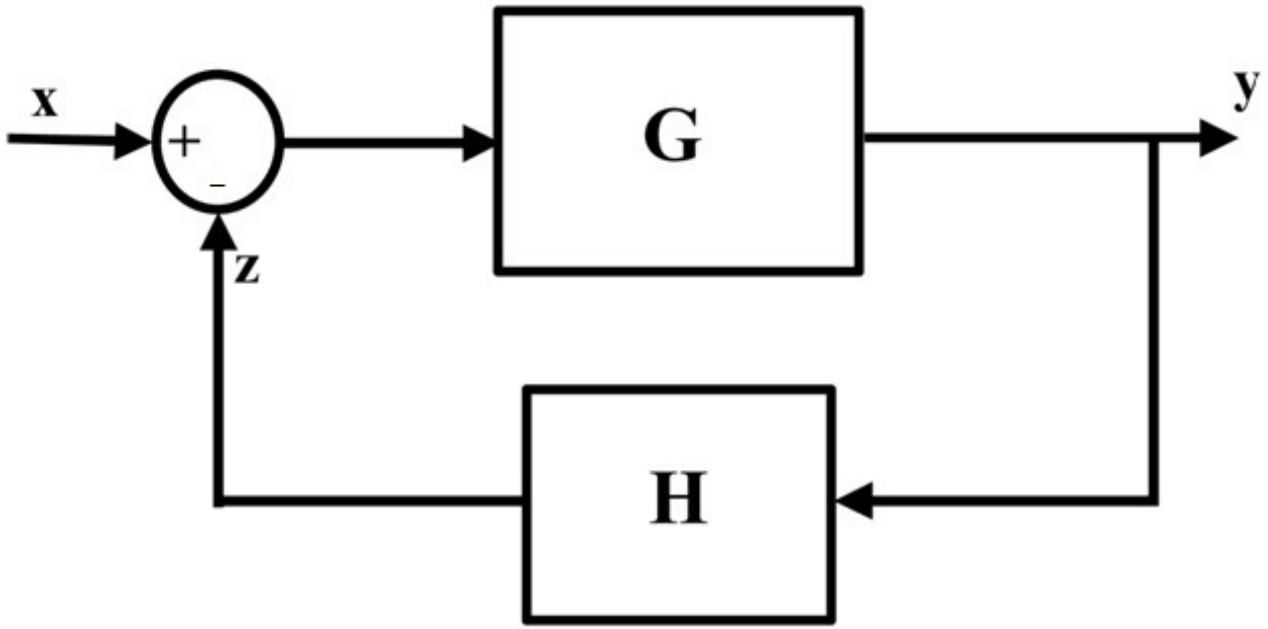
Control Systems I

HS 2025



About me:

