Autonomous Satellite Launch and Assembly (SATLASS)

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Abstract

The project examines the development of an attachable space station module, Autonomous Satellite Launch and Assembly SATLASS), in order to assemble and deploy customizable CubeSats in orbit. The conceptual design was optimized using quantitative and qualitative methods to ensure compatibility with modern technology and overall cost-effectiveness. Consequently, it was determined that SATLASS's structure would be an expandable module with compound aromatic-polyamide reinforced bladder and androgynous International Berthing and Docking Mechanism (IBDM) ports which will achieve full axial expansion in five stages. Furthermore, it was established that CubeSat's electronics and payload will be assembled using a robotic arm while a 3D printer will manufacture standardized frames and a Nanoracks CubeSat Deployer (NRCSD) will operate the deployment of the satellites. Finally, the report identifies future areas of research, such as software requirements, communication, operations, and cost and acknowledges key issues with the current design that needs to be addressed to accomplish a comprehensible SATLASS design. Currently, the report is in its first draft with a revision session to be taking place within April 2022.

Design Process

Throughout the research and design process, the team found various options for each primary hardware component of the module. The following logistics were considered in the selection of each part:

- If the component has been tested in space previously
- The durability of the component
- Which option would be the most time efficient during CubeSat manufacture

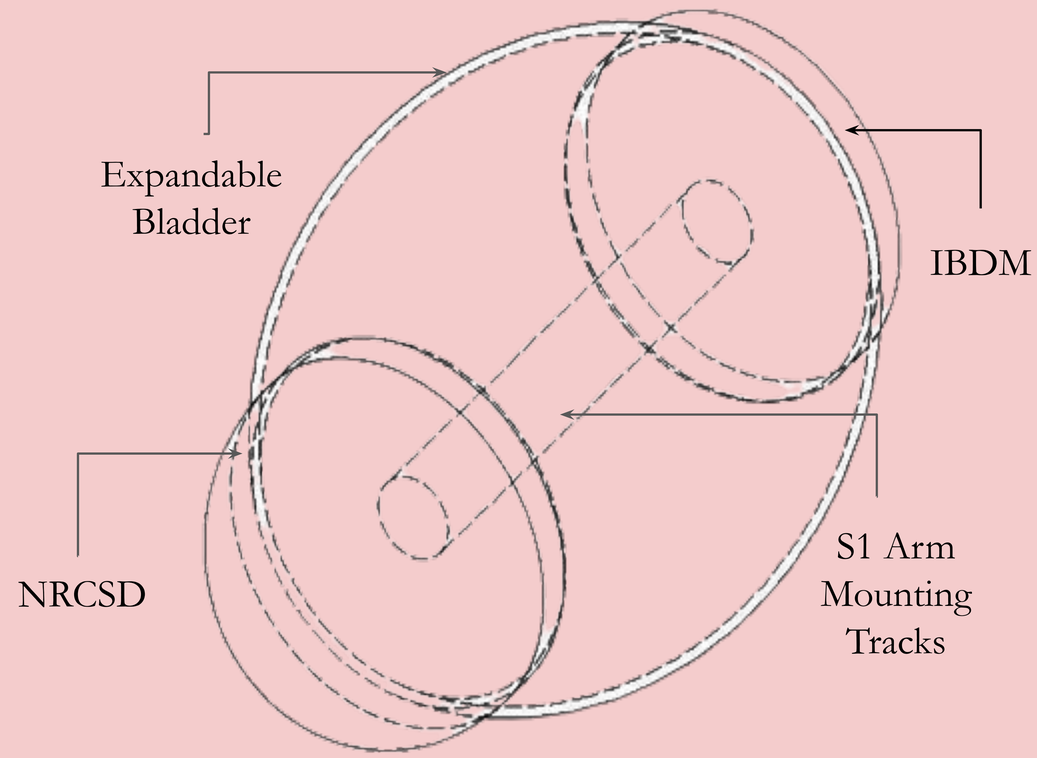
Finalized components

- Expandable Module - compound aromatic-polyamide reinforced bladder
- The International Berthing and Docking Mechanism (IBDM)
- Nanoracks Bishop Airlocks
- Five steps to full axial expansion
- Made In Space 3D printer
- GITAI S1 8+1 DOF Robotic Arm

