

IGLUNA

A habitat in ice

17 June –

3 July 2019

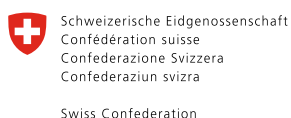
Discover the 20
team projects

Zermatt

Glacier Palace → 9:30-16:00

Vernissage → 17:00-23:00

C. Loretz





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The Field Campaign of the student demonstrator Moon Habitat takes place from 17 June until 3 July in Zermatt

From 17 June until 3 July, all the IGLUNA project teams will gather in Zermatt to demonstrate the results of their one-year commitment to designing a potential and sustainable Moon habitat. The twenty projects will be split up into two locations: in the Glacier Palace of the Matterhorn glacier paradise and at the Vernissage Art Gallery of the Backstage Hotel.

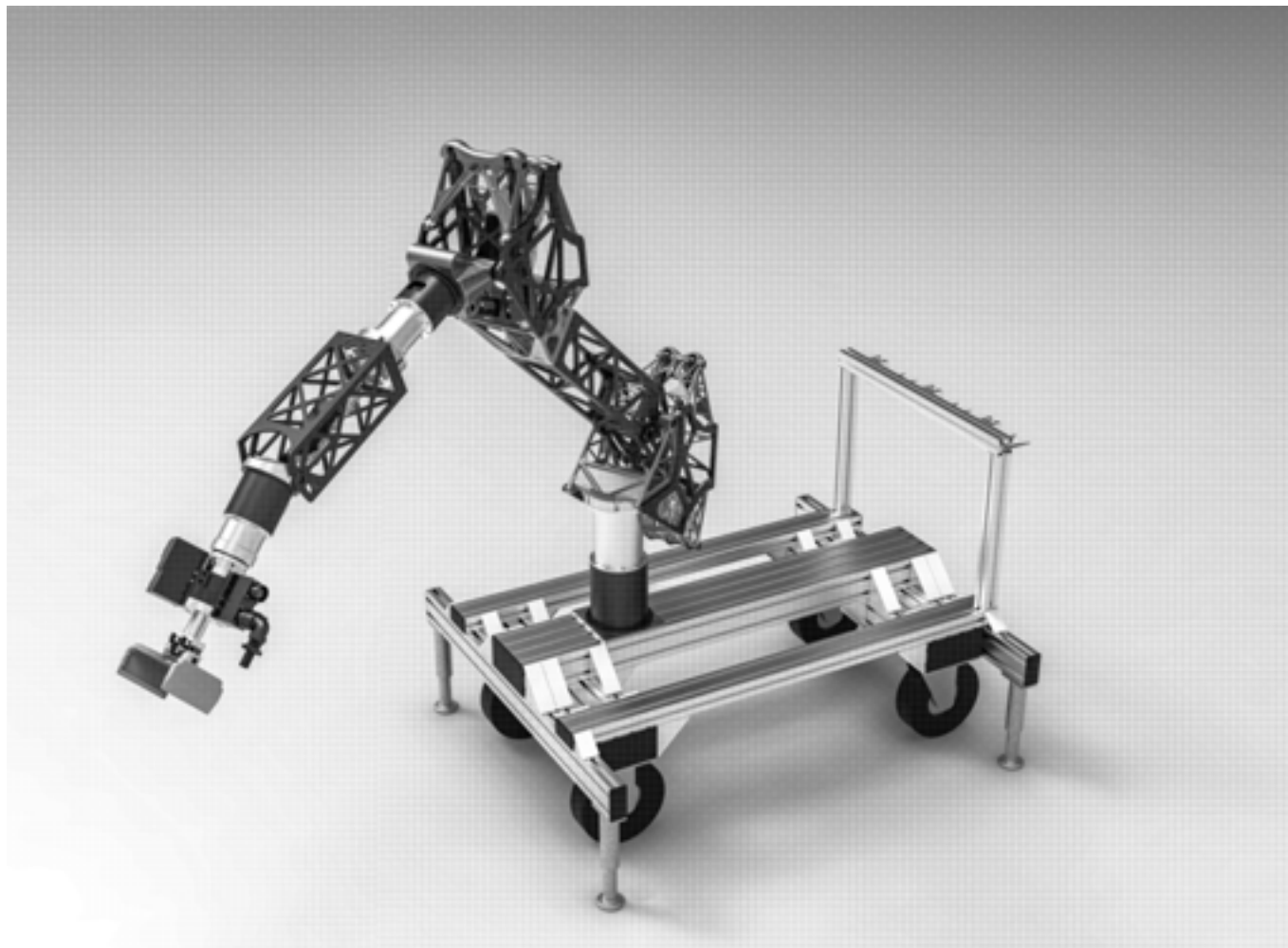
During this past academic year, more than 150 students from 9 European countries and from several faculties have gathered their knowledge to design a habitat potentially suitable for extreme environment, such as on the Moon. They needed to study and cover the essential aspects to sustain life in a long-term vision: structure and construction of the habitat, life support (as oxygen or food), power management, communication and navigation, human well-being and science. Each team could thus contribute to this Moon habitat, whatever their expertise.

One part of the projects will be tested at the Glacier Palace, such as the construction robot and the food and oxygen production. The other projects, as the virtual reality and the lunar habitation design, will demonstrate their concept at the Vernissage Art Gallery.

During the first week (17 – 24 June), the students will set up their projects. All the IGLUNA modules will be fully assembled by Monday 24 June. After a week trial and demonstrations, the teams will dismantle their design during the last three days (1 – 3 July). However, visitors are allowed to visit the teams at any time in order to discover the several steps for the complete installation of a habitat in an extreme environment.

The Field Campaign is also an occasion that will gather many other scientific and space related projects. We are glad to host other experiments as the Radiation Monitoring from CERN and the MIT HYDRA Drill experiment. Interactive activities are also organised to make this knowledge accessible to all publics. IGLUNA consists of the following projects, which will be present at the field campaign from 17 June until 3 July 2019.



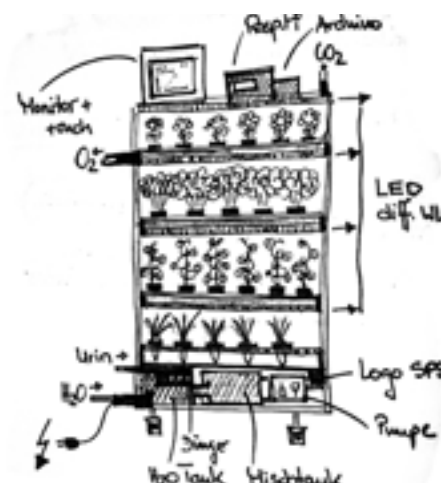


Construction robot (CHIRON)

Robotic arm that has interchangeable tools to cut out ice blocks and build a wall with them.

Topic Conception & Structure

About A mobile robotic system, which is equipped with a robotic arm and which carries a set of autonomously interchangeable tools. The robot should be able to complete the process of cutting out ice-blocks and placing them to build a wall on its own.

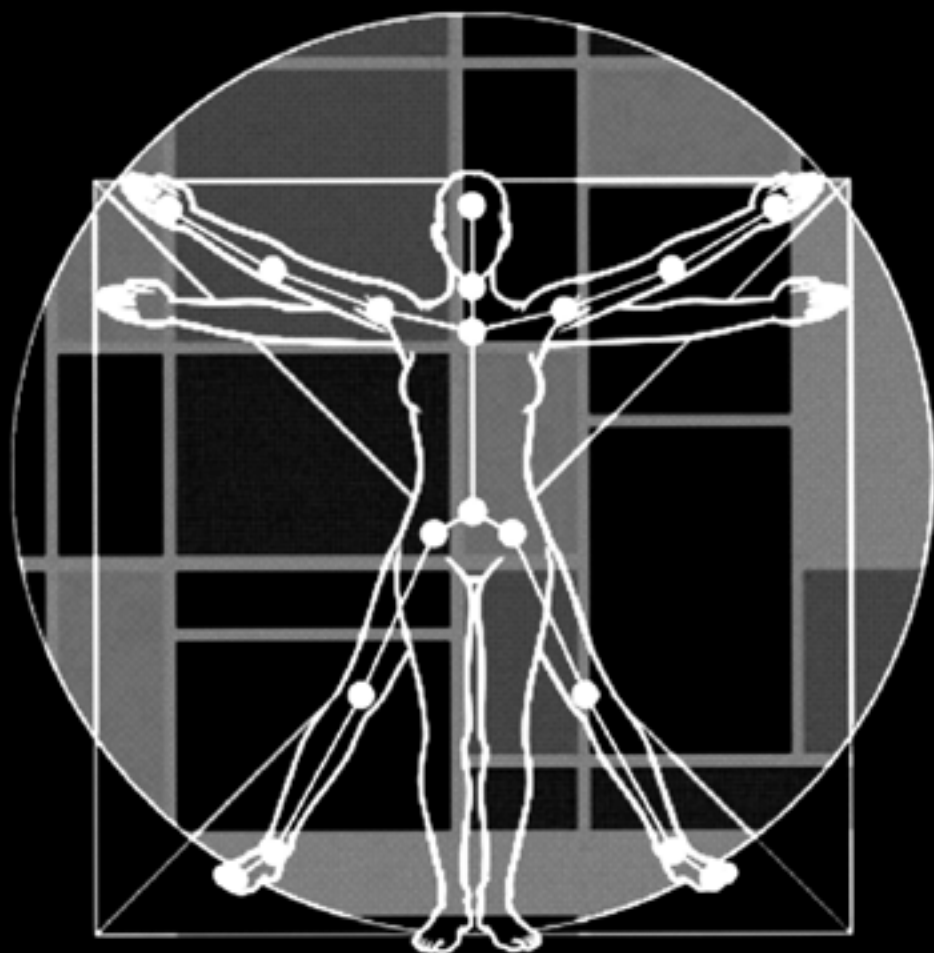


Smart Waste-based Agriculture Growing System (SWAG-System)

Optimized closed agricultural growing system for a lunar habitat that uses human waste as nutritional input integrated with hydroponic and lunar soil-based agricultural systems.

