Aerospace Experiential Component Summary

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Overview

For my Aerospace Concentration Experiential Component I designed a satellite constellation for a Space Solar Power Competition (SSPC) organized by Space Canada. My work for this competition qualified for SSPC finals held in Milan Italy at the International Aeronautical Congress (IAC). The prize for qualifying to finals also included free attendance to the Space Generation Congress (SGC).

In this presentation I will describe my submission to the SSPC, my experiences at the SGC and IAC, as well as explain how this experience enriched my learning in aerospace engineering.

Part 1:

Space Solar Power Competition (SSPC)

My Contributions

The theme of the SSPC was open-ended: all innovative and unconventional ideas that explored potential uses of space solar power were welcome. My team developed a space-based solar power satellite constellation to supply power to the surface of the moon, allowing longer lunar Extravehicular Activities (EVAs) and power for lunar exploration architectures.

My contributions to the project included designing a satellite constellation; determining the number of planes, satellites, and constellation parameters, and providing justifications for each choice. I analyzed the constellation using MATLAB's R2024a Lunar Orbital Propagation tool along with the aerospace and mapping toolboxes. I also designed the satellite components—such as the laser, battery, cooling system, solar panels, and focusing system—to ensure they interact effectively within the larger system. Additionally, I calculated the power delivered using LPT and created MATLAB figures to visually represent the constellation.

Link to Competition Finals Acceptance Letter
Link to Competition Information

My Team Pictured from Left to Right:
Anna Tretiakova, Madelyn Hoying, Vanessa Chen

Skills and Learning

Before this project, I had no prior experience with orbital mechanics or satellites. To design the constellation, I had to do extensive learning on Earth-based satellite constellations. After designing the constellation, I learned to use MATLAB Simulink to create the images shown on the left. Using the MATLAB results, I then calculated the theoretical power delivery to various points on the Moon.

More technical details can be found in the paper linked at the end of this presentation.

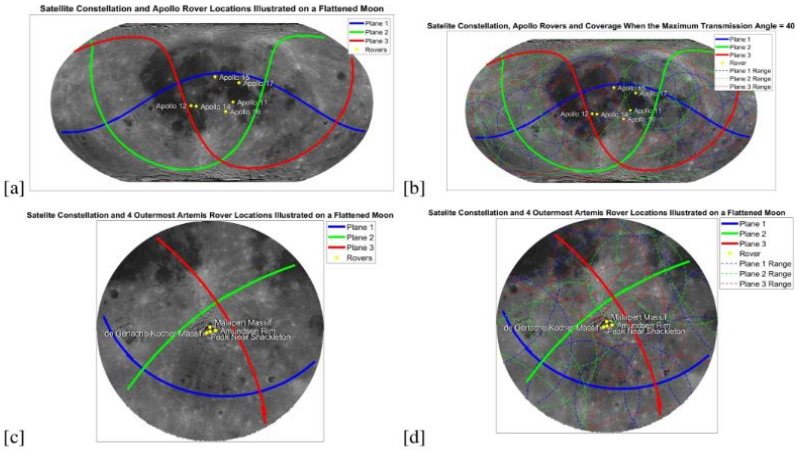


Fig. 3. Apollo (a, b) and Artemis (c, d) landing site coverage with the proposed constellation. [b] and [d] illustrate the satellite coverage when the transmission angle is 40 degrees.

	Percent of Time Spent Over Top of Location					
Apollo Location	Plane 1	Plane 2	Plane 3	All Planes	Overlap?	Total Power (kW)
Apollo 11	0.150	0.154	0.000	0.304	no	38.8
Apollo 16	0.048	0.144	0.100	0.291	no	31.400
Apollo 12	0.154	0.000	0.207	0.361	no	39.000
Apollo 17	0.206	0.159	0.000	0.365	no	39.400
Artemis Location	Plane 1	Plane 2	Plane 3	All Planes	Overlap?	Total Power (kW)
Malapert Massif	0.000	0.185	0.185	0.370	yes	40.000
Peak of Shackleton	0.000	0.185	0.185	0.370	yes	40.000
Amundsen Rim	0.000	0.167	0.189	0.356	yes	38.400
de Gerlache-Kocher Massif	0.000	0.185	0.189	0.337	yes	36.800

Fig. 5. Summary of the total power delivered to the representative receiver locations and the percentage of time spent in the receiver cone over the location, out of each two-hour orbital cycle.

Part 2:

Space Generation Congress (SGC)

What the is the SGC?

The Space Generation Congress (SGC) is an annual conference organized by the Space Generation Advisory Council for young professionals and students interested in space. Held just before the International Astronautical Congress (IAC), it brings together future leaders to discuss key issues in the space sector, collaborate on projects, and network with industry experts, fostering the next generation of space professionals.

This year, the main theme of the SGC was Space Sustainability. I attended thanks to the Space Solar Power Competition scholarship, which covered my participation.

Link to Learn More About SGC

Scholarship award ceremony
(I am third from the left)

Activities - Working Group

At the Space Generation Congress (SGC), attendees participate in working groups, which are collaborative sessions focused on specific themes or challenges in the space sector. Each group learns about their specific topic through guest speakers and then develops space policy recommendations. I was part of Working Group #4 organized by the European Space Agency (ESA). The main topic of this working group was satellite data management.

