Winter 2024

IAF SPACE HABITATS COMMITTEE (SHC)

Introduction

The Space Habitats Committee (SHC) aims, in co-operation with other IAF committees and symposia, to foster the importance of building an international and interdisciplinary understanding of the issues and stakes raised by future space habitats (e.g., settlements on celestial bodies and orbital infrastructures)..

Summary

The field of human spaceflight remains full of daily breakthroughs (Artemis 2, Denmark's current mission aboard the ISS, crucial longburn of Arian 6, new astronaut assignments by the Canadian Space Agency, etc.). The field of space architecture equally demonstrates developments to support future crewed missions beyond the Low Earth Orbit - be it forthcoming plans for additional modules to China's Tiangong space station, the building of commercial space stations by Axiom Space and Blue Origin, or the expected applications of NASA's Artemis program for lunar and Martian missions.

Highlights

NASA'sArtemis program aims at establishing sustainable lunar human presence. This initiative involves the development of new technologies and architectural concepts for lunar habitats.

DLR's Eden project continues development work and has conducted fluid dynamics calculations for the Air Management System of the foreseen ground test demonstrator (GTD). The previously tested prototype EDEN ISS MTF has returned to Germany and is now refurbished for operation at ESA's Luna Test Facility.

Private companies like Axiom Space and Blue Origin have plans to build commercial space stations, offering opportunities for commercial research, tourism, and other activities. These ventures may drive innovation in space habitat technology.

All agencies work on advancements in ISRU (In-Situ Resources Utilization) technologies, which are crucial for space architecture. It involves using local resources, such as extracting water from lunar soil or ice, for life support and construction.

Future Outlook

Among many directions that are currently being explored within the community:

- EDEN will become a joint initiative with the Canadian Space Agency, contributing prominently in the GTD development, starting with a design study in early 2024.
- The growth of space tourism and commercial ventures is expected to stimulate the development of space habitats designed for short-term stays. Companies like Virgin Galactic and SpaceX are leading the way in this regard.
- Research into novel construction techniques, such as 3D printing and in-situ resource utilization, will likely continue. These methods could help reduce the cost and complexity of space habitat construction.
- Research into advanced materials suitable for space environments, including radiation resistant materials and those capable of withstanding extreme temperature variations, will likely be a key area of exploration for the upcoming years.
- Emphasis on human-centric design principles will likely grow, focusing on creating living spaces that support the physical and mental health of astronauts. This includes considerations for lighting, ergonomics, and recreational spaces.

Committee activities

The Committee will keep organizing its yearly webinar (usually in January) to help SHC members connect and share ideas between the IAC and the Spring Meetings. After the successful publication of its 2023 article in ROOM magazine, the Committee will also explore other platforms to publish a 2024 research paper featuring projects developed by SHC members. Committee members are gearing up for the 2024 IAC in Milan, including by organizing side events in space art, architecturen and design to facilitate networking and inspiration.

All Committee members are working on exciting projects that aim at advancing innovation and feasibility in the field of space habitats. This edition of the Committee Brief highlights the following project: TERRA LUNARIS.

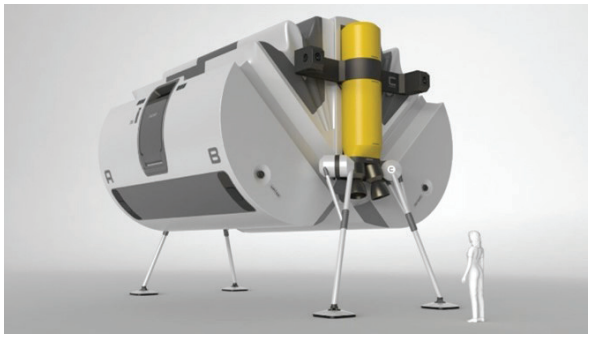

Image 01: Inflating Procedure.
Credits: Dirk Schumann, Schumanndesign.

"TERRA LUNARIS: concept for a lunar habitat", developed by Schumanndesign – Terra Lunaris is a study for a lunar habitat using non-flexible construction elements, inflatable outer shell structures and variable elements for subdividing the interior of the habitat to make it properly functional and utilizable. The habitat is designed for deployment on the moon's surface, which enables a much less massive and more lightweight construction as the effect of gravity on the moon is far less than on earth, namely by a factor of 6. The concept enables a minimalized transport volume to be transformed into a utilizable volume that is many times greater, thanks to an automated configuration process conducted at the final deployment location. A core element of the habitat is the solid framework structure, together with the engine segments located externally on each side and comprising the fuel tanks needed for operation of the braking thrusters for the descent onto the moon's surface and, in the upper part of the segments, thrusters for correcting the trim during landing. The second key aspect of the concept is the possibility to avoid the need to equip the large utilizable space of the module retrospectively by bringing in the required interior elements from outside, but instead to already include 90% of these interior elements in the initial configuration and then simply take them into operation through straightforward, mostly manual work procedures.

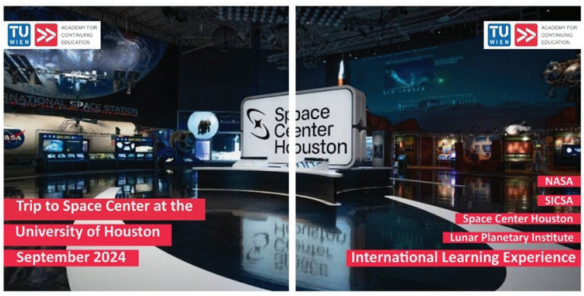

Image 02: EVAs. Cooperative International Workshop for Advances Space Architecture, September 2024.
Credits: TU Wien.

Another interesting collaborative international design initiative is the collaborative workshop between two major educational partners SICSA University of Houston, and TU Wien, EMBA for Space Architecture program. Sharing expertise and resources will accelerate progress in the field of space architecture.