Topic Life Support

About A closed agricultural growing system that only uses human waste materials as nutritional (urine, org. waste) input. Both a hydroponic system and a lunar soil-based agricultural system are integrated. A closed loop for water, nutrients and essential (trace) elements. A smart monitoring system will control the whole growing process, optimize all important parameters and inform the lunar habitants about growing status.



Sociokinetic analysis for the optimization of habitats in extreme environments

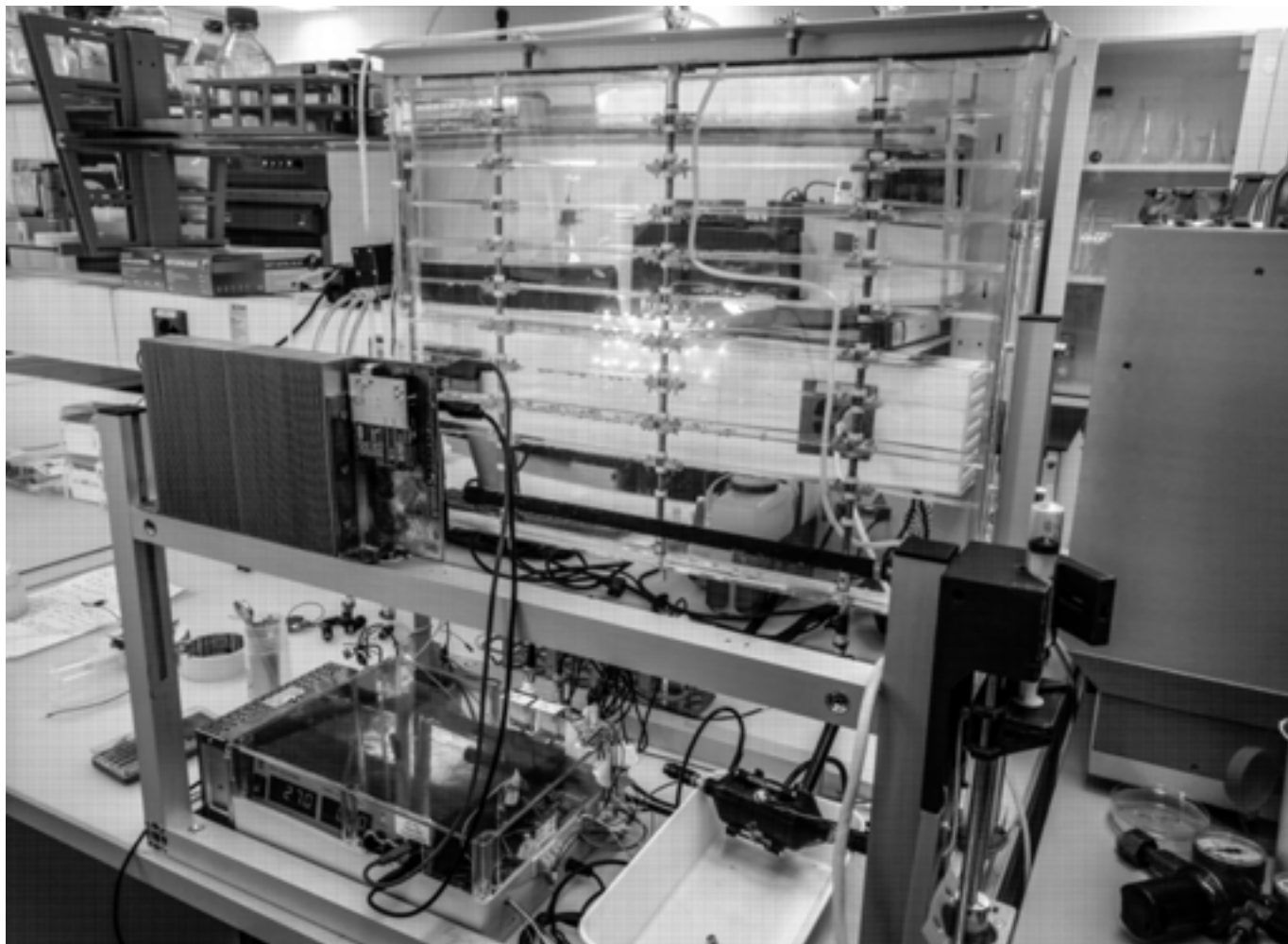
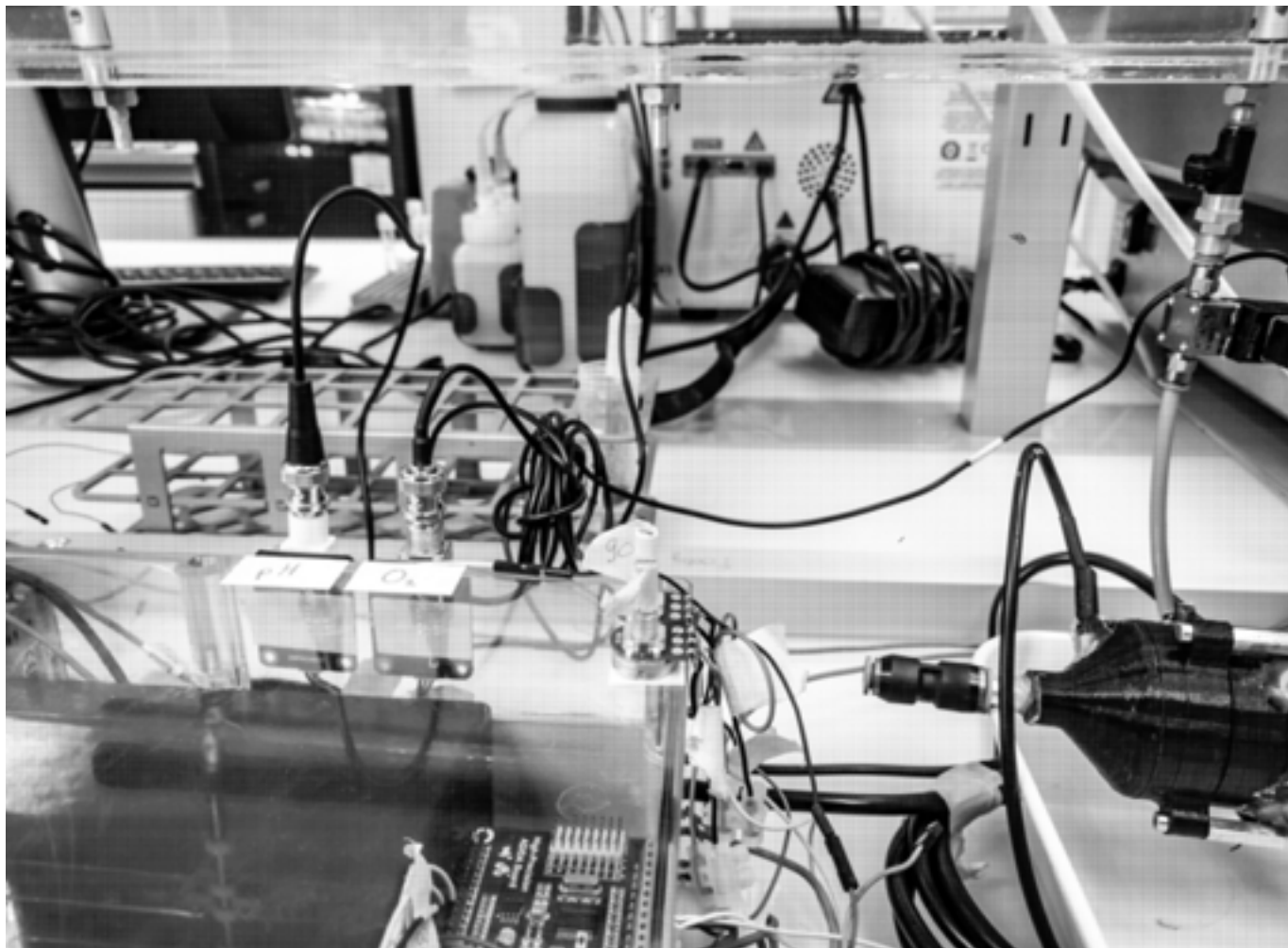
Tracking of people with multi-camera motion capture algorithms inside the habitat to establish the relationship between humans and the built environment.

Topic Conception & Structure

About “ISA” is an Innovative Sociokinetic Analysis which implements video-based motion capture algorithms. It helps to study the human movements within the habitat in extreme environments.

The goal of ISA is to provide solutions on how to improve the design of the habitat and the safety of its occupants in extreme and hostile environments. During the Field Campaign in Zermatt, the team P03 will install several cameras in the IGLUNA habitat.

Finally, after the algorithms implementation and statistical data analysis, general recommendations for improving the habitat design and occupancy will be given.