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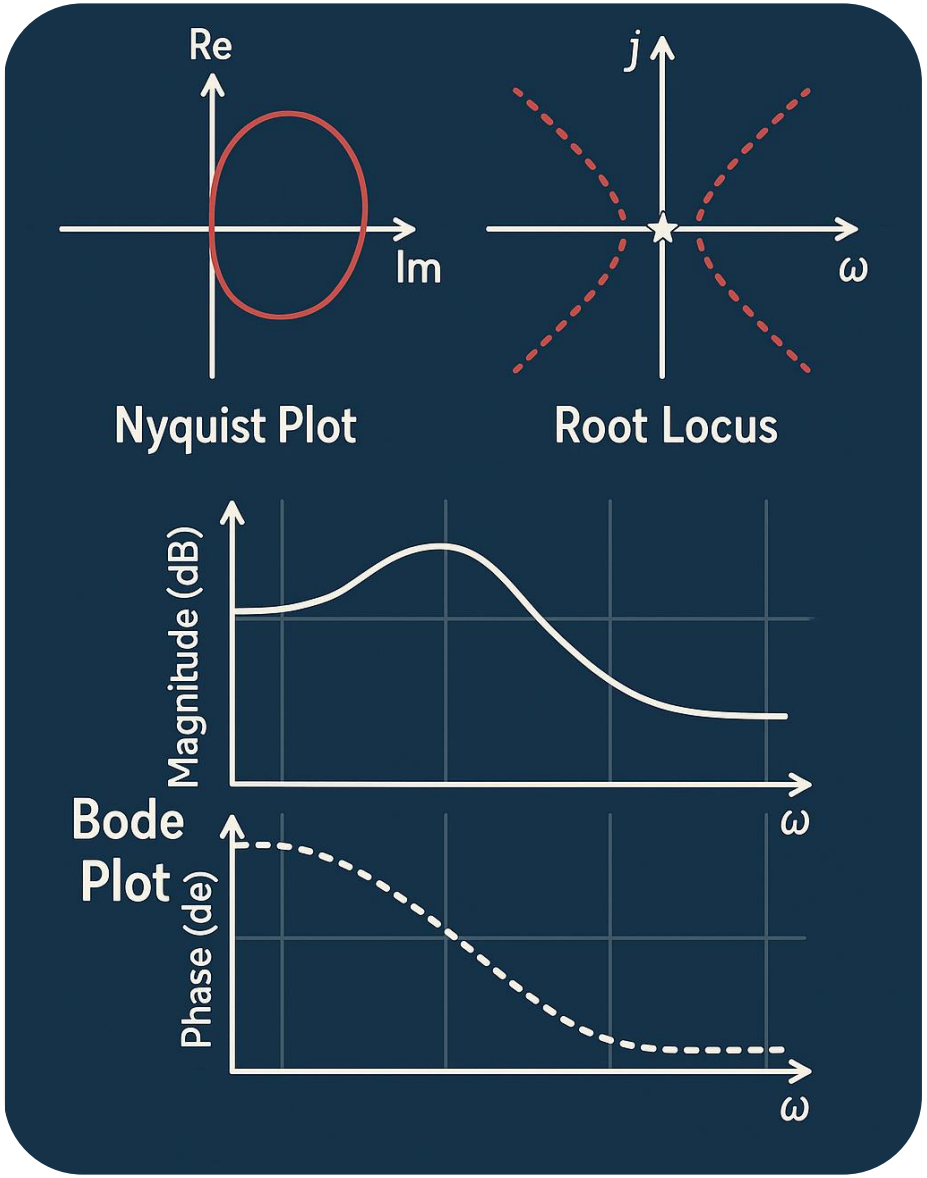
Where do you find all the documents?

https://n.ethz.ch/~dcosta/

Exercise Structure

1. Theory Recap
2. During the recap we will also do some exercises of the old exams
3. Dedicated time for exercises
4. If you don’t understand something, ask
5. It’s my first time as a TA, so if you have suggestions tell me



Course organization

You can attend:

- Lectures
- Recitations
- Study Center

Useful things to know:

Script

Problem sets

Tools

Disclaimer for this course:

1. This course combines a lot of concepts from different lectures:
   - Linear Algebra II -> ODEs
   - Mechanics III -> Modeling
   - Analysis III -> Laplace Transformations

2. It may seem very abstract in the beginning
   - Solution: **Bare with me, it will eventually make sense**

3. We will always try to connect everything to real-life examples to make the concepts easier to understand

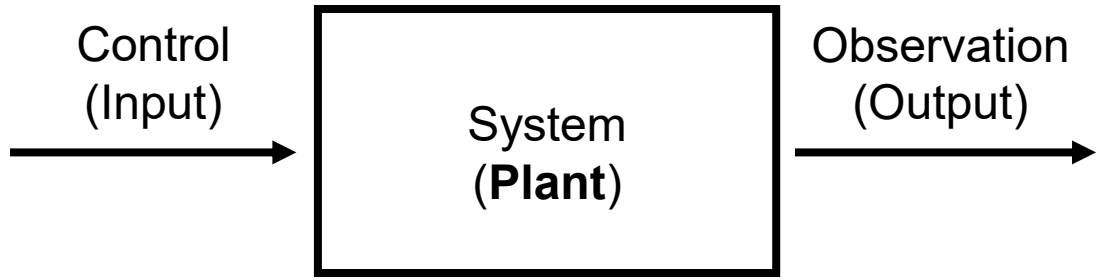
What is Control Systems?

We will start with the System
- Often called **Plant**

Examples of physical systems:
- Drone
- Robot
- Car
- Etc.

