Chair of Spacecraft Systems
TUM School of Engineering and Design
Technical University of Munich

Engineering Project / Semester Thesis

Start date: As soon as possible

Topic: *On-Board Computer for EventSat mission: Mission Command and Test Setup*

We are seeking students to help in the development on the onboard computer for EventSat mission. This is an incredible opportunity to get hands-on programming experience for a real mission going to space.

The EventSat mission is a 6U CubeSat technology demonstration mission sponsored by the Chair of Spacecraft Systems to apply event cameras to detect stars and other space objects. Event cameras are a specialized type of camera that use changes in brightness on a pixel-by-pixel level to detect motion in view. Building upon existing work, which has demonstrated the effectiveness of these cameras on ground in conjunction with telescopes, our mission seeks to demonstrate the effectiveness of this class of camera for space-based observation.

As a university CubeSat project, we recognize the fact that most students have never had the chance to work on flight software, and thus the tasks on this project are intended to be a learning process where students develop the necessary skills alongside the satellite itself. The most important skill we are looking for in students is the passion for the work and the willingness to devote the time to build the necessary programming skills and associated programs.

There are a multitude of opportunities available, whether it is writing embedded software, creating software architecture design documents, or performing unit testing and validation of existing code. We are happy to tailor tasks to your personal interests, existing strengths, and skills you would like to build professionally long-term.

Goals

- **Technical Understanding:** gain insight into the main processes inside the on-board computer and understand its interactions with other subsystems
- **System Integration:** Understand and apply the PyGS platform to interact with and validate satellite hardware components through Python-based workflows.
- **Automated Functional Testing:** Develop scripts and auxiliary tools to automate EnduroSat subsystem tests and streamline ground-to-OBC communications.

Tasks

- Develop Python scripts utilizing the PyGS API to send commands and automate interactions with OBC and connected modules.
- Integrate pre-defined FIDL files, designing code to call and test the FIDL-defined interfaces.
- Optionally, design a lightweight graphical user interface (GUI) to centralize and simplify testing/configuration tasks.

- Validate the system using real hardware; document all procedures and troubleshooting steps for future team members.

Documentation and Presentation:

- Prepare detailed user documentation (e.g., Wiki pages, GitLab repositories, LaTeX documents)
- Write a semester thesis document in double-column paper format
- Develop a short presentation summarizing the results

Requirements

- Basic understanding of CubeSats and their operations in low-Earth orbit
- Familiarity with Python
- Familiarity working with version control tools (Gitlab/GitHub)
- Familiarity or coursework in electronics/circuits, including use of lab instrumentation (oscilloscope, logic analyzer, multimeter)
- Experience with GUI development in Python (e.g., Streamlit, PyQt) is an asset but not required
- Note: This project is subject to export control regulations. An NDA must be signed, and some nationalities might not be eligible to work on the OBC.

Expected results:

- A comprehensive and user-friendly functional test set-up for satellite hardware, including modular Python scripts and an optional GUI
- A comprehensive semester thesis in double-column paper format
- Well-documented code maintained on a GitLab repository
- A brief presentation outlining the project results

References

[1] L. Schuberth *et al.,* "Leveraging Event-Based Cameras for Enhanced Space Situational Awareness: A Nanosatellite Mission Architecture Study," *75th International Astronautical Congress (IAC)*, 2024. [Online]. Available: https://mediatum.ub.tum.de/node?id=1759594

Supervisor

Clemente J. Juan Oliver, M.Sc.
Phone: +49 89 289 – 55752
E-mail: clemente.juan@tum.de