POLITECNICO
MILANO 1863

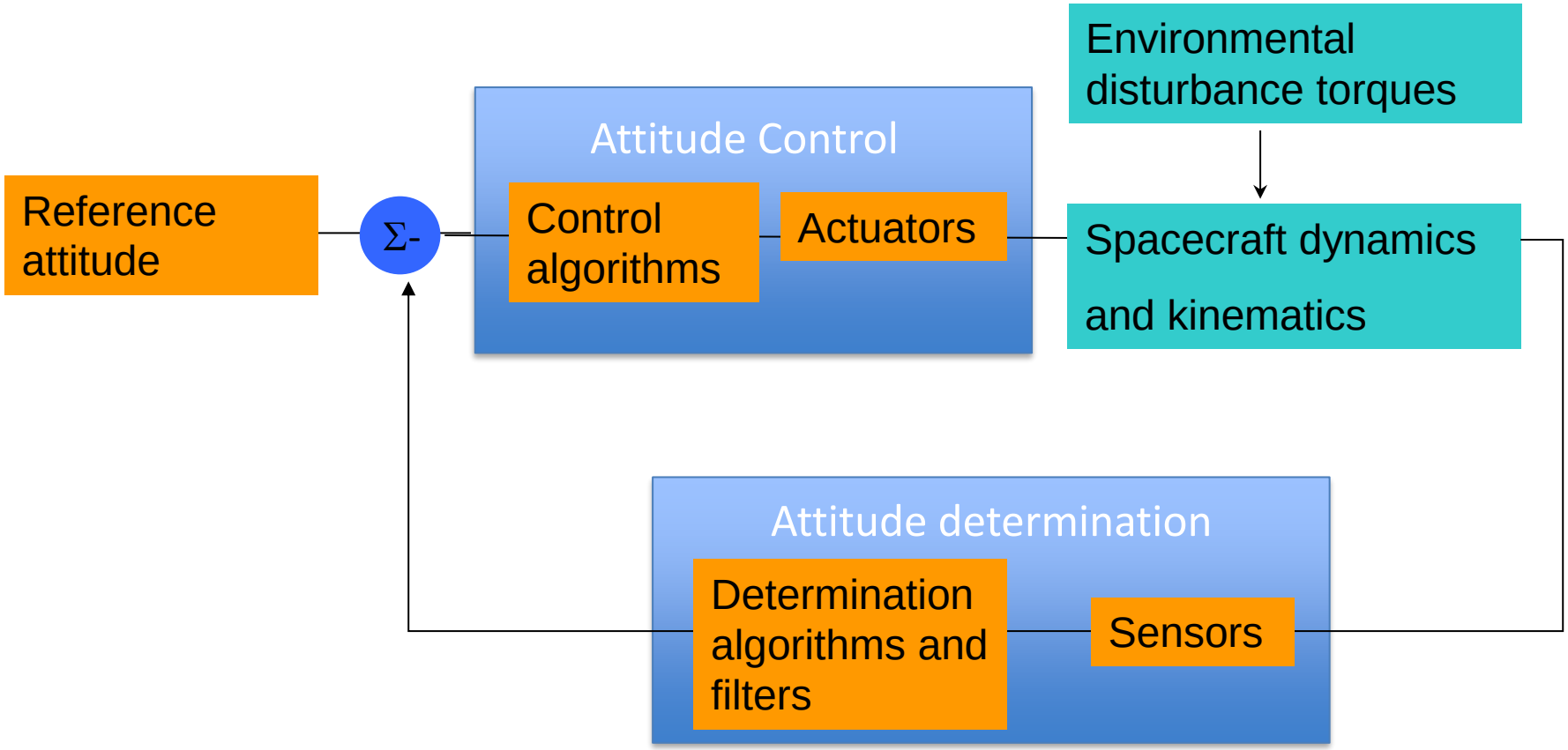
Spacecraft Attitude Dynamics

prof. Franco Bernelli

Instructions for projects

Objectives

- Simulate the complete attitude dynamics and control loop



- Show and quantify that the attitude control improves the pointing performances with respect to the uncontrolled case. Define at least 1 performance parameter and make statistical analysis on it.

Project specifications

- Orbit specifications NOT assigned (you can use the orbit of your Orbital Mechanics assignment)
- Class of spacecraft assigned, either cubesat (3U, 6U, 12U - mass 4 to 15 kg), microsat (10 to 100 kg), minisat (100 to 500 kg), large satellite (over 500 kg)
- Pointing requirements NOT specified, you should define them (justify selection)
- You are expected to model the attitude dynamics including the 2 most relevant perturbing torques, selected according to your orbit and spacecraft shape (justify selection)
- Attitude parameters assigned, you are expected to use those to simulate attitude kinematics
- One sensor assigned, you are expected to use this and eventually add any other sensor, if needed (justify choice)
- Actuators assigned, you are expected to use those and eventually add any other actuator, if needed (justify choice)
- Control logic NOT assigned, choose one and implement it
- Specifications can be modified **only if strictly necessary**
- Simulate at least one full orbit

Project specifications

Mission: (i) de-tumble (ii) slew maneuver (iii) Earth/Sun/inertial pointing with 3 axis stabilization

Each group member responsible for performances in one of: (i) attitude determination (ii) de-tumble (iii) slew maneuver (iv) pointing with 3 axis stabilization

Specifications can be modified **only if strictly necessary**

Team activity

- The team as a whole is responsible for the results and report
- For practical reasons, the team can assign specific tasks to each member
    - 1 responsible for attitude determination
    - 1 responsible for detumbling
    - 1 responsible for slew manoeuvre
    - 1 responsible for target tracking

Report Structure

- **Length –** maximum 20 pages (+cover and index), font size 12, single column
- **Figure** – Block scheme of the ADCS architecture (e.g. sensors + actuators + controller + algorithms + kinematics)
- **Model description –** models used and assumptions
- **Control and determination algorithms –** justify choices
- **Results** – Clear plots with axes labels and units, compare and contrast algorithms
- **References -** all material used, including theoretical and data of the hardware

Define notation used, do not copy and paste Simulink diagrams or plots.

Report Delivery

- Report delivery via the delivery folder on WeBeep
- Deadline for delivery is January 7, 2025, regardless of date of oral exam (delivery folder will be closed after that date)
- Project is valid only for the present academic year, if the exam is not passed then a new project should be completed in the following academic year
- Deliver project report in pdf format and Simulink code in a separate zip file
- PLEASE use these names for the files you upload:
    - GroupNumber.pdf (example 38.pdf) for the project report
    - GroupNumber.zip (example 38.zip) for the Simulink files