Algal bioreactor

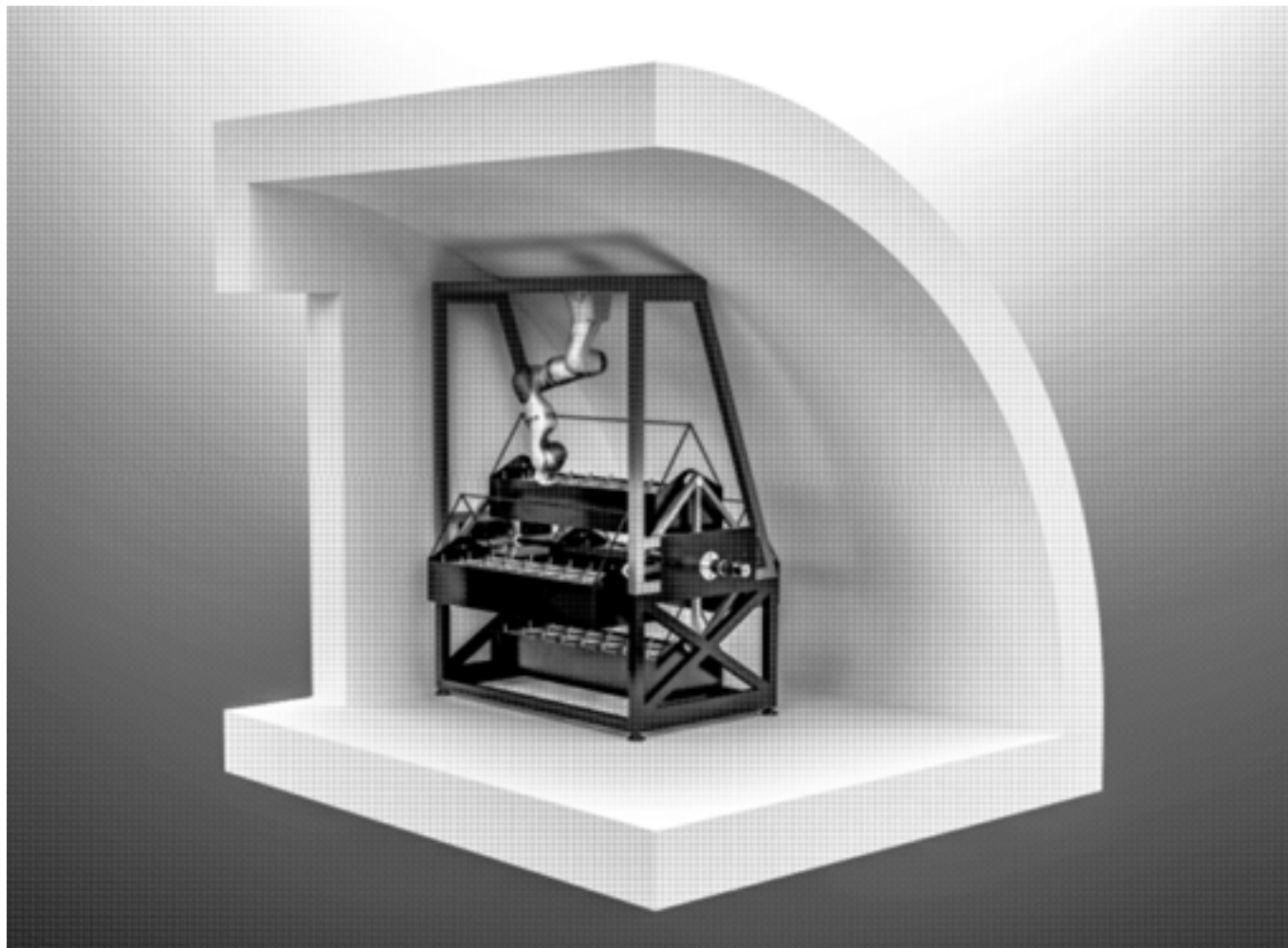
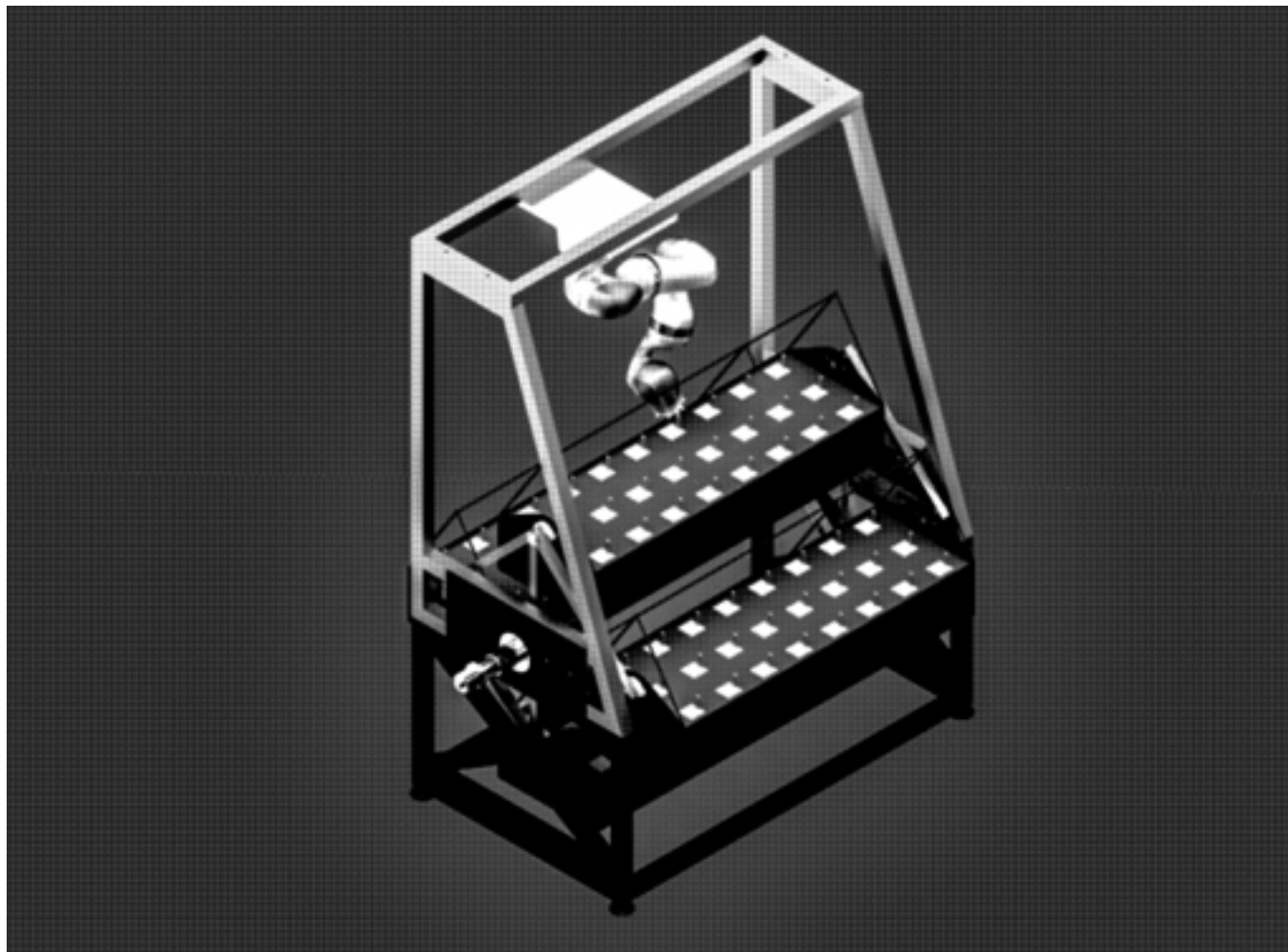
Bioreactor for cultivating algae and producing oxygen.

Topic Life Support

About A simple but robust bioreactor with high surface-to-volume ratio, is ideal for cultivating algae and producing oxygen. The system utilizes modular design, is flexible in various operating conditions and have the potential for future scale-up for a space habitat.

HSLU
Lucerne, Switzerland





GrowbotHub

Aeroponic and lunar soil system (SWAG).

Topic Life Support

About An automated structure hosting the aeroponic and lunar soil system by SWAG and minimising human effort. The plants grow on shelves that move to the Growbot when ready to be consumed, which is determined through image processing. The Growbot picks up the plant in its pot, empties out the vegetable and replaces it by a new pot. The astronauts can come retrieve the fresh produce directly from the GrowbotHub.

University of Lausanne and EPFL
Lausanne, Switzerland

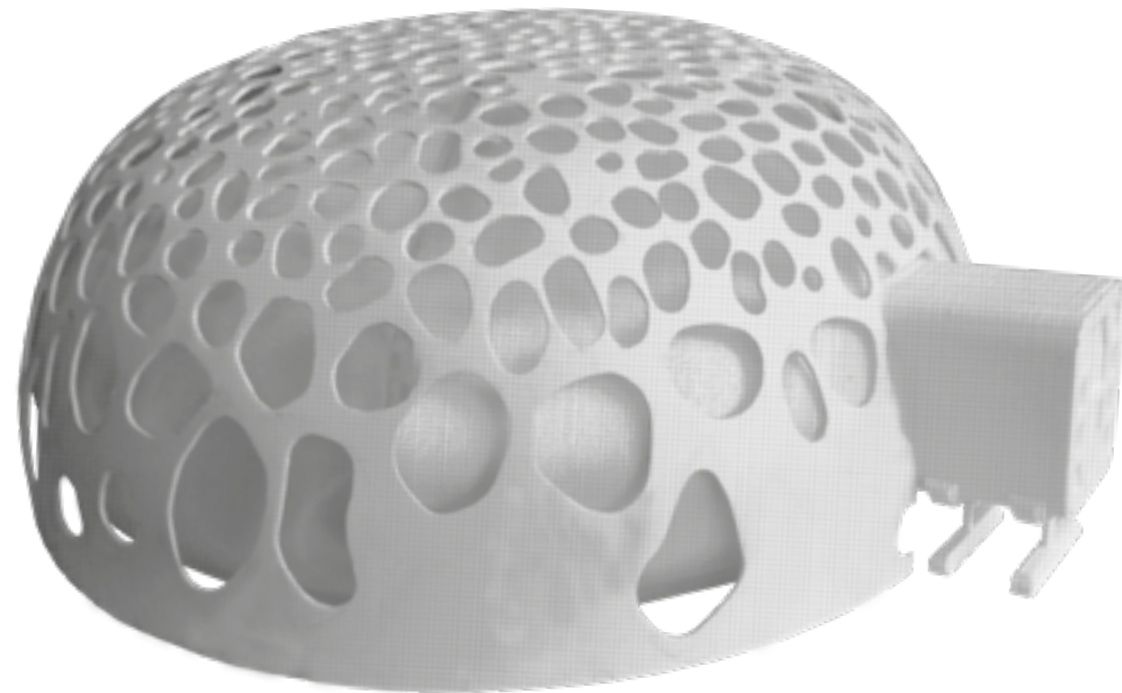
Habitat concept in lunar lava-tube (MOONY)

Moon habitat design, placed under the lunar surface, exploring logistic, human and environmental requirements participating in a Lunar mission scenario.

