Engineering Project / Bachelor Thesis / Semester Thesis

Start date: As soon as possible

Topic: *On-Board Computer for EventSat mission*

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:** develop a comprehensive perspective on the mission flight software, subsystem interactions, and end-to-end system requirements
- **FSW Architecture Design:** streamline, modularize, improve and document FSW, focusing on reliability, maintainability, and clarity
- **Integration & Validation:** support the integration and validation of subsystems into the FSW stack, ensuring readiness for testing and mission operations

Tasks

- Refine the overall FSW architecture

- Update and optimize existing code, improve documentation, and ensure best practices in code style, structure, and maintainability

- Collaborate with hardware and test teams to integrate new features, address functional requirements, and resolve interface issues

- Participate in version management, code review, and iterative system validation cycles

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
- Experience in C/C++ programming (embedded systems, RTOS)
- Familiarity in Python
- Familiarity working with version control tools (Gitlab/GitHub)
- 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 cleaner, more robust, and maintainable FSW codebase supporting the system's mission requirements.
- Improved documentation and easily traceable system interfaces
- 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

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