Internship / Master Thesis Proposal – 4 to 6 months

Title:

Development of the Ground Station and Control Command Center 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 2017. The CSEP brings together and coordinates, through its projects, students, teacher-researchers, industrials and French space agencies. It is financially and operationally supported by the education 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). With a strong educational vocation, the project is currently led by twenty students, supported by numerous space actors.

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, it is important to design the ground segment in parallel to the satellite to improve the reliability of the mission and to plan the operations accordingly.

IonSat will make use of UHF and S-band ground stations. To use the UHF ground station from Ecole Polytechnique it needs to be adapted for the needs of the project, this link can be also shared with the radio amateur community, however, since there is no global or full-time coverage of radio amateurs, there will be many gaps in the gathered data. The S-band 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.

IonSat will make use of UHF and S-band for transmissions. An UHF ground station has already been in use for years, and needs upgrade to fit the requirements of the project. This link is robust, easy to setup, and will be shared with the radio amateur community. However, since there is no global or full-time coverage by radio amateurs, there will be many gaps in the gathered data. In order to overcome these shortcomings, the satellite will also include a S-band downlink, to send down all measurements onboard the satellite at higher bitrate, but on a unique site, which may be different from the main control center location. Ground infrastructures shall be adapted to allow all data collection in this situation.

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

- Review the ground segment requirements,
- Assess the potential mission problems (risks) in the ground segment system,
- Adapt the ground station for the IonSat mission,
- Design the ground data-handling system (command & control center) for the IonSat mission less prone to human error,
- Implement the ground segment telemetry downlink decoder software (simple control center),
- Build proof-of-concept for the ground data handling system using the satellite data and simulation,
- Evaluate reliability, flexibility and performance of the software system.

The intern will work with two full time engineers of the CSEP, 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 telecommunications engineering, computer science, electrical engineering, or related domains.
- Knowledge of RF systems and link budget analysis.
- Experience writing software, managing databases, and networking protocols.
- Knowledge in UNIX like systems and Python language.
- Good English proficiency.
- Knowledge in aerospace systems is a plus.
- Being a radio-amateur is a plus.

Behavioural Requirements
- Self Motivation and autonomy.
- Communication and teamwork.

Internship duration: between 4 and 6 months, from February 2022.

If you are interested, send your CV and a cover letter, clearly indicating your motivation and availability dates.

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