Topic Conception & structure

About An inflatable and modular habitat where the design of the environment and different assets aims to foster the best psychophysiological conditions for the inhabitants. It is set-up in a lava-tube on the Moon's North Pole, assuring protection from radiations, meteorites and highly variable temperatures, and ice's proximity.

Politecnico di Milano
Milan, Italy





P07

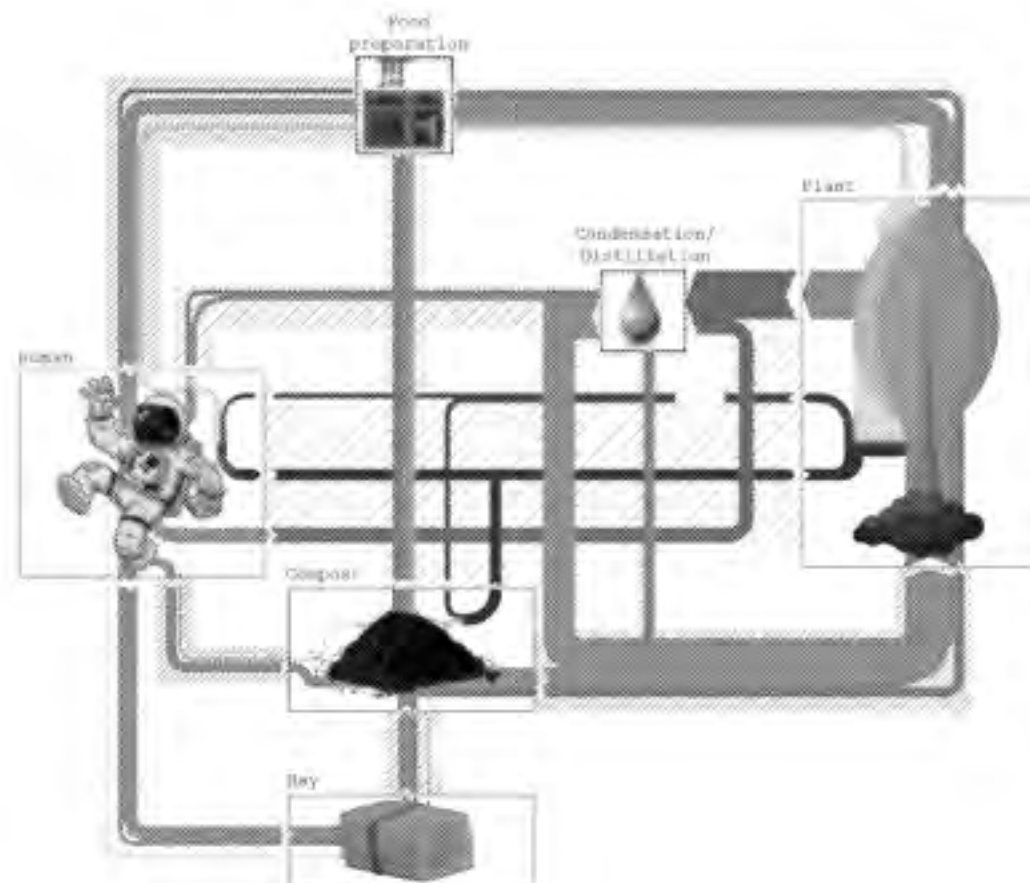
Bricks Arch Structure for Ingenious Construction (BASIC)

Insulated shelter construction and life support system design.

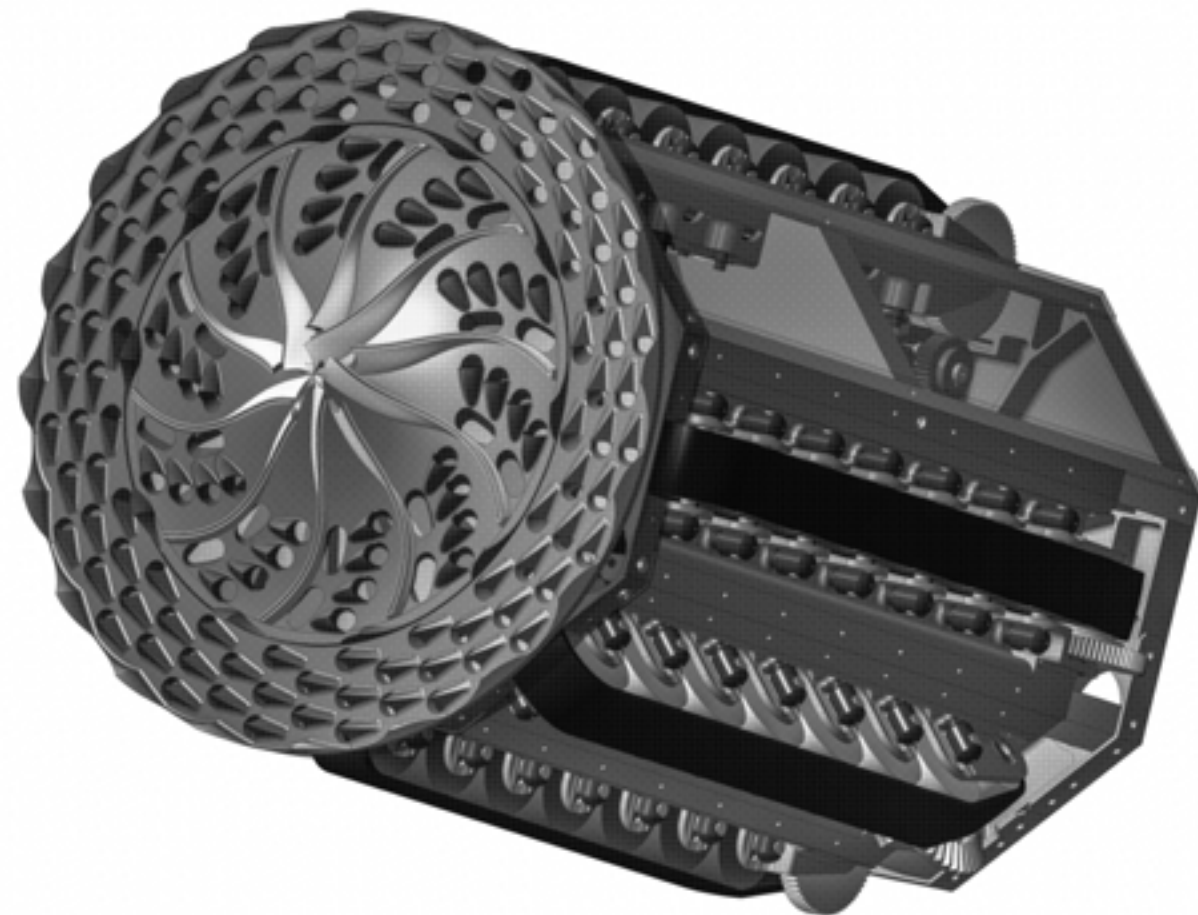
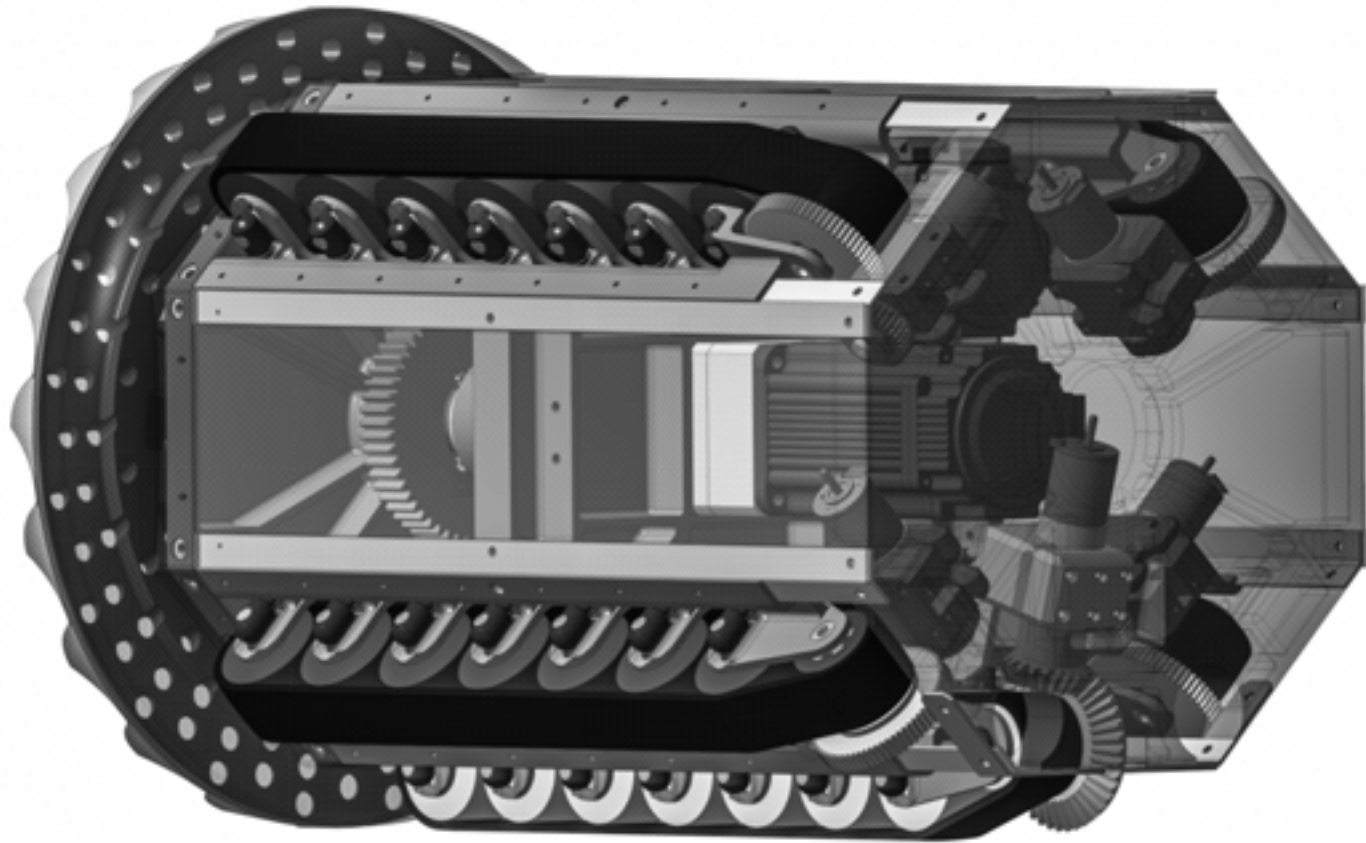
Topic Conception & structure

