TEAM

091

CubeSat Solar Activity Monitoring

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Introduction

Problem Statement

- **CubeSat** is a small, low-cost satellite units used for space research and monitoring.
- Solar flares and CMEs release high-energy radiation that can disrupt satellites, power grids, and communication systems.
- These space weather events also increase health risks for astronauts, pilots, and high-altitude populations.
- Earth's magnetic field and ozone layer provide limited protection during extreme solar activity.
- Current monitoring systems are costly, delayed, or difficult to use.
- A real-time, low-cost, and accessible alert system is needed to protect critical sectors from space weather threats.

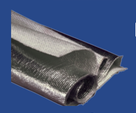
Constraints

The aim is to Develop a CubeSat to monitor space weather and deliver real-time solar activity alerts, helping industries reduce economic losses and protect human safety while considering the following.

- Development time limited to 4 months
- The total project budget should not exceed 7000 SR
- Compliance with the International Space Law and Space Qualifications
- The CubeSat total weight should be 5KG or less

Multy-layer Isolation System

Sheliding



Radiation-heat isolation

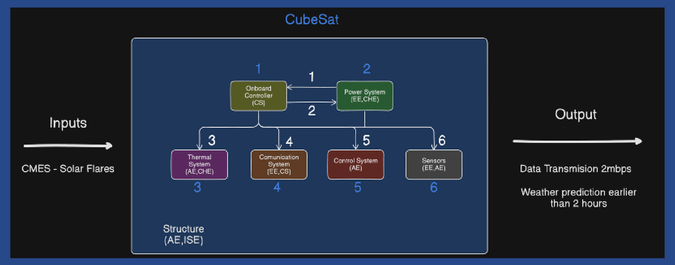
Vibration isolation

Electrical isolation

Concept

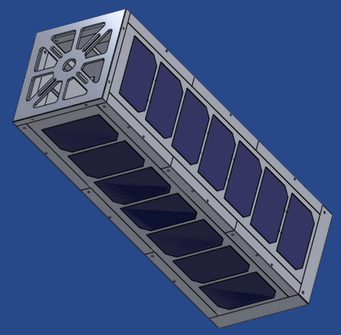
Specifications

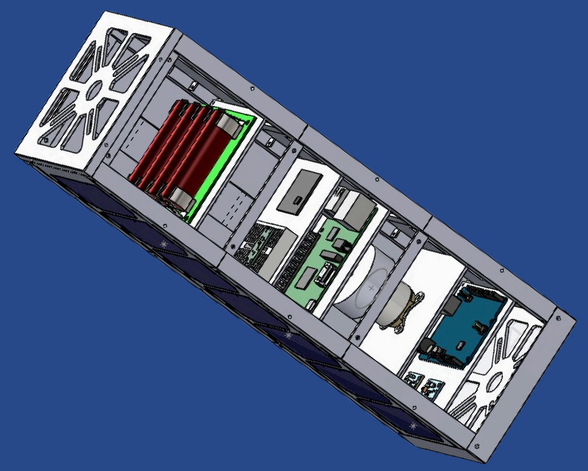
- Operating temperature range: 0°C to 50°C
- CubeSat size: 3U (10×10×30 cm)
- Battery capacity: 30 Wh (Lithium-ion)
- Mission altitude: 600–800 km
- Data transmission rate: 2 Mbps
- Solar panel output: 15 Wh
- Early warning alerts displayed on dashboard 1 hour before solar events



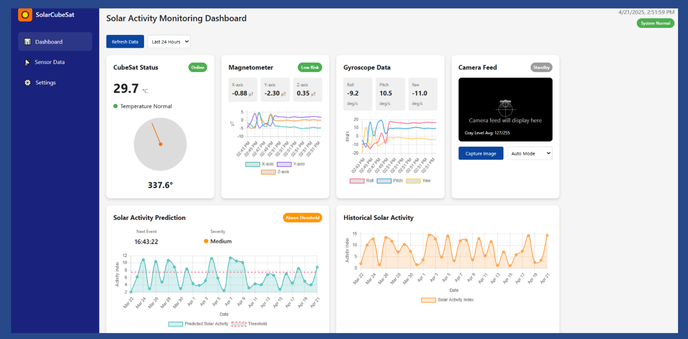
Multidisciplinary Prototype Summary

Final Prototype

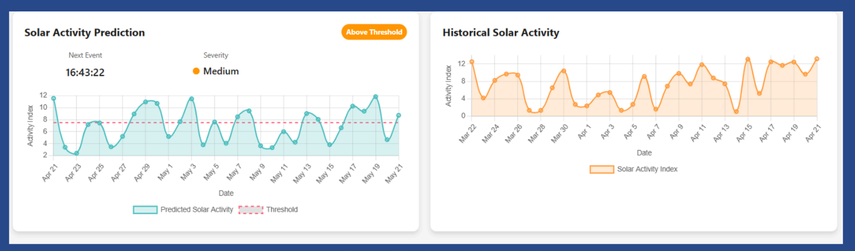




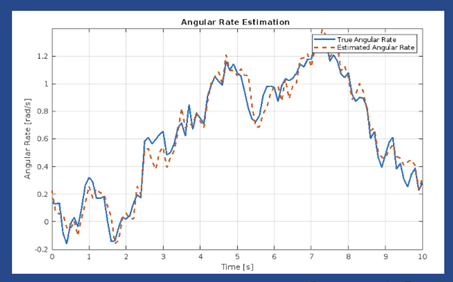
Validation and Verification

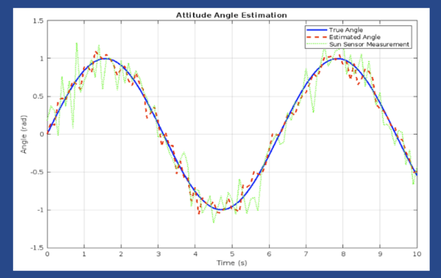


Solar Activity Dashboard



Prediction Model





Control System Simulation

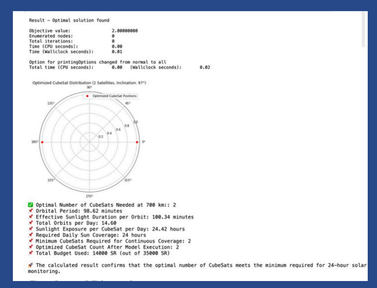
$$\min \sum_{i=1}^{N_{Max}} x_i$$

subject to:

$$7000 \times \sum_{i=1}^{N_{Max}} x_i \leq 140000 \quad \text{(Budget Constraint)}$$

$$\sum_{i=1}^{N_{Max}} T_{sun} \times x_i \geq 24 \quad \text{(Coverge Time Constraint)}$$

$$\frac{360}{\sum_{i=1}^{N_{Max}} x_i} \leq 2\theta_{deg} \quad \text{(Angular Coverage Constraint)}$$



Complete Mathmatical Formulation