

Internship / Master Thesis Proposal – 4 to 6 months

Title: ADCS Detailed design and initial testing 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 developed one of the first French student nanosatellites: X-CubeSat, launched into orbit on May 17, 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, 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: startups (ThrustMe), industries (Thalès Alenia Space) and agencies (CNES, Onera).

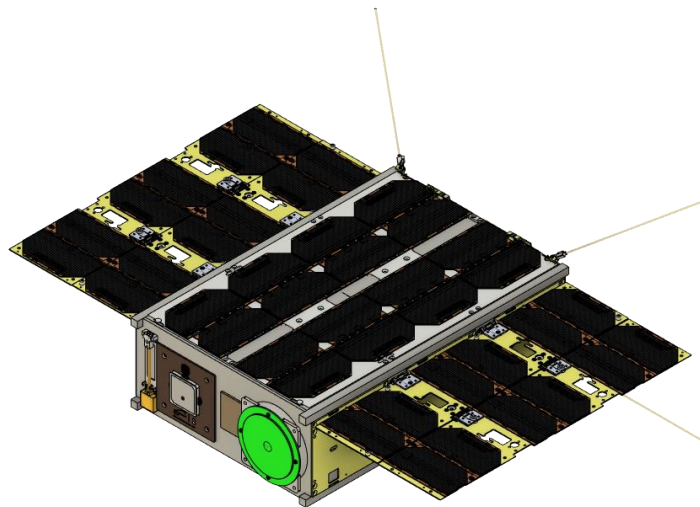


Illustration of IonSat, viewed from the front and top

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, component testing, design of lab test environments and set ups to



support ADCS development and testing, etc., 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:

- Continue to evolve the ADCS for the IonSat mission: Iteratively implementing and improving Attitude Determination and Control algorithms, and assessing preliminary performances/feasibility on functional simulators.
- Perform 'hardware in the loop' tests on a 'FlatSat' model.
- Define Concept of Operations for the spacecraft attitude determination and control system.
- Perform analyses to determine fault detection, isolation and recovery options.
- Implement software to support various pointing modes and attitude control scenarios.
- Design and plan payload testing configurations on the ground when testing spacecraft attitude determination and control system performance both in-lab and in-orbit.
- 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.
- Recent participation in projects developing space hardware and software (preferably spacecraft attitude determination and/or control).
- Strong understanding of classical dynamics, orbital mechanics, modeling and simulation.
- Knowledge of the development (from cradle to grave) 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 required.
- English & French language proficiency.
- Knowledge of electric propulsion systems and flight guidance navigation and control systems and software would be a major advantage.

Behavioural Requirements

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

Internship duration: between 4 and 6 months, starting from March or April 2022

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



Contacts:

Ricardo Colpari colpari@lpp.polytechnique.fr

Antoine Tavant antoine.tavant@polytechnique.edu