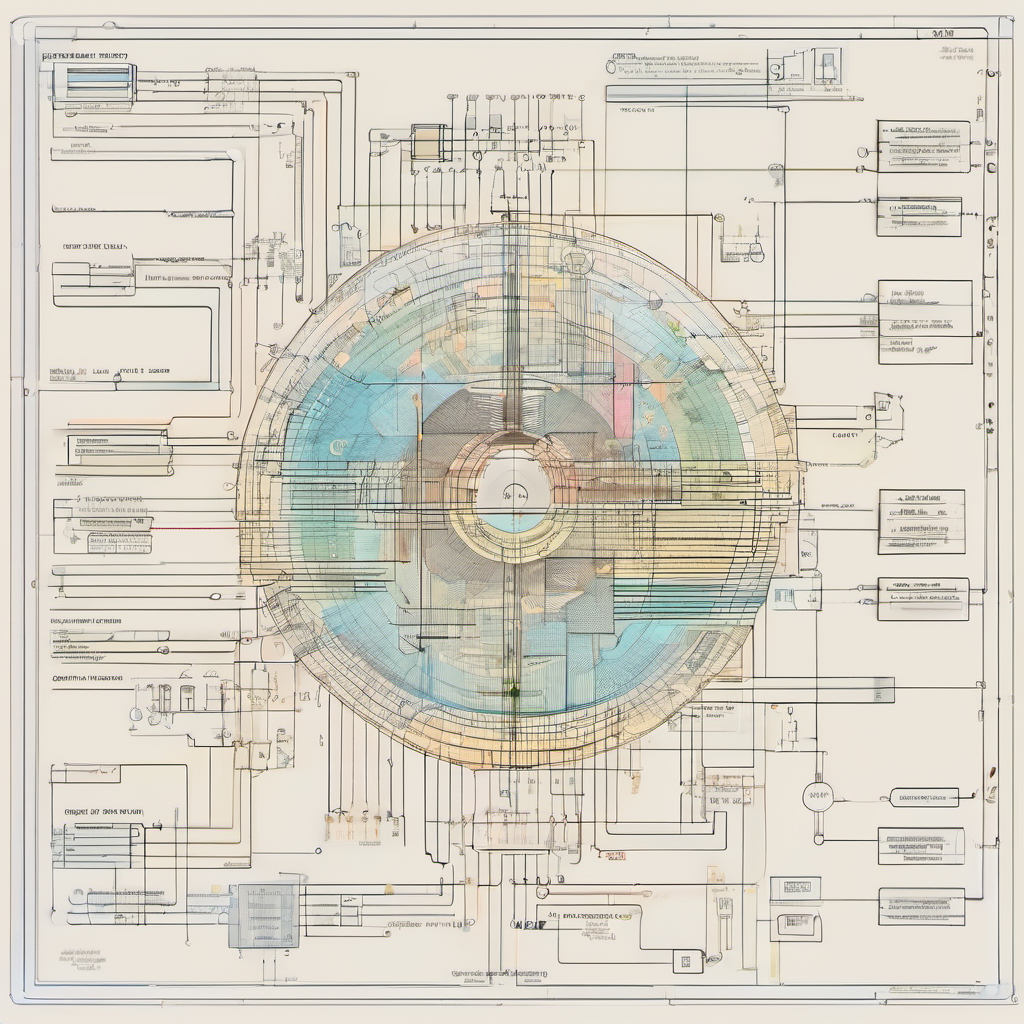
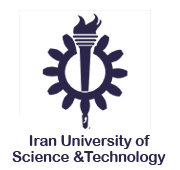
|  |
| --- |
| Linear Control Systems  Design of a controller with given criteria |
|  |
| December 2022  By Arian Hajizadeh |





# Introduction

This is the final project regarding linear control systems course conducted by Dr. Soheil Ganjefar at Iran University of Science and Technology during the fall of 2022 and winter of 2023. In this project we tackle the task of designing a controller for a given system illustrated in Figure 1.1 This system is structured as a closed-loop configuration with negative feedback. Our objective is to analyze the provided information in each section and devise a well-suited controller that ensures optimal performance for the system. Join us on this journey as we delve into the intricacies of control theory and embark on the exciting process of controller design.

