AEROSPACE DYNAMIC SYSTEMS ANALYSIS II

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→ INTRODUCTION TO FEEDBACK CONTROL

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Automatic control plays a dominant role in modern engineering
The concept of "feedback" is everywhere in common life too

This class is about → (1) classical control theory (from 1922 with Minorsky to the 40's and 50's)

→ (2) Modern control theory (60's and 70's)

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→ What is FEEDBACK? It is used to refer to a situation in which two or more dynamic systems are connected together in such a way that each system outputs influences the inputs of the other(s), so that their dynamics are strongly coupled ("CLOSED-LOOP SYSTEMS")

↓ it is a circular argument

↓ the behaviour of a feedback can be counterintuitive

↓ we need a FORMAL METHOD to understand it

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→ What is CONTROL? It is the use of algorithms and feedbacks in engineered systems

↳ for example, in fly-by-wire control system, where we can find feedback control systems

↓ the common concept is "to let the machine be autonomous"

→ A feedback control system has 3 MAIN TASKS:

1. to SENSE the system behaviour → through a sensor
2. to DEFINE and COMPUTE the actions necessary to let the system behave as desired → I adapt my output to all the actions necessary for the behaviour I want my system to have
3. to ACTUATE the actions necessary to let the system behave as necessary

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these 3 tasks are made CONTINUOUSLY in a machine that has a feedback control system

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BASIC LOOP OF SENSING - COMPUTING - ACTUATING CAPABILITIES

→ the system dynamics must be

1. STABLE → the system reacts with bounded outputs to bounded inputs and/or to variation of initial conditions
2. CAPABLE OF DESIRED DYNAMIC PERFORMANCES (tracking of commands, rejection of disturbances)

we have a system with a certain architecture, which we know

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these two are our desires for our systems

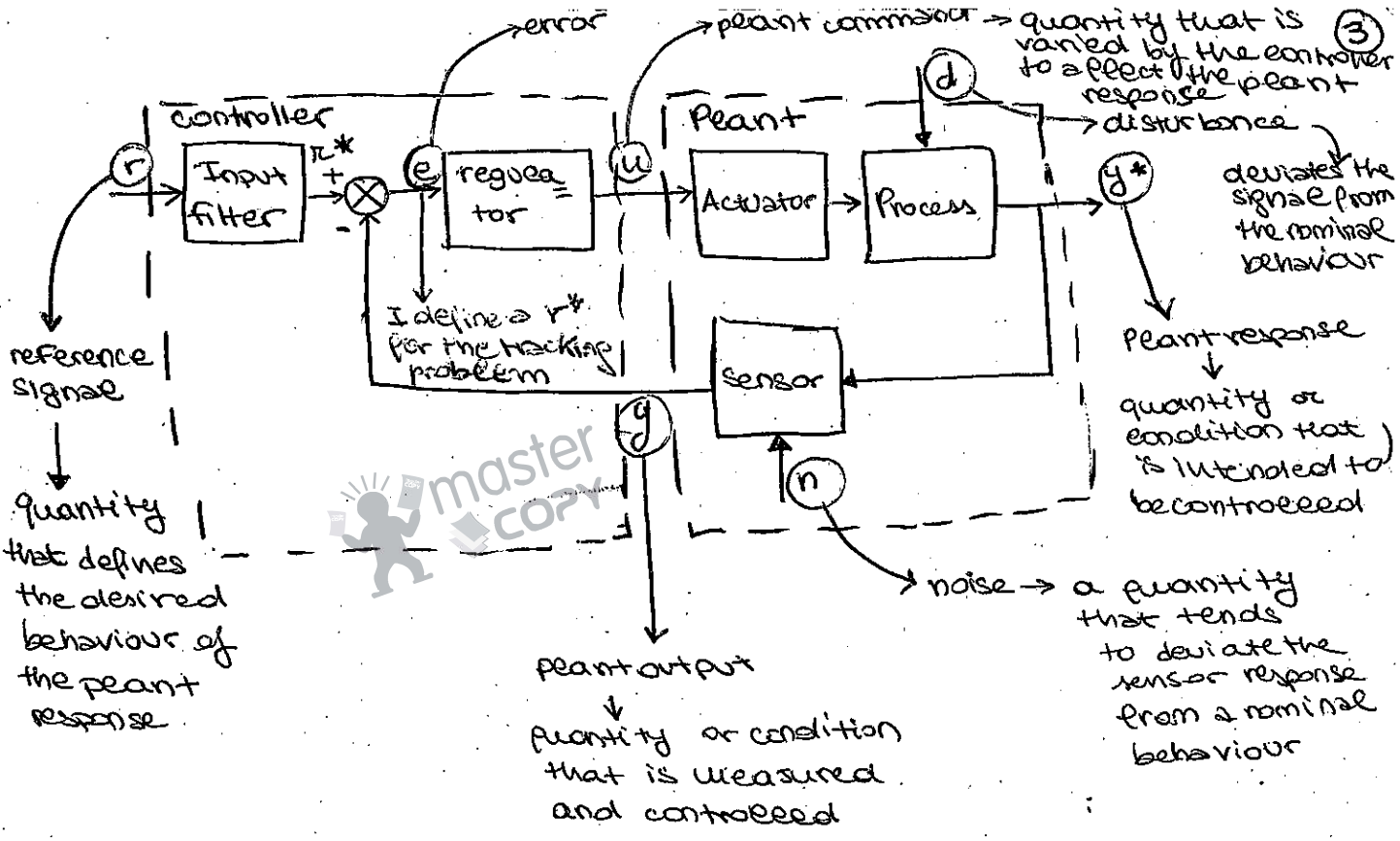
→ we want to handle a system that is both stable and capable of desired dynamic performance

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we provide an input and our system responds coherentely with it

we want our system to not just respond to our input, but to do it in a certain way depending on our purpose

example: students don't only have to answer a question, but the purpose of a teacher is to make their knowledge grow in a certain way → 1) stable 2) capable of desired dynamic performance



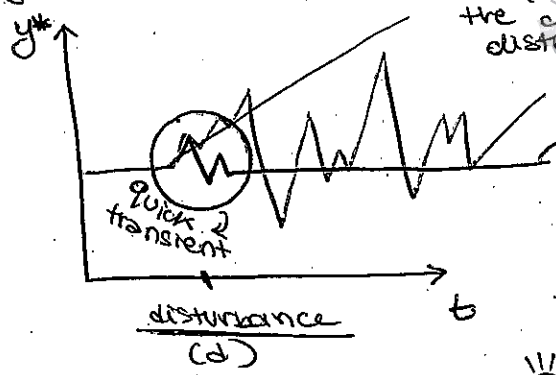
Plant = equipment / machine / device performing a function that is to be controlled

Actuator = plant subsystem that converts the plant command into an action that affects the plant response (for example, an electric motor)

Sensor = plant subsystem that converts the plant response into a measurable quantity

→ Basically, there are two approaches:

① Regulator problem → It is focused on the capability of the closed-loop system to reject the disturbances



→ rejection of the disturbance

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after a transient, the system is capable to go back to its behaviour