About An insulated vault structure assembled by interlocking bricks made of ply-wood and glass-fiber «sandwich», offers an environment adapted for humans.

An interactive presentation and a space toilet mock-up will show the life-supporting functions of closed artificial ecosystem.



EPFL,
Lausanne, Switzerland



Digging robot with navigation in ice capability

Robot with the capability to navigate
in ice and dig its own path.

Topic Communication & navigation

About The project consists of designing, building and testing a robot with the capability to navigate in ice and dig its own path. The robot will be a maul which can drill in ice along a pre-planned path, doing its own calculations and accurately measure the position and attitude control.

University Politehnica of Bucharest,
Bucharest, Romania

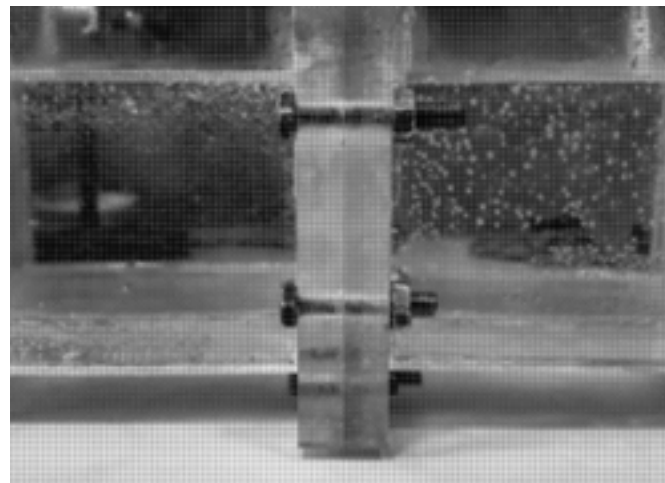
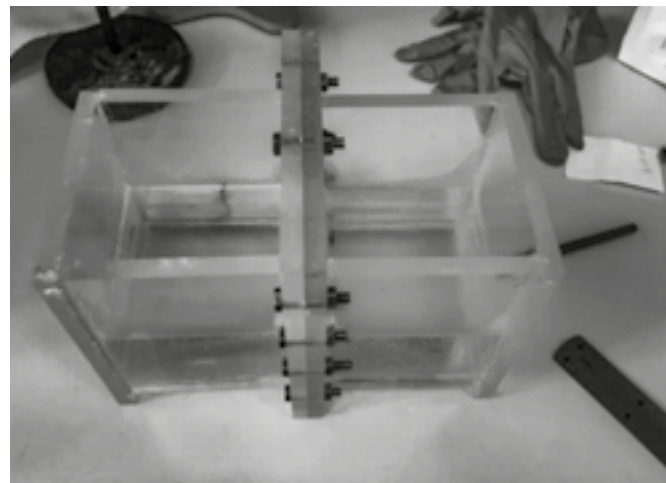
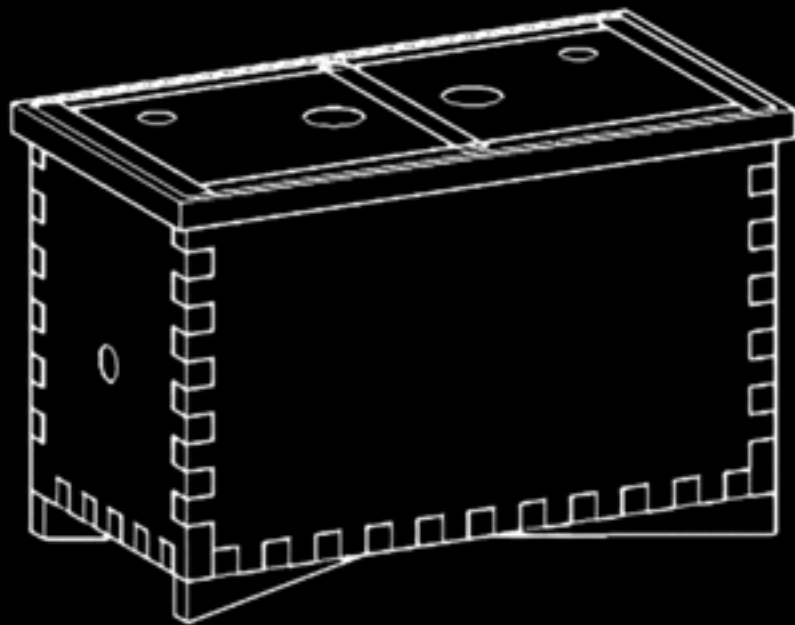


Demonstrator for Oxygen Production (DOP)

Demonstrator of gaseous hydrogen and oxygen production through water electrolysis.

Topic Life Support

About The project focuses on the development and setting up a Demonstrator for Oxygen Production (DOP) able to work under severe conditions in space and in the long run. The DOP is a key element for engineer teams who plan on long periods of survival in space. The solution of building an oxygen generator based on water electrolysis is taken into consideration in the first stage to supply the oxygen for human activities. Water electrolysis will deliver oxygen and hydrogen.



University Politehnica of Bucharest,
Bucharest, Romania

CircaDia

Human health monitoring by schedule management through circadian rhythm and fatigue analysis

Topic Human well-being

About The team measures vital signs like heart rate, temperature, acceleration, blood oxygen saturation, breath per minute and skin conductivity with a device. Estimating physical fatigue based on measured bio-signals is a novel method. The team plans to build up a real-time system. This new method of scheduling would be personalized to fit the natural rhythm of the individual and the team.