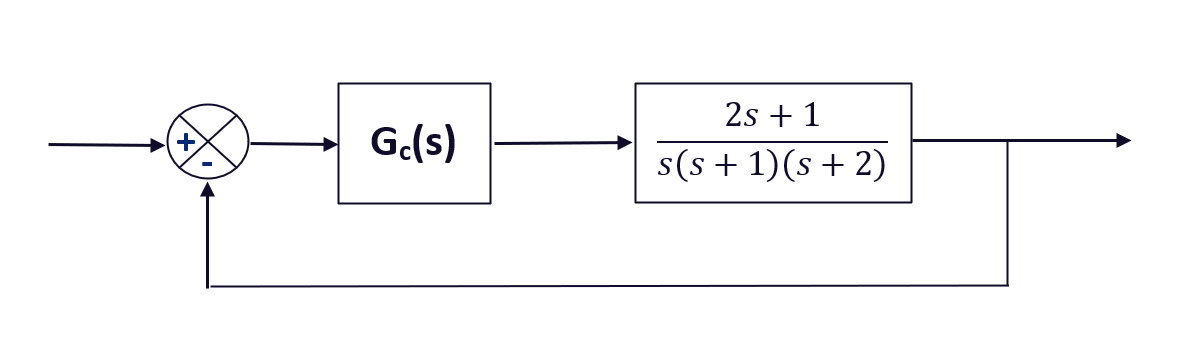


Figure 1-1 Block diagram of the system

In this project, our objective is to design a controller that meets specific performance requirements for the system. We aim to achieve a maximum overshoot of 30 percent, a settling time of less than 2 seconds, and a kv value greater than or equal to 40.

# System Analysis and Design Parameters

In this project, the initial step involves analyzing the system to determine whether an additional controller is required, and if the desired properties cannot be achieved using a simple gain as the control unit. The first step is on obtaining and studying the root locus of the system, as well as the desired poles. This analysis will provide valuable insights into the system's stability and performance characteristics, enabling informed decisions regarding the controller design. Therefore, the root locus and desired poles can be seen in figure 2-1.

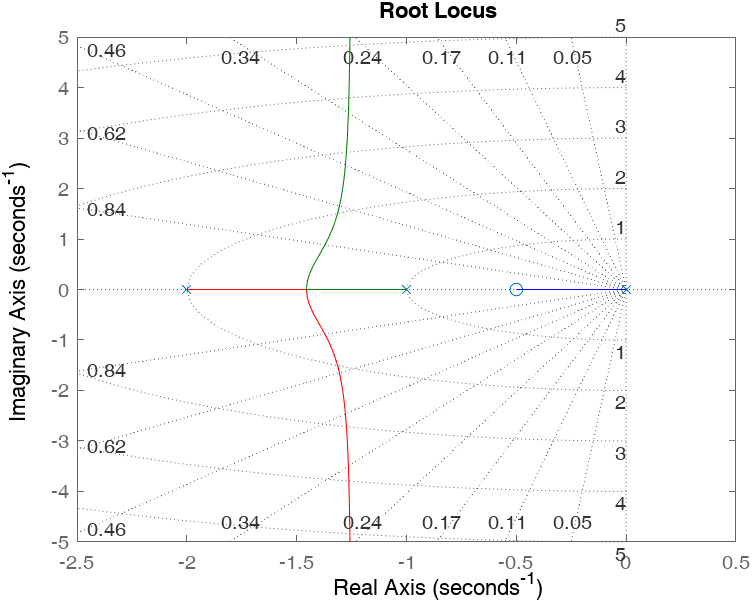


Figure 2-1 root locus of the given system

As for the desired poles we can write the following:

(2-1)

(2-2)

(2-3)

(2-4)

With these calculations the desired points are obtained and can be checked on the s plane alongside the root locus diagram in figure 2-2.

As it is inferred from figure 2-2, the desired poles are not on the root locus diagram of the system. Therefore, additional controller design is needed to achieve the desired characteristics given.

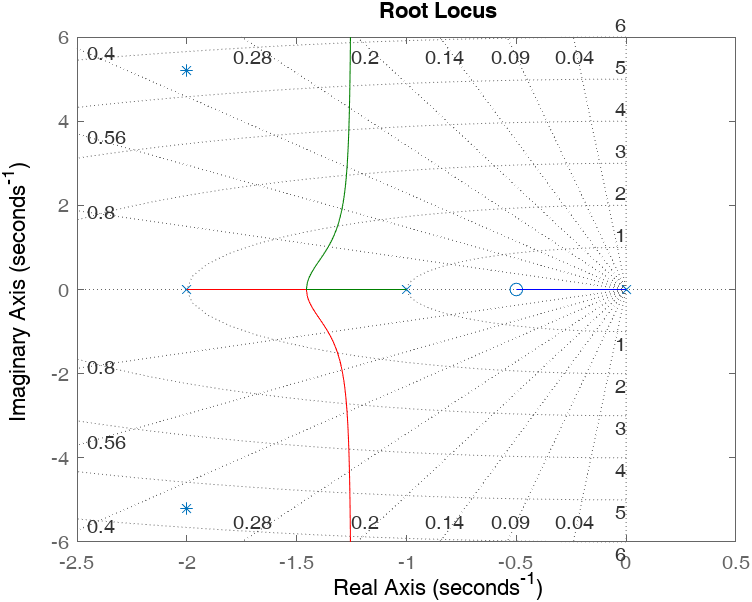


Figure 2-2 root locus of the system alongside desired poles

Once it has been established that an additional controller is necessary for the system, the next step in the project is to design a suitable controller. However, due to the limitations of linear control systems, the scope of this project focuses on the design of a phase lead and phase lag controllers. More complex controller designs are not within the scope of this project. Consequently, the upcoming chapters will be dedicated to the objective of designing both phase lead and phase lag controllers. Through these controller designs, we aim to enhance the system's performance and achieve the desired system characteristics.