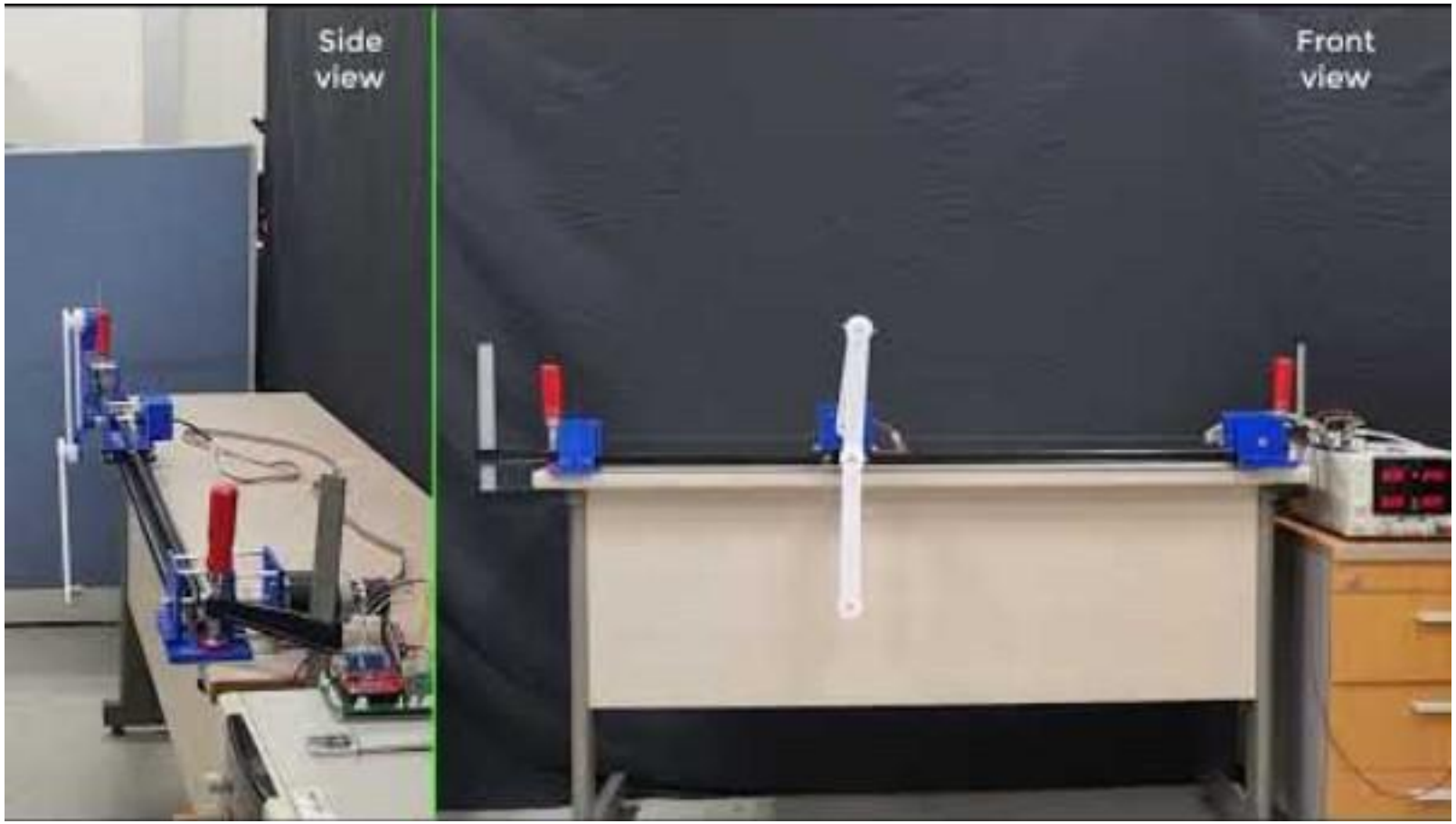
We will look at SISO and mostly linear systems

(single-input, single-output)

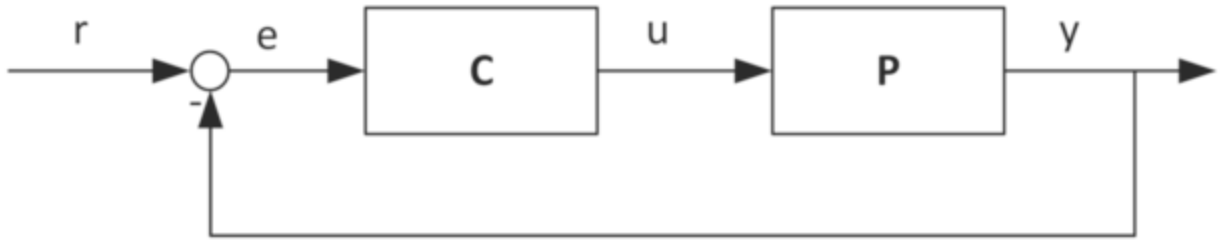


Objective: Given some reference the controller generates the needed input so that the output matches the reference

