MP-282
Dynamic Modeling and Control of Multirotor Aerial Vehicles

Syllabus

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Practical Info

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Objectives

MP-282 has been devised to teach:

- how to describe the dynamics of different kinds of MAVs
  - with fixed or tilting rotors
  - tether-constrained or free
  - connected to an aerostatic balloon
- how to design flight control, guidance, and path planning algorithms
  - hierarchical control scheme
  - position and attitude control
  - control allocation
  - waypoint-based guidance
  - path planning

Official Program (3-0-0-9, maximum 3 credits)

- Introduction: modeling; control allocation; attitude and position control; reference governor; trajectory planning; and path planning.
- Kinematics and dynamics: coordinate systems; translational motion; attitude motion; attitude parameterizations; tether-constrained flight.
- Control force and torque and control allocation: quadcopter; hexacopter; octacopter; quadcopter with longitudinal tilting rotors; quadcopter with transversal tilting rotors.
- Introduction to flight control: attitude control; position control; reference governor.
- Other control methods: sliding mode control; model predictive control.

Chronogram

The course plan is as follows.

- Month 1: Introduction and Dynamic Modeling
  - Introduction
  - Coordinate systems, equations of motion, attitude parameterizations
  - Dynamic modeling of tethered MAVs
  - Dynamic modeling of MAVs connected to aerostatic balloons
  - Resulting control forces and torques
- Month 2: Flight Control of Fixed-Rotor MAVs
  - Hierarchical control structure
  - Attitude and position control
  - Control allocation

Chronogram

- Month 3: Guidance and Path Planning
  - Waypoint-based guidance
  - Path planning
- Month 4: More on Control Methods and Simulation
  - Geometric control
  - Sliding mode control
  - Hardware-in-the-loop simulation
  - etc.

Methodology

- Lectures and discussions using slides and board
- Lab demonstrations (hardware-in-the-loop simulation)
- Simulations (exercises starting in the class and going on at home)
- Theoretical exercises (homework)

Evaluation

- Grade 1:

exam 1	50 %
simulation	25 %
exercises	25 %

- Grade 2:

exam 2	50 %
simulation	25 %
exercises	25 %

- Final grade:

simulation-based work + draft paper	100 %

Bibliography

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