Master Thesis Proposal – 4 to 6 months

Title:

Development of the Ground Segment Data Handling System for the IonSat project

Context of the internship

The Centre Spatial de l'École polytechnique (Space center of École polytechnique, CSEP), created in 2010, proposes and supervises space projects for École polytechnique students. It is at the origin of one of the first French student nanosatellites, X-CubeSat, launched into orbit on May 17, 2017. The CSEP brings together and coordinates, through its projects, students, teacher-researchers, industrialists and French and European space agencies. It is financially and operationally supported by the education patronage program *Espace, science et défis du Spatial (*Space, Science and Challenges), led by Professor Pascal Chabert.

IonSat is a 6U nanosatellite project equipped with an electric propulsion engine, dedicated to demonstrating the feasibility of nanosatellite missions in very low orbit (300km). It is at the frontier of space applications, and is positioned in the NewSpace philosophy. With a strong educational vocation, the project is currently led by twenty students, supported by numerous space actors: startup (ThrustMe), industries (Thalès Alenia Space), agencies (CNES, Onera).

Internship description

The IonSat satellite plans to make use of global network of radio amateurs and their ground stations for receiving and gathering the continuous data telemetry in a central database (Mission Control Center). From lessons learned of previous CubeSat missions, there were many flaws in the data-handling system of the ground segment due to a very late system development, this problem needs to be tackled early in the design to improve the reliability of the mission.

IonSat will make use of low-speed continuous telemetry downlink and high-speed downlink for passes over an S-band ground station. The low-speed link is very robust and is a proven system, however since there is no global or full-time coverage of radio amateurs, there will be many gaps in the gathered data. The high-speed downlink will send down all measurements onboard the satellite, however because this component of the ground system is not located on the same site as the main control center, it can be the source of compatibility issues, besides, it is less reliable due to dependency on the attitude control of the satellite.

The main objective of this thesis is to develop a reliable ground segment data handling system for this mission. In order to accomplish this objective, the internship will focus on:

- Ground segment requirements review
- Assessment of the mission problems (risks) in the ground segment system,
- Design the data-handling system for the IonSat mission which is less prone to irreversible human error,
- Develop ground segment telemetry downlink decoder software,

- Build proof-of-concept for the data handling system using the satellite data and simulation,
- Evaluate reliability, flexibility and performance of the software system. As a result, novel data handling system for IonSat satellite which is more secure, flexible and reliable and ready to use for the mission.

The intern will work with two full time engineers of the CSEP, and can use the help of the space team of the Laboratory of Plasmas Physics, specialized in conception of space-ready hardware and on-board electronics. There are also frequent contacts with experts from the French aerospace agencies (CNES, ONERA) and companies (Thalès) partners of the IonSat Project.

Technical Requirements

- M1 or M2 level in informatics (computer science) and programming, electrical engineering, or related domains.
- Experience writing software, managing databases, and networking protocols,
- Knowledge in UNIX like systems,
- Good English level
- Knowledge of RF systems and link budget analysis is a plus
- Knowledge in aerospace systems is a plus
- Being radio-amateurs is a plus

Behavioural Requirements

- Self Motivation and autonomy
- Communication and teamwork

Internship duration: between 4 and 6 months, from September 2021
If you are interested, send your CV and a cover letter, clearly indicating your motivation and availability dates.

Contacts: Antoine Tavant antoine.tavant@polytechnique.edu
Ricardo Colpari colpari@lpp.polytechnique.fr