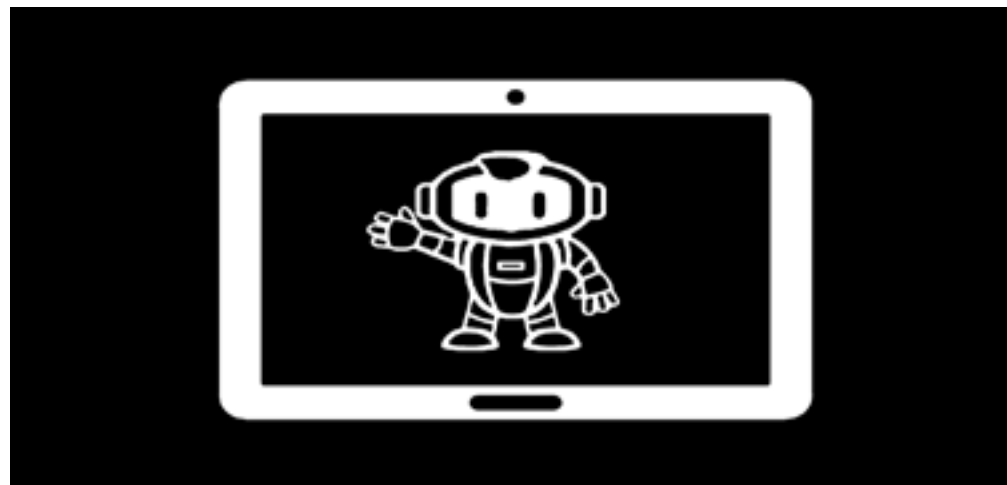


LunAva

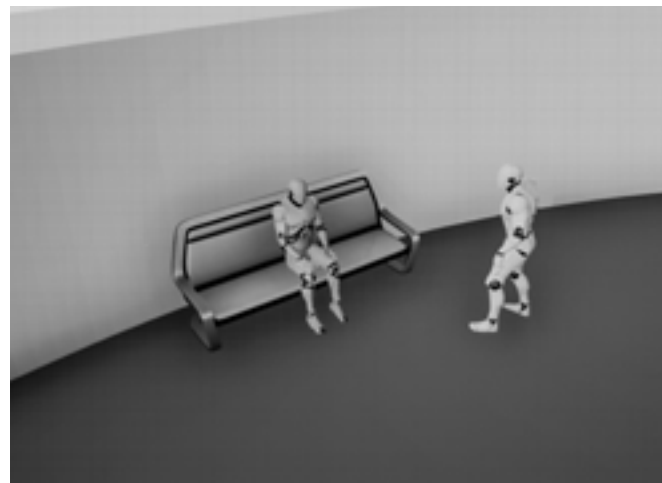
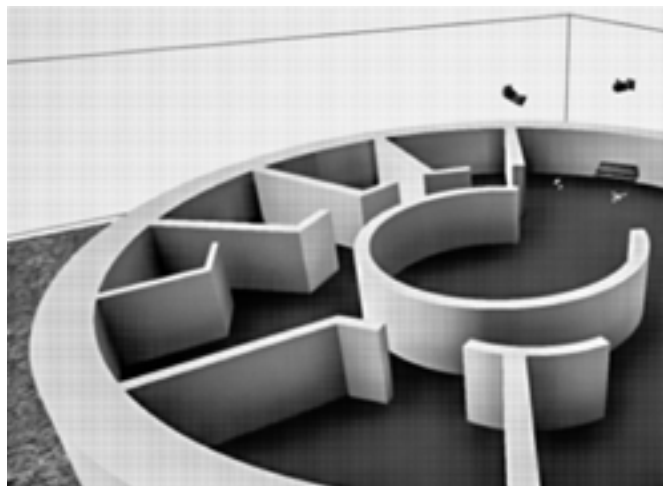
Avatar that assists in the management of human capital and information communication in space.

Topic Human well-being

About A personal virtual companion (=avatar) that assists in communication tasks among crew members and control. Based on a platform that collects and validates information in order to create strategy for improving social dynamics on the moon.



Tallinn University of Technology
Tallin, Estonia



Smart Monitoring

Intelligent rule-based decision engine that can reason and make decisions on incomplete monitoring data.

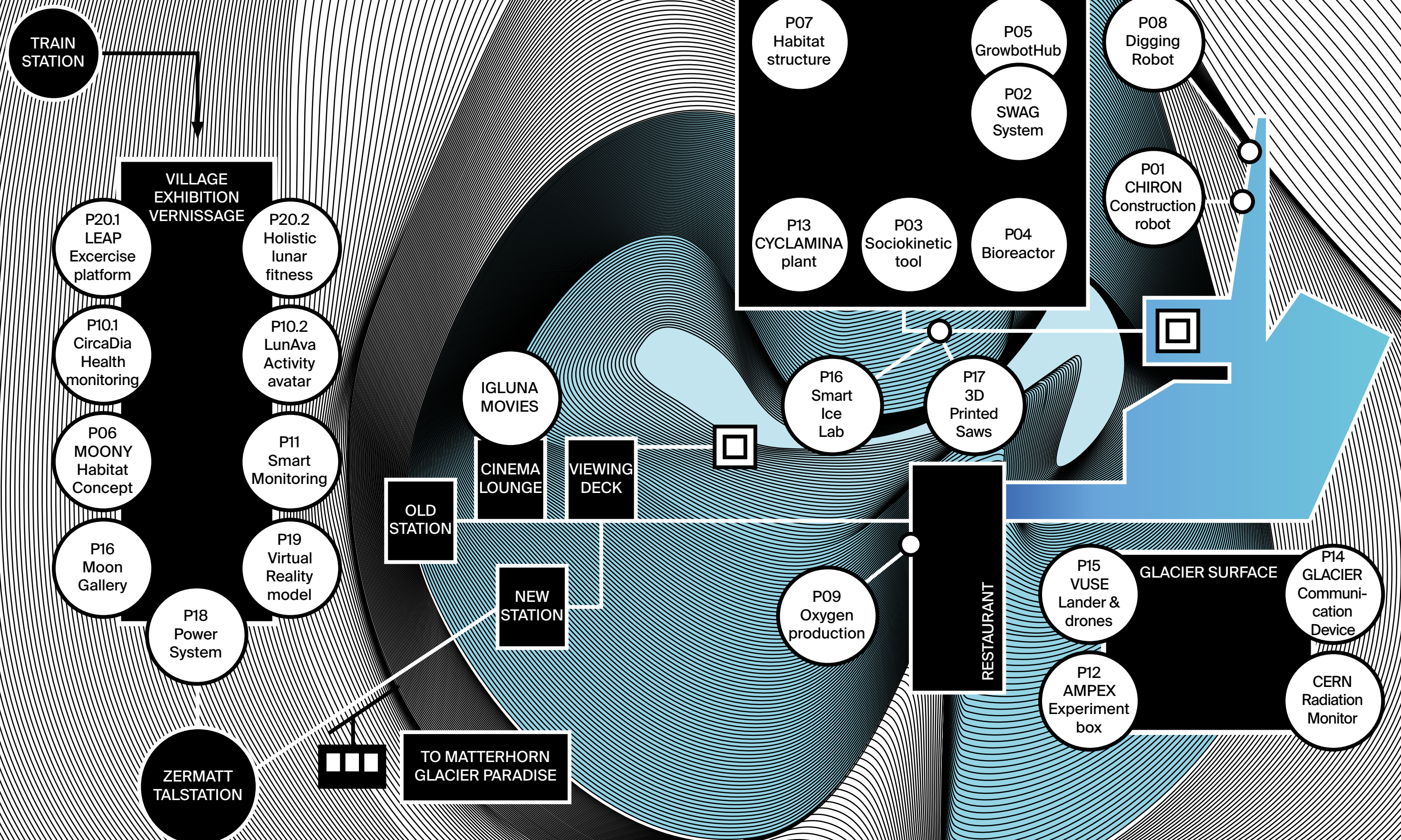
Topic Human well-being

About Creating an intelligent rule-based decision engine that can reason and make decisions based on incomplete monitoring data.
 Defining a use case with habitants having specific comfort profiles, action scenarios, energy constraints. Building a demonstrator with emulated sensor basis and visualising it using a virtual world simulation.

Tallinn University of Technology
 Tallin, Estonia



EXPOSITION OVERVIEW – MAP



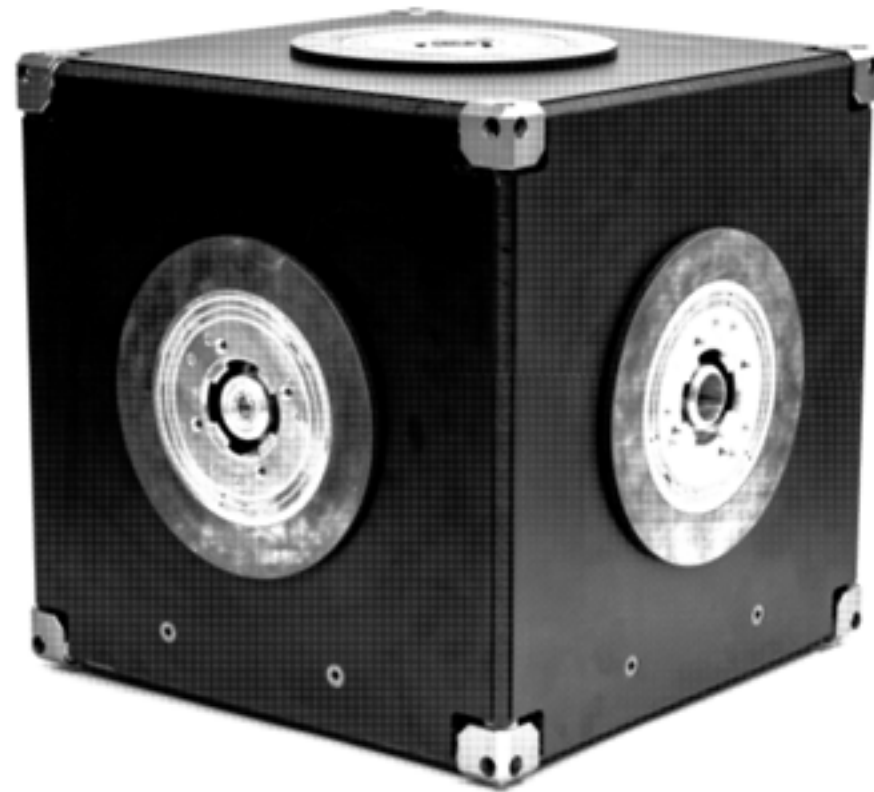


Aachen Modular Planetary Exploration System (AMPEX)

Experiment box based on iBOSS technics including a drill to extract ice cores and a corresponding handling system.

Topic Science

About Our project demonstrates a new modular approach in space exploration: The development of an ice core drill integrated with the iBOSS technology for ice extraction and sampling. Heating cartridges, or as we call spikes, melt the ice below the structure and fix the iBLOCK on the surface. In future projects, we will introduce a handling system including a robotic arm which docks with the iBLOCK's interface to relocate the drill.