We discussed questions like:

- What laws and regulations should govern Earth Observation (EO)?
- How can EO satellites and space technologies help solve societal challenges?
- How can public-private partnerships and commercial funding connect space innovation to real-world benefits?

My Working Group #4
(I am third from top right)

Activities - Working Group (continued)

Some space policy recommendations we came up with:

- Reassess decision-making frameworks for EO to evaluate when space-based sensors can complement ground-based ones, and strengthen partnerships between the space sector, other industries, and academia for data fusion in decision-making.
- Encourage the space sector to bridge gaps between publicly and commercially available EO data, and develop AI and machine learning techniques like pattern recognition and data fusion.
- Establish a Unified Data Library through ESA to organize open-source satellite imagery data.

As someone with no prior experience in policy work, it was interesting to participate in these discussions and help develop policies for complex, uncharted issues.

My Working Group #4
(I am third from top right)

Activities - Learning & Networking

The SGC also hosted panels, company presentations, and small group discussions with experts and young professionals in the space field.
Companies and Space Agencies that spoke at the event:

- Vast: a company that is building innovative space stations.
- HEO: company that specializes in non-earth imaging
- The UK Space Agency
- European Space Agency

Having mostly worked with NASA in the space industry, I found it interesting to hear perspectives from other space agencies and the work they are doing. Participating in this event informed me of potential career path to pursue after undergrad, which has been incredibly valuable as my senior year approaches.

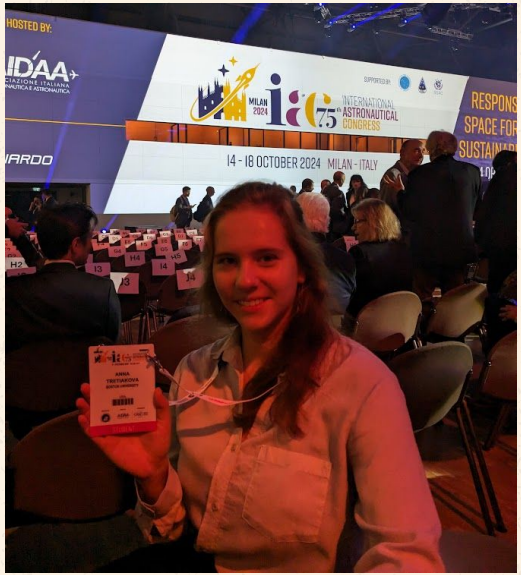
Photo from SGC instagram during a networking event
(I am in the top right corner)

Part 3:

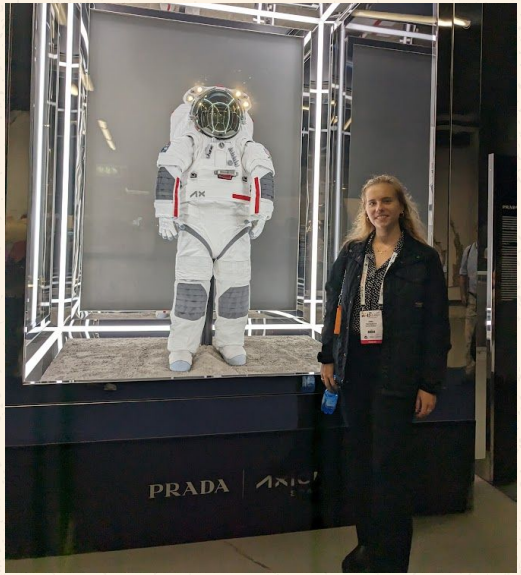
International Aeronautical Congress (IAC)

Conference Experience

Attending the conference was both educational and inspiring. I had the unique opportunity to engage directly with leading space companies, gaining understanding of their work and potential career paths. The academic talks broadened my understanding of recent advancements and challenges in the space industry, while conversations with actual astronauts were particularly impactful; hearing their personal journeys to space fueled my own ambition and passion for the field. This experience provided rare, well-rounded perspectives on the many ways I could contribute to the future of the aerospace industry.



Myself at the IAC opening ceremony



The prada astronaut suit display

Presentation

My work was presented as an interactive presentation. My team and I had 10 minutes to briefly explain our project and answer questions from judges and other spectators. Presenting research in such a formal setting for the first time was incredibly educational, as it allowed me to get feedback on my eight months of work from professionals who have been in the field for over 20 years. Furthermore, I watched the presentations of the competitor teams and asked questions about their projects.

It was incredibly fulfilling to engage in discussions about such a niche topic with others who share the same passion.

Please note that I no longer have access to the interactive presentation. All the information that was on it is identical to what is published in the paper.

My teammate and I presenting to the judges and other attendees of the conference

Part 4:

Funding: Provost Scholars Award

2024 Provost Scholarship Recipient

The Provost's Scholars Awards recognizes outstanding students in their first two years of college who show intellectual curiosity, a willingness to take risks, and a commitment to scholarly growth. Each year, up to 20 students receive a $1,000 award to support research or creative projects, covering expenses like conference travel or research supplies. Recipients are chosen in the spring and honored at the Provost's Academic Awards Ceremony during Family & Friends Weekend in October. The awards are administered through the Undergraduate Research Opportunity Program (UROP).

I used the received funds to pay for my plane tickets and conference registration. Pictured on the right is myself at the Provost's Academic Awards Ceremony getting acknowledged for receiving this award.

Link to the Acceptance Letter

Myself at the Provost's Academic Awards Ceremony

Final Links

Link To Paper Full Text

Link to Researchgate Publication