Example: inverted pendulum

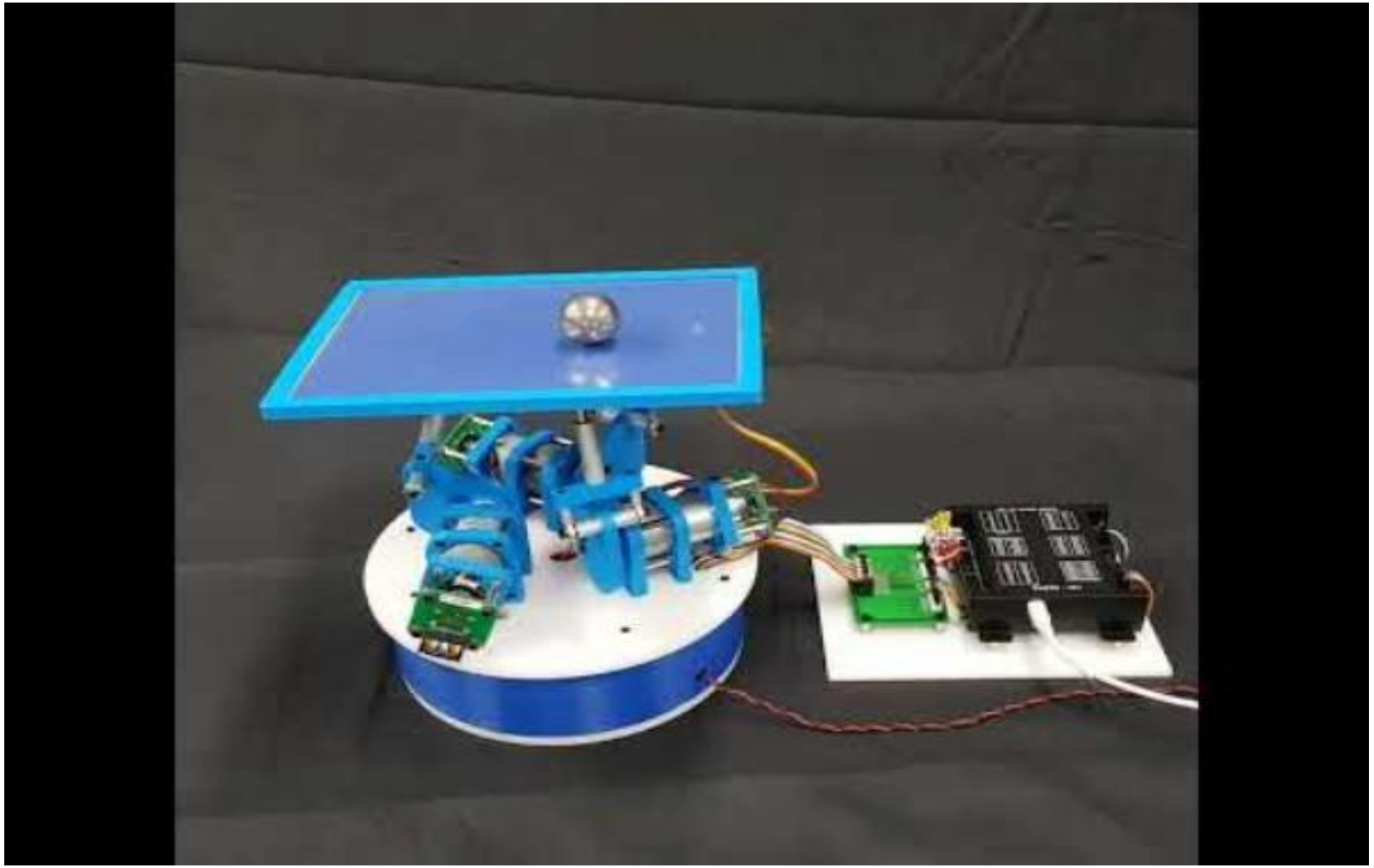


What are our control objectives?



- **Stabilization:** make sure the plant does not deviate too much from the desired behavior
- **Performance:** execute the desired task as accurately as possible
- **Robustness:** perform well even in the presence of disturbances, noise, etc.

More examples:



Main objectives:

1. **Modeling:** learn how to represent a dynamic control system in such a way that it can be treated using mathematical tools

2. **Analysis:** understand the basic characteristics of a system, and how the input affects the output. We will try to understand how a system will behave under feedback, given its open-loop behavior

3. **Synthesis:** figure out how to modify a system, typically by feedback, in such a way that it behaves how we want

ONE LAST THING: EXAM

This year you will get a 1-sheet (2 A4 pages) summary sheet.

- it will be created through feedback with the students.
- after each week the summary will be updated on Moodle with new formulas/informations