EventSat CubeSat Mission Requirements Definition and Traceability

Supervisor: Dr. Sydney Dolan

Background:

The EventSat mission is a 6U CubeSat technology demonstration mission that is focused on evaluating event-based cameras for space situational awareness. 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. The EventSat mission payload has two objectives, carefully selected to maximize the impact of this technology demonstration and to address key performance questions about the use of event cameras in orbit. First, the mission seeks to develop a database of space-based event camera observations. Second, the mission will identify resident space objects in the event cameras field of view using the event camera.

The planned timeline for the mission involves a preliminary design review in early fall 2025, and a CDR in spring 2026. At present, there is a need to develop the associated systems engineering for the CubeSat mission, namely the requirements definition, organization, traceability, and mapping to mission verification outcomes. This semester thesis will focus on coalescing all requirements for the EventSat mission to create a comprehensive requirements document, developing an organization system to ensure future requirements have meaningful IDs and organization, and providing an initial assessment mapping system requirements to design outcomes. This project is an excellent opportunity for students to get hands-on systems engineering experience in the context of a real CubeSat mission.

Schedule

Below is my best estimate of how the work would progress from this task description, and the first things that you would be tasked to do.

Initial Phase - Onboarding

- Reading key documents describing the stage of the design for the mission (configuration documents, interface control documents)
- Meeting team subsystem leads to discuss requirements generation status

Middle Phase - Requirements Definition

- Create organization system of all existing EventSat Requirements, assign unique identifiers and classify requirements into different types
- Create a requirements definition document
- Identify inconsistencies between subsystems, improve general requirements writing and propose new requirements

Final Phase Requirements Traceability

- Generate Requirements Traceability matrix by establishing initial traceability links that map each requirement to corresponding design artifacts

- Verify completeness and coverage of traceability of the matrix through periodic reviews with subsystem leads and automated tools

Expected Deliverables

By the end of the semester thesis, the student will have produced.

1. (Most Important) semester thesis document, that features:
    - An explanation of the recommended organization system for all requirements
    - Key takeaways and explanations of the setup of the requirements traceability document
    - Key takeaways and explanations of the requirements document
    - Future work and areas of the design that are unable to be defined at the PDR stage
2. Requirements Document
3. Requirements Traceability Document

Supervisor Expectations

General Personal Beliefs on Mentoring in a Research Setting: As a mentor, my goal is to give you tasks that are well-defined, manageable to achieve in an agreed upon timeframe, and aligned with your personal interests and overall professional development. I try very hard to give clear guidance on the things I ask for, and justification for why I am asking at all. This is so you can understand my perspective on your work and the value of every step in the research process, even the cumbersome ones. I hope to earn your trust so that you feel comfortable asking for clarification, and even pushing back on me if you have alternative ideas for how something could be done.

Meeting: I expect to meet with you at least once a week to have a formalized research update on the progress of the masters thesis. In this meeting, we will cover your of progress and key updates, discuss any challenges or resources you need from me, and set goals for what should be completed by the next meeting. I do not expect that you come to every meeting with results, but I do expect you to be able to clearly articulate what you have been working on, and what has been taking up your time so far. For our research tag-ups, I am presentation agnostic, meaning that you can use powerpoint, canva, a latex file, a word doc, a hand drawing. These meetings are also a great opportunity for you to prepare actual figures and tables of your work, which will be useful when you actually write your thesis so that the thesis writing effort is implicitly 'done' already months in advance.

Physical Location: This project requires a lot of systems engineering, which will require talking with different subsystem leads to get an updated understanding of the complete design.. As a result, there will periods during this thesis where it makes the most sense to physically be in the Chair to be able to talk with people and establish a line of communication. During those times, I expect you to physically be here to work. Otherwise, I do not have any strong preference if you find it easier to work at home, or if there are days when you would rather not make the commute. Please just communicate with me if you need a virtual meeting instead of face-to-face when we have a meeting planned.

Vacation: I trust you to manage your time appropriately. If you want to take time off, please do, just give me heads up when it is so I can make sure that there are no important deadlines near your vacation + I do not bother you when you are on break + that you are not stressed about your work on your thesis when you should be relaxing.

General Communication Expectations: Feel free to message me on Teams, by email, or to just physically get my attention when I'm working at my desk. I am a strong proponent of writing expectations down and having clearly articulated, tractable communication, so as a mentorship thing I will often be writing down my specific task requests of you for clarity.

Publishing: Publishing is not guaranteed to anyone that works at the chair. With high-quality work, and a little bit of luck, I believe it will be possible to publish the work done on this thesis if that is an active area of interest to you. If publishing is an important thing that you would like for your career, please let me know and we can identify possible publishing opportunities for you to work towards.

Ethics and LLMs: The process of research means that the fundamental questions we are seeking to answer are unknown. You may have some inherent intuition about what the answer may look like, or what solution may be the best, but the whole reason we pursue research is because we do not know for sure. I am placing a lot of trust in you to perform research ethically, meaning that the data has not been cherry-picked, and that you will explore multiple options to determine what the strengths and weakness of each. Do not manipulate results or data just to have an answer. It is fine to show up to meetings without a result, or if the answer we learn isn't that new or exciting. Similarly, on the research writing front, please do the writing yourself. Services like ChatGPT and other LLMs are nice tools, but ultimately cripple your abilities as a writer, and also hinder me from truly helping you because I'm not critiquing a thought that came from your head, I'm correcting an LLM. You will become a much stronger writer through the masters thesis process if you learn how to write the document yourself, rather than to massage an LLMs outputs into something you think I would like (I likely will not enjoy what the LLM has to say at all). If I ask you to write a formal document, please refrain from the use of LLMs.