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

Master Thesis / Semester Thesis / Bachelor Thesis

Start date: As soon as possible

Topic: *Data Handling & Telemetry for EventSat mission*

We are seeking students to help in the development of the command and data handling systems for EventSat mission, to later integrate into the telemetry pipeline. 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.

Building upon an existing work developed at the Chair, the student will focus on integrating real mission telemetry into the OBC for later downlink.

There are a multitude of disciplines involved, whether it is writing embedded software, further defining telemetry, improving testing and validation of data... 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 to retrieve data and properly store it
- **Interface Development:** collaborate with other subsystems to define and test interfaces with the OBC
- **Embedded Software:** develop embedded software in C/C++ that will be deployed in the mission
- **Telemetry pipeline:** define, handle, store and transmit the necessary telemetry and housekeeping data of the mission from each subsystem

Tasks

Telemetry and houskeeping data refinement
Extend prior work on the definition of data to be stored and downlinked. Tasks include using hardware interfaces between the subsystems and sending telemetry data to the OBC. Define and

implement the necessary telemetry hooks inside the OBC SDK and any other relevant software components.

Structure and optimize data handling
As part of this, study and leverage the EnduroSat data cache system: all data written into the data cache is available as telemetry within the EnduroSat software stack and should be used accordingly. Potentially configure and develop functional Micropython test scripts and schedule files for EnduroSat satellite hardware using the PyGS platform/Software-defined radio.

Jetson telemetry integration

Implement telemetry collection for the Jetson payload processor, potentially via the debug port interface. This task involves defining the interface and agreeing on the data to be collected and forwarded through the telemetry pipeline.

Documentation and Presentation:

- Prepare detailed code and documentation (e.g., Wiki pages, GitLab repositories, LaTeX documents)
- Write a thesis document in the Chair's format
- Develop a short presentation summarizing the results

Requirements

SW & Programming

- Proficiency in Python (data pipelines, scripting, embedded test scripts)
- Familiar with C/C++ with emphasis on object-oriented and embedded programming
- Familiarity with data processing libraries HDF5/h5py for telemetry dataset construction
- Experience with version control (GitLab/GitHub), CI/CD workflows, and documentation practices (Wiki, LaTeX)

HW & Systems

- Basic understanding of CubeSat subsystems and LEO operations
- Experience or coursework in electronics/embedded systems (oscilloscope, logic analyzer, I2C/SPI/UART protocols)
- Familiarity with FreeRTOS or RTOS concepts is a plus
- Experience with MicroPython or embedded scripting environments is desirable

Domain Knowledge

- Exposure to fault detection, scheduling, or control problems in spacecraft operations is advantageous

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:

- CDH & Telemetry infrastructure (dict, Micropython scripts, schedule files…)
- A comprehensive document/report in the Chair's 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

[2] S. Dolan, L. Schuberth, R. Arge, R. M. García Alarcia, V. Messina, C. J. Juan Oliver, F. Salmaso, J. Sindermann, F. S. Avogadro, and A. Golkar, "Design and Analysis of an Event Camera Payload for Space-Based Object Detection on the EventSat 6U CubeSat Mission," 15th IAA Symposium on Small Satellites for Earth System Observation, 2025. Available: https://mediatum.ub.tum.de/node?id=1833764

Supervisor

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