2SC5191 – Control strategy of a nanosatellite

Instructors: Giorgio Valmorbida
Department: DOMINANTE - GRANDS SYSTÈMES EN INTERACTION, DOMINANTE - CONSTRUCTION VILLE TRANSPORTS
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
This module is developed in partnership with Thalès Alenia Space. The main goal is to introduce the main tasks on the design of a nanosatellite. For a satellite mission, the participants will propose a satellite orbit, choose sensors and actuators, design the mission modes, propose a dynamical model, design a control laws, simulate the trajectories and assess the resulting performances.

Quarter number
ST5

Prerequisites (in terms of CS courses)
Course "Cubesat design and control: attitude and orbit control systems" of the specific course "performance and flight trajectories".

Syllabus
Traceability matrix : methods for the validation and verification of requirements. Proposal of mission modes, hardware selection. Definition of pointing, mass and power budgets. Disturbance torque assessments. Selection, layout and sizing hardware components.
Dynamics modeling, and simulation including torque disturbances. Writing the technical notice.

Class components (lecture, labs, etc.)
The group will be split into teams of 5 students, which will work independently from the other teams. Each day, a part of the satellite design will be proposed and a document of requirements will be provided. Each team has to deliver either a short report or software, and to give a short talk by the end of the day.

Grading
The evaluation will include a final report, the developed software, and the final oral presentation. At the end of each session, the teams will also

present the results of the day, which will be accounted for in the final mark.

Course support, bibliography
Course handouts "Guidage et Pilotage d'un Satellite"

Resources
• Document of requirements in an industrial format
• Orbit simulation software, satellite instrumentation software.
• Supervision by Thalès e Alenia Space engineers and CentraleSupélec Professors

Learning outcomes covered on the course
The main goals are

- Understand aspects and constraints in satellite design, develop models for each design stage and understand the dynamical behavior of the satellite
- Choose a satellite orbit to satisfy the requirements
- Design the hardware by choosing sensors, actuators and energy generators
- Propose a set of operational modes and the control laws to satisfy the performance requirements.

Validate each step of the design with simulation (GMAT, VTS Timeloop, Matlab/Simulink)

At the end of the module, the participants will have completed the main steps in the desing of a AOCS : the choice of the orbit, the choice of harware components and the AOCS architecture as well as the design and validation of control laws.

Description of the skills acquired at the end of the course

- Analyze, design and implement complex systems made up of scientific, technological, social and economic dimensions. (C1)
- Acquire and develop broad skills in a scientific or academic field and applied professional areas. (C2)
- Act, engage, innovate within a scientific and technological environment. (C3).
- Have a sense of value creation for his company and his customers (C4).
- Be operational, responsible, and innovative in the digital world (C6).
- Know how to convince (C7).