RWTH Aachen University
Aachen, Germany



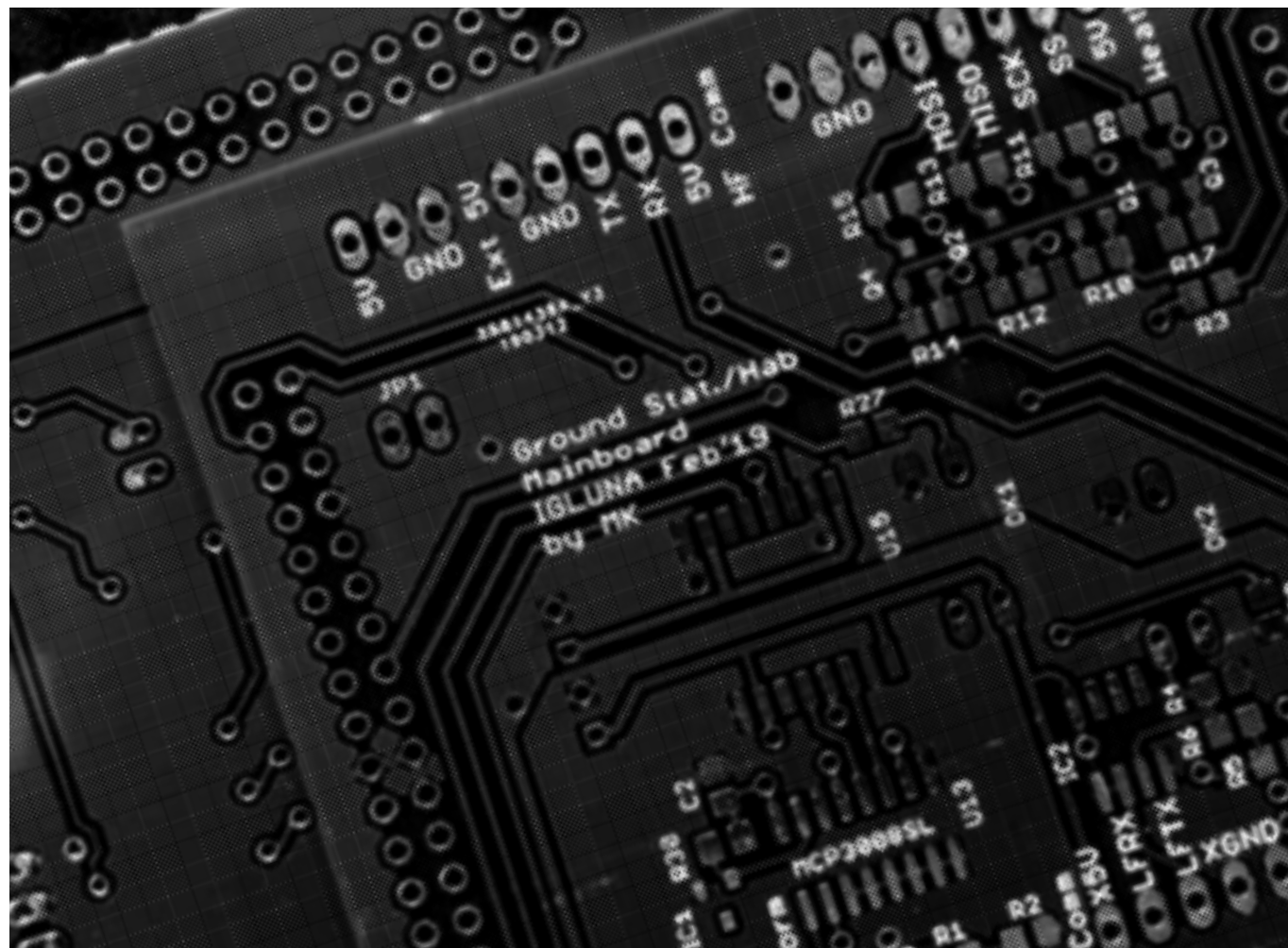
Cybernetic Companion pLAnts to Mitigate Insufficient iNteraction with nAture (CYCLAMINA)

Plant-computer interface that will augment a typical plant (i.e. with movement, sound, pseudodecisions) using the plant's electrophysiological signals as input.

Topic Human well-being

About An innovative Human Plant Computer Interface aiming to mitigate the insufficient interaction with Nature and the psychological pressure of astronauts in space. The plant, *Codariocalyx motorius*, is augmented with pseudo-decisions, sound and light in order to communicate with human. In addition, the astronaut will also provide stimuli the plant, closing the loop. The impact is assessed using EEG and psychological questionnaires.

Technical University of Crete & Agricultural University of Athens
Athens, Greece



Guidance and Localisation for Astronauts Cooperating in Environmental Roughness (GLACiER)

Habitat-astronaut radio communication and localization outside the habitat in real time using radio modules.

Topic Communication and Navigation

About The project focuses on habitat<->astronaut radio communication and localisation of the astronaut outside the habitat in real time using radio modules mounted throughout the EVA area (trilateration), supported by GNSS. Secondary objectives are: weather station (temperature, humidity, pressure, insolation), storm detecting station.

Warsaw University of Technology
Warsaw, Poland

VU Science Experiments (VUSE)

Science-based platform for geological, astrobiological and glacial research focused on analysis of ice cores.

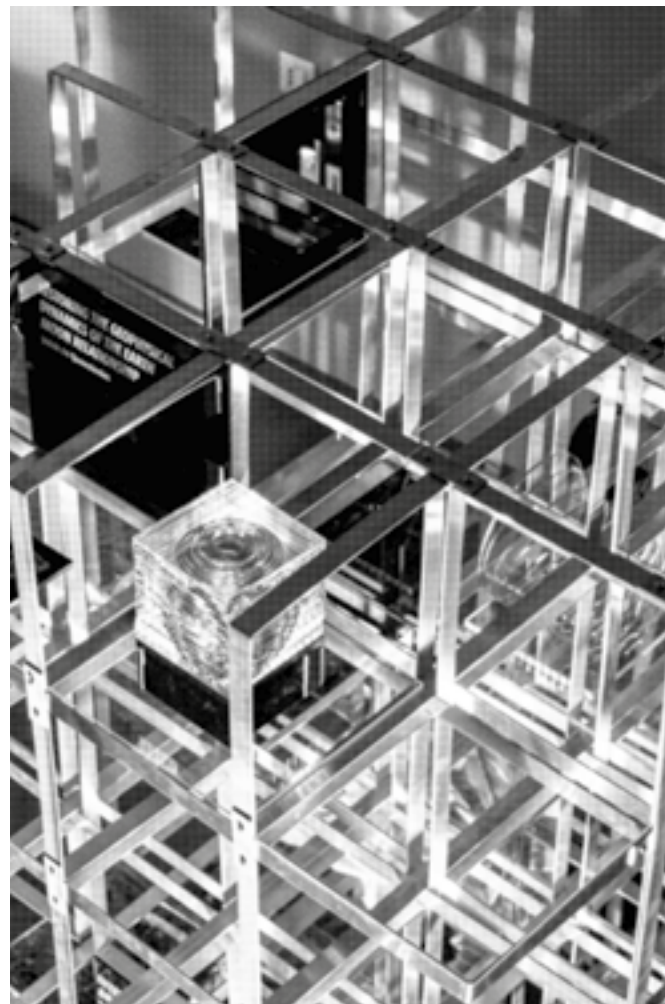
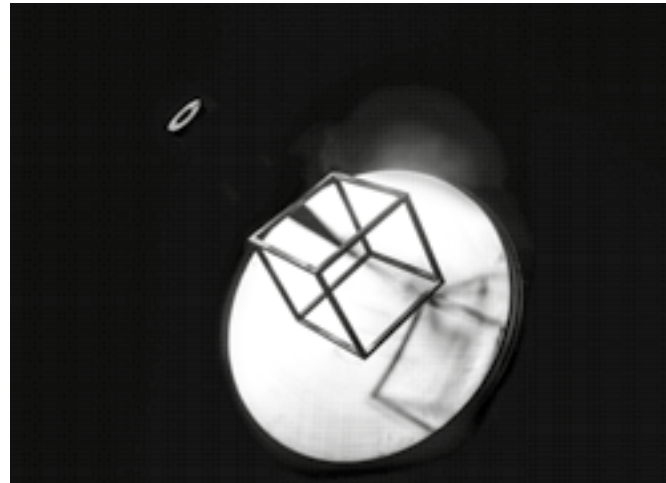
Topic Science

About VUSE is a science based platform for geological, astrobiological and glacial research. Our main objective is to analyse ice cores and collect various data to determine the history of the glacier. We provide the instruments for the SMART-ICE lab and the glacier research station. We are going to perform analog astronaut simulations, both IVA and EVA.



