Internship / Thesis Proposal – 4 to 6 months

Title: Robust attitude control techniques for IonSat

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 developed one of the first French student nanosatellites: X-CubeSat, launched into orbit in 2017. Through its projects, the CSEP brings together and coordinates students, teachers, researchers and some industrial partners within 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 CubeSat project using an electric propulsion engine, dedicated to demonstrating the feasibility of nanosatellite missions in Very Low Earth Orbit (300km). It is at the frontier of space applications, with a strong educational vocation, the project is currently led by twenty students, supported by numerous space actors: startups (ThrustMe), industries (Thalès Alenia Space) and agencies (CNES, Onera).

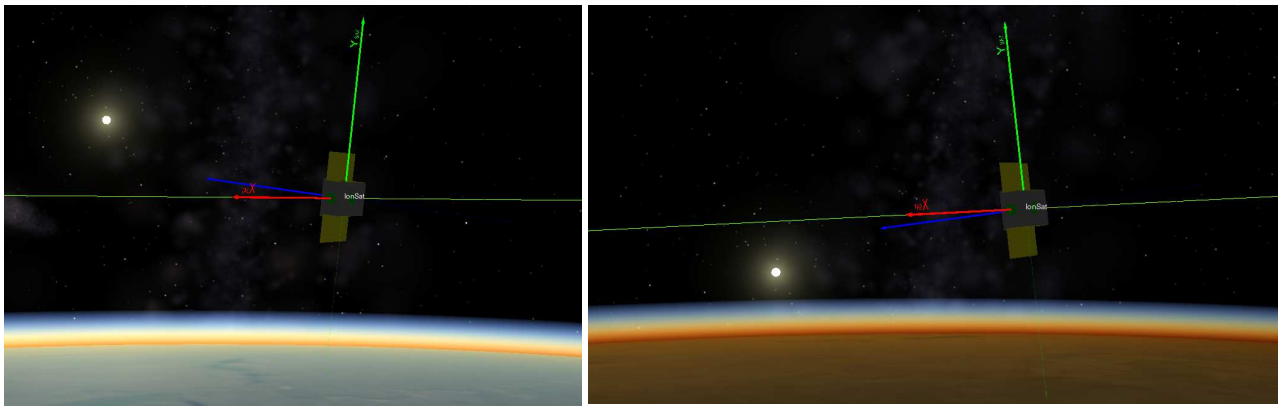

Illustration of IonSat on orbit.

Internship description

The IonSat project has completed its preliminary design phase and is moving towards validating the design through tests in engineering models. In this context, the intern will be responsible for the implementation, optimization and enhancement of ADCS for the IonSat project. Work during the internship will include flight code and algorithm implementation, while developing software and simulation capabilities. It will be also necessary to work and configure a test framework/simulator.

The main activities during the internship will be about:

- Design and implement a control algorithm, robust enough for uncertainties in the satellite, comparing different approaches, such as sliding-mode control, H_∞ control, time optimal control, etc.

- Design and implement a control algorithm for the desaturation of the main actuators of the satellite.
- Continue to evolve the ADCS for the IonSat mission: assessing preliminary performances/feasibility on functional simulators.
- Define Concept of Operations for the spacecraft attitude determination and control system.
- Perform analyses to determine fault detection, isolation and recovery options.
- Develop and maintain technical documentation for ADCS development.

The intern will work with one CSEP full-time engineer, when necessary the intern will receive the help of the space team of the Laboratory of Plasmas Physics, specialized in conception of space-ready magnetometers and on-board electronics. There are also frequent contacts with experts from the French aerospace agencies (CNES, ONERA) and companies (Thalès Alenia Space, ThrustMe) partners of the IonSat Project.

Technical Requirements

- Bachelor's degree in Electrical/Electronic, Aerospace, Mechanical Engineering or related field.
- Strong understanding of classic control systems, such as PID, non-linear control systems, robust control methods.
- Knowledge of the development of three axis stabilized spacecraft incorporating momentum, magnetic, and propulsive control.
- Knowledge of Matlab/Simulink is required.
- Programming proficiency in one or more programming languages (e.g. C, Python, etc.) is desired.
- English language proficiency (French proficiency is a plus).
- Knowledge of advanced control systems and software would be a major advantage.
- Recent participation in projects developing space hardware/software is a plus.

Behavioural Requirements

- Self-Motivation and Autonomy.
- Team player, attentive to timelines.
- Affinity with the Space industry.

Internship duration: between 4 and 6 months, starting from February/March 2023 in Palaiseau, France.
If you are interested, send your CV and a cover letter, clearly indicating your motivation and availability dates.

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