INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

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Télécommunications

Satellite Communications and Navigation Project

IDENTIFICATION

CODE : TC-5-S1-EC-PRJSAT
ECTS : 2.0

HOURS

Lectures :	0.0 h
Seminars :	0.0 h
Laboratory :	0.0 h
Project :	32.0 h
Teacher-student contact :	32.0 h
Personal work :	0.0 h
Total :	32.0 h

ASSESSMENT METHOD

The course will be evaluated in two ways. On the one hand, groups must deliver a project report and Python notebooks with the design and analysis. On the other hand, an oral defense of each group will be evaluated.

TEACHING AIDS

The project (in five modules) will be provided in synchronous live working hours (presential or virtual, to be defined) with room for questions and answers between the students and the corresponding professor for the module. Open discussions will be encouraged. Asynchronous follow-up (project hours) will also be provided.

TEACHING LANGUAGE

English

CONTACT

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AIMS

At the end of this course, participants will be able to design, analyze, optimize, and evaluate a complete space mission using state-of-the-art software tools. This course must be taken together with TC-5-SYS-SAT (Satellite Communications and Navigation), where the main theoretical content will be provided: space applications and actors, orbital parameters and design constellation fleets, suitable orbital propagators, radiolocalization and navigation satellite systems, link budgets, radiocommunication systems comprising satellites and launchers, communication protocols and multi-hop space networks and current market trends spanning the public and private sectors.

CONTENT

The Satellite Communications and Navigation Project course follows the same five modules as the SAT course. An expert on the specific domain will guide each module. Each module will be a part of the overall final project. The students will work in groups of 2 or 3 throughout the project.
Module 1 - Applications and Orbital Dynamics by J. Fraire (Inria)
Space applications and distributed missions
Trajectories and orbits, Keplerian laws, and orbital parameters,
Orbital perturbations and orbital propagators
Module 2 - Radiolocalization & Navigation (GNSS) by F. Marmet (CNES)
Radiolocalisation/radionavigation techniques
GNSS system and signals
GNSS receiver architecture and error budget and positioning performance
GNSS in urban environments and other complements
Module 3 - Radiocommunication (Physical layer, Launchers) by O. Bompis (CNES)
Radiofrequency systems in space
Frequency bands and coordination organisms
Ground station networks
Link budget computation
Module 4 - Markets & Actors (Current/Future Systems) by A. Terrasse (NATO)
Space applications
Satellite communication systems and their economics
Business considerations
Module 5 - Protocols & Networks (Link and Upper layers) by J. Fraire (Inria)
Link multiplexing and medium access control
Inter-Satellite link and space networks
Communication protocols and Internet limitations
Delay-tolerant networking for near-Earth and deep space systems

PRE-REQUISITE

In addition to the TC-5-SYS-SAT course, basic handling of maths, physics, and programming is welcome but optional. The course modules are approved with group-based projects where different disciplines can co-exist.