VU Amsterdam
Amsterdam, the Netherlands





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Smart Ice Lab & Moon Gallery

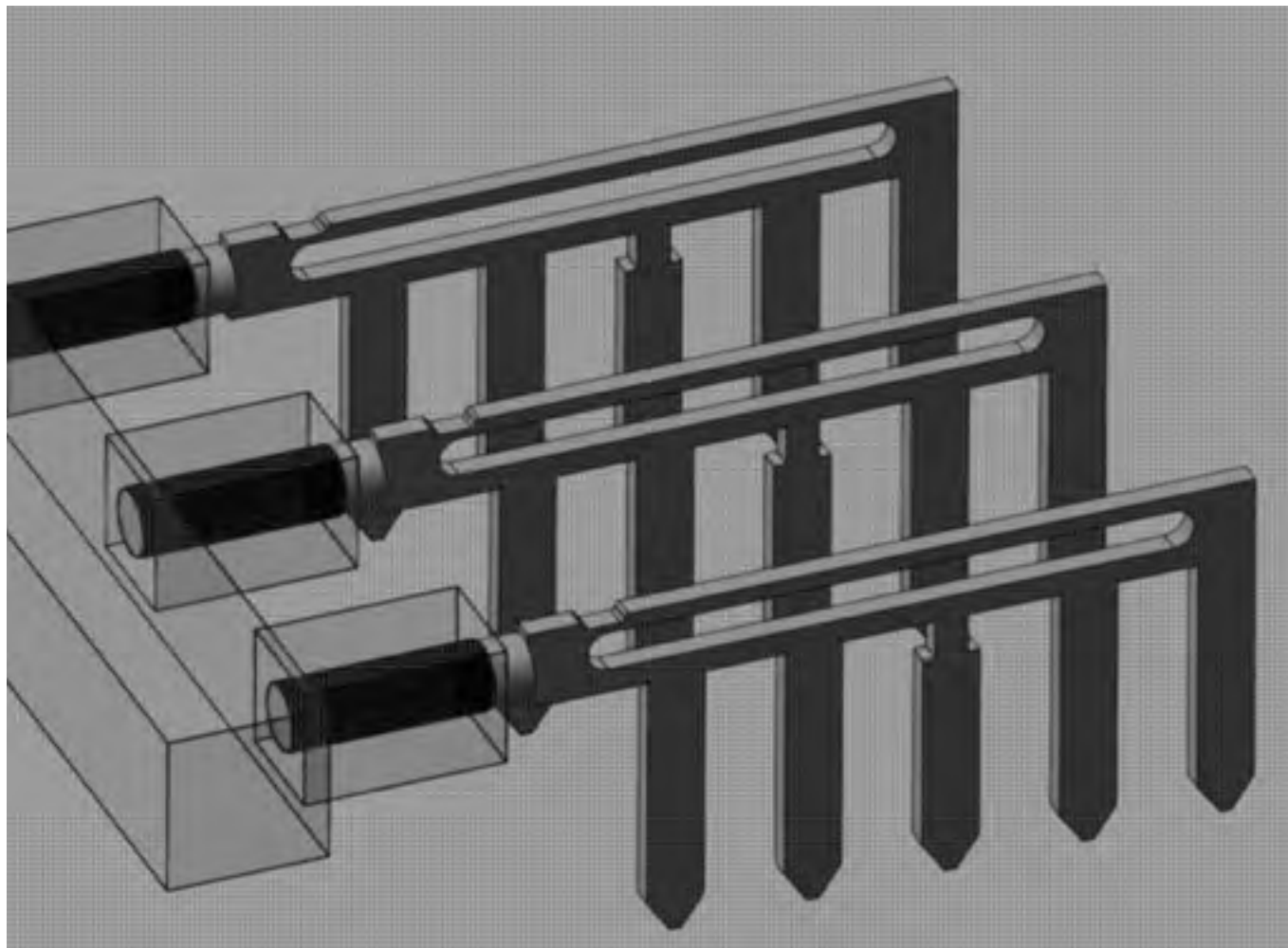
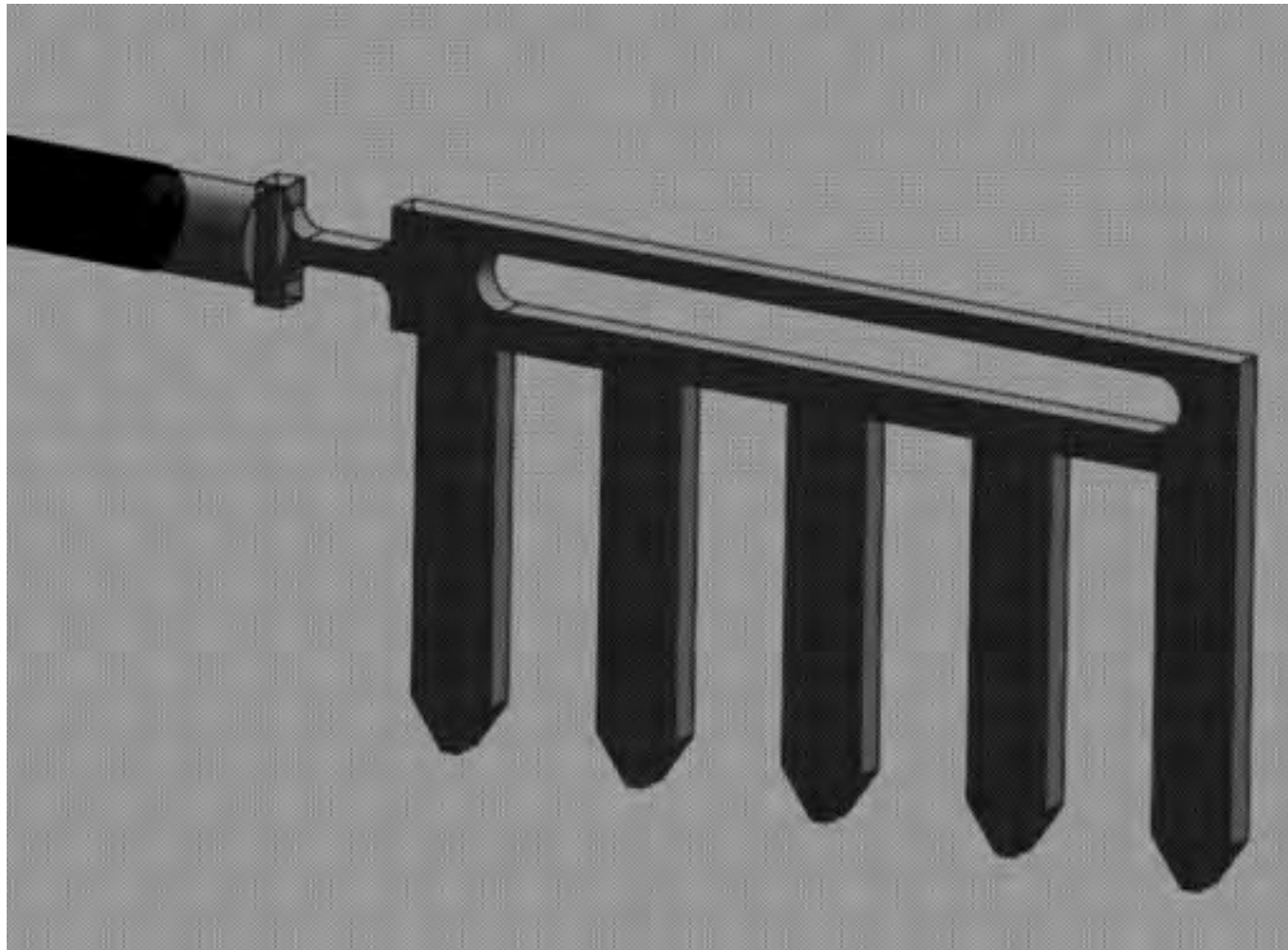
Working station and platform to conduct experimental research, visualize scientific data and provide public outreach.

Topic Science

About Smart Ice Lab shall provide scientists with the capability to conduct examinations and measurements on ice samples and cores, and preserve the integrity of these for current and future investigations.

Moon Gallery intends to launch 100 artifacts to the Moon within the compact format of 10 x 10 x 1cm plate on a lunar lander as early as 2022. In this Petri dish-like gallery, we are developing culture for future interplanetary society.

ILEWG and BTU
Amsterdam, the Netherlands



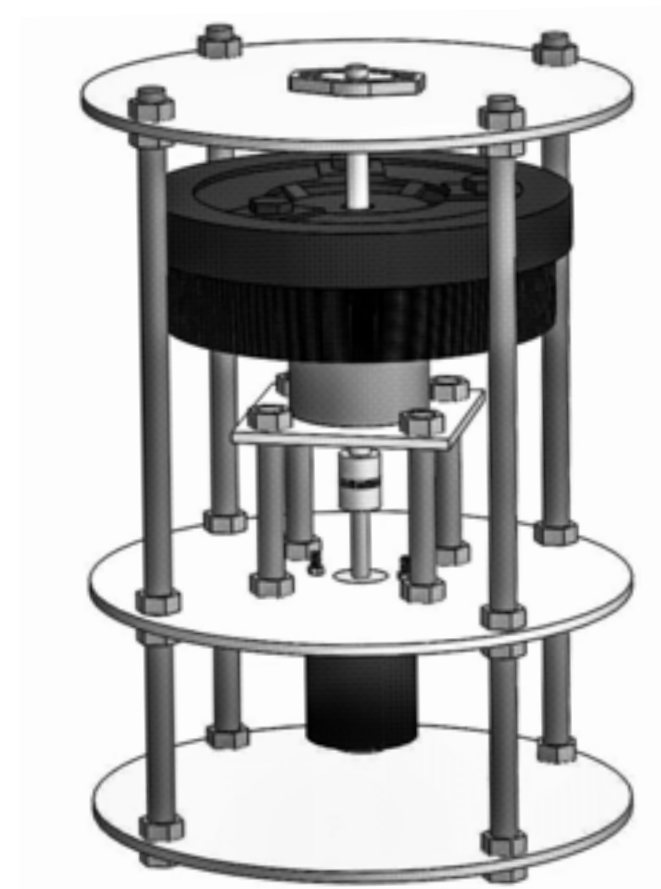
3D – Laser Shock Peening of a High Performance Ice Saw (Hephaestus)

High performance additively manufactured ice saw through the use of the 3D - Laser Shock Peening technique.

Topic Science

About A high performance additively manufactured ice saw through the use of the 3D – Laser Shock Peening (LSP) technique to demonstrate that this novel process is able to produce parts for Space that can withstand longer fatigue life cycles. 3 x Ice Saws will be tested simultaneously:

- A traditional,
- A Selectively Laser Melted (SLM) As Built (AB) Saw,
- A 3D – LSP Ice Saw.



Designing a power system for a moon inhabitation (MPS)

Design for the system in charge of generation, storage, distribution and control of power supply.

Topic Power Management

About A theoretical design for the system in charge of generation, storage, distribution and control of the power supply for the IGLUNA project.
Involves