SSM
Scuola Superiore Meridionale

Course title:

Spacecraft Attitude Control via Momentum Exchange Devices

Duration [number of hours]**: 24**

PhD Program [MERC/MPS/SPACE]**: SPACE**

Name and Contact details of unit organizer(s):

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Course Description [max 150 words]**:**

This class rigorously develops the concepts, mathematical procedures, and methods associated with control of the attitude of a spacecraft. The class will introduce the main types of actuators used in spacecraft and how to command the actuators. Topics include control methods based on Momentum Exchange Devices (Reaction Wheels, Control Moment Gyroscopes). The 2 take-home homeworks will incrementally build a Simulink model simulating the attitude control of a generic spacecraft.
By the end of this course, the student should be able to do the following:

1. Understand and model rigid body rotational dynamics.
2. Understand the effect of momentum exchange devices (MEDs) on a spacecraft attitude and how to design their control laws.
3. Choose key parameters for the algorithms operating the systems above.
4. Write Simulink models (blocks) running software for attitude control.

Syllabus [itemized list of course topics]**:**

1. Review of Euler's law and rigid body dynamics (kinematics and kinetics)
2. Review of spacecraft rotational mechanics
3. Introduction to spacecraft main subsystems, with focus on attitude
4. Introduction to use of Simulink and leads to constructing HW1
5. HW1 – simulation of full rigid body rotational mechanics (using quaternions)
6. Reaction Wheels control
7. Control Momentum Gyroscopes control
8. Variable Speed Control Momentum Gyroscopes control and leads to constructing HW2
9. HW2 – implementation of the general control law handling all MEDs

Assessment [form of assessment, e.g., final written/oral exam, solutions of problems during the course, final project to be handed-in, etc.]**:**

2 software-based homework, weighting 50% each.

Suggested reading and online resources:

Notes taken in class should be sufficient.

Suggested books:

1. Spacecraft Attitude Determination and Control, Wertz.
2. Space Vehicle Dynamics and Control, Bong-Wie.

3. Fundamentals of Spacecraft Attitude Determination and Control, Markley and Crassidis.
4. Spacecraft Momentum Control Systems, Leve, Hamilton, Peck.

Students must have access to MATLAB and Simulink.