Master Thesis Proposal – 4 to 6 months

Title:

CubeSat Structure Design and Modelling 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

Design of structure is very dependent on the subsystems that it is intended to support. In this case designing is happening from inside – out. Every subsystem has its own limitations, support requirements and heat dissipation requirements, each subsystem has certain number of mounting holes and specific shape, size, need for extra space for electrical connections and accessibility for testing purposes. Working back and forward between team members and defining optimal design for each part is what makes this spacecraft design robust and convenient for mission's needs. As the system is so compact it is crucial to accommodate allowed space inside the Spacecraft as efficient as possible

Therefore, the mission sets a list of requirements that need to be met with the design of the structure. Using some experience gained in previous work, it is possible to create more reliable and more cost-effective supporting structure that meets all the CubeSat specifications and copes with launch stress.

The main objective of this internship is to design, analyze and test a structure with spare internal space. By using Computer Aided Design (CAD) modelling and Computer Aided Engineering (CAE) tools for analysis. A more cost-effective and high reliability frame for IonSat structure design is expected. Systems engineering skills need to be applied to create structure that fits all mission requirements and makes integration simpler.

The internship will focus on:

- Mission-specific design and integration process description in detail.

- Coupled Loads analysis of designed structure.
- Rapid prototyping: quick fabrication of a model of a physical part or assembly, a 3D printer can be used to produce 3D models of 6U CubeSats.
- Assembly and analysis of the prototype, verify if design is going in desired direction, add and easily modify components and import changes to CAD models right away.
- Achieve optimal position of Center of Gravity.
- Material selection in accordance with properties like outgassing, operational temperatures, and its applications.
- Part design through adaptation for machining.
- Apply critical thinking abilities alongside engineering principles to address unexpected problems

The intern will work with two full time engineers of the CSEP, and can use the help of mechanical engineers of the Laboratory of Plasmas Physics. 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 structural analysis, with background on mechanical or aerospace engineering, or related domains.
- Experience designing mechanical systems using 3D CAD software and 2D drawings.
- Experience sizing basic mechanical components and structures,
- Good English level
- Knowledge in aerospace systems is a plus

Behavioural Requirements

- Self Motivation and autonomy
- Communication and teamwork

Internship duration: between 4 and 6 months, from March 2022
If you are interested, send your CV and a cover letter, clearly indicating your motivation and availability dates.

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