Conclusion

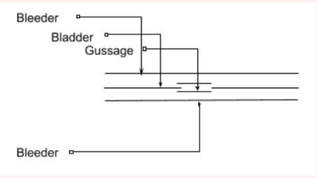
SATLASS's team focused on engineering the internal and external structure of a space station module, therefore, the current version of this design does not acknowledge some major components that are vital to the development of a fully autonomous Cubesat manufacturing facility in orbit. Primarily, the design does not take into account any operational requirements of the module, such as industrial waste management, electric power supply, internal and external communication systems, cargo resupplying ability, autonomous and human-control functionalities and maintenance of the pressurized environment. Furthermore, analysis of precautionary measures to isolate the module from the station in case of emergency needs to be considered in future iterations. A fully developed design would consider communication between the ground and the module, along with fiscal analysis as to the total expense for such an endeavor. Moreover, the 3-D printers and robotic arms chosen must be tested extensively to ensure that they work within the context of the module design. This project has aided in our understanding of space station design, and allowed for extensive research on the various components needed to ensure a functioning space facility. An insight into systems engineering design was gained as the team attempted to arrange different components to ensure that they all worked well to accomplish the project's goal.

Manufacture **cubesats in-orbit** for a **fraction** of the **current cost** and in **less** than **30 days**

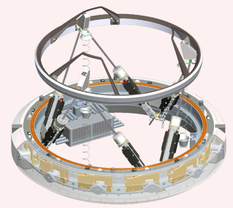


Scan to see SATLASS components at work and more

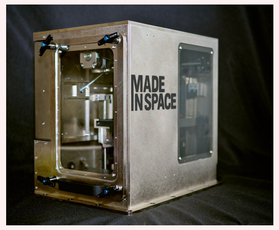
Module Bladder Design



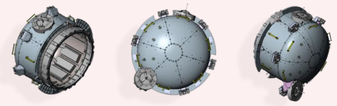
IBDM



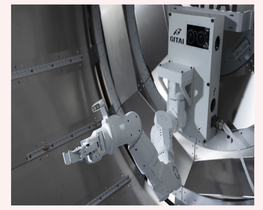
Zero-g printer



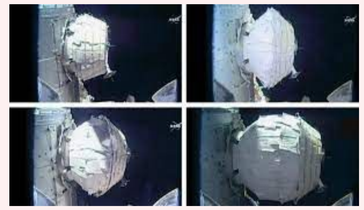
Nanoracks Bishop Airlock Module



S1 Robotic Arm



Deployment Method



Sources

[1]*NanoRacks*. 2022. [Online]. Available: https://nanoracks.com/wp-content/uploads/Bishop-Overview-Configuration.jpg

[2]"Redirect Notice," *Google.com*, 2014. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.esa.int%2FESA_Multimedia%2FImages%2F2014%2F06%2FBerthing_and_Docking_Mechanism&psig=AOvVaw3DR47uRbeECgX3j5YJUWzR&ust=1648938906569000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCJjr06r28_YCFQAAAAAdAAAAABAO (accessed Apr. 07, 2022).

[3]"S1 | GITAI," *GITAI*, Jun. 08, 2020. https://gitai.tech/en/product/s1/

[4]M. Johnston, M. Werkheiser, K. Cooper, M. Snyder, and J. Edmunson, "3D Printing In Zero-G ISS Technology Demonstration," Apr. 2012. Accessed: Apr. 07, 2022. [Online]. Available:ntrs.nasa.gov/api/citations/20140012888/downloads/20140012888.pdf

[5]"Demonstrating Technologies For Deep Space Habitation Bigelow Expandable Activity Module (BEAM)," 2016. [Online]. Available: https://www.nasa.gov/sites/default/files/atoms/files/2016-march-beam-factsheet-508.pdf

[6]"Basic Concepts and Processes for First-Time CubeSat Developers NASA CubeSat Launch Initiative." [Online]. Available: https://www.nasa.gov/sites/default/files/atoms/files/nasa_csli_cubesat_101_508.pdf