SWIMSat: Science Weather and Meteor Impact Monitoring using a Low-Cost 6U CubeSat

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Presentation Outline

• Introduction to Space Hazards
  o Coronal Mass Ejections
  o Meteor Impacts
• Mission Overview
• Spacecraft Design Overview
• Challenges
• Project Future
Coronal Mass Ejections

Photo Credit: http://giphy.com/gifs/space-fire-sun-RCk2tX2HldzX2
Coronal Mass Ejections

Photo Credit: https://svs.gsfc.nasa.gov/11660
Meteor Impacts

Chelyabinsk, 2013
Meteor Impacts

SWIMsat Network Goals

- Meteor flux and distribution
- Publicly released data

Bolide Events 1994–2013
(Small Asteroids that Disintegrated in Earth’s Atmosphere)

Goals

Dedicated satellite network for space hazards:
- Real-time monitoring
- Provide alerts/warnings
- Forecasting*

*Provide minutes to hours forewarning
Mission Overview

- Low-cost 6U (36 x 24 x 12 cm) CubeSat
- Near continuous, autonomous monitoring
- Geostationary Orbit (GEO)
- 2 year mission
Mission Success

Success Criteria

– Successful detection of an M class solar flare event

Image Credit: NASA/ESA
Success Criteria

– Successful detection of at least one 0.1 kT or larger airburst

SWIMSat Spacecraft

Design

– Typical 6U bus/components
– Instruments
  1) Coronagraph
  2) Meteor camera
SWIMSat Spacecraft
Hardware Architecture

- Tyvak Intrepid Watchdog Set #1
- Tyvak Intrepid CD&H #1
- Tyvak Intrepid Watchdog Set #2
- Tyvak Intrepid CD&H #2
- Spacecraft Main Computer System
- Mirrored Data Storage
- 32 GB SD Flash Card
- Spacecraft Peripheral Computer System
- Space Micro CSP Peripheral Computer #1
- Space Micro CSP Peripheral Computer #2
- X-band Radio
- XACT Attitude Control & Determination
- Meteor Monitoring
- Solar Coronagraph
- Thermal Management
- Propulsion + Attitude Thrusters Cold Gas
- Solar Panel Gimbaling
On Board Algorithm
SWIMsat Conops

1. Deploy into GEO
   - L + 12 hrs

2. Calibrate Instruments
   - L + 15 days

3. Start Data Gathering
   - L + 45 days

4. Enter GEO Disposal Orbit
   - L + 770 days
<table>
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<th>Mission</th>
<th>SWIMSat</th>
<th>MSat</th>
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<tbody>
<tr>
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<td>6U</td>
<td>3U</td>
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<td>Number of Sats</td>
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<td>Propulsion</td>
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Challenges

• Low TRL
• Operation in GEO
• In-house development
• Meteor detection algorithm
Autonomy

• Space hazards are rare, but critical to detect
• Not feasible to perform continuous monitoring by humans
• Onboard autonomous algorithm for continuous monitoring/tracking
• Images and video of event transmit to ground
Next Steps

• Viability of prototype CubeSat for space hazard monitoring
• Coverage vs. altitude vs. launch opportunities
Next Steps

SWIMsat Mission Schedule

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<tr>
<th>Phase</th>
<th>Duration</th>
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Acknowledgements

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References

1. http://www.nasa.gov/content/goddard/the-difference-between-flares-and-cmes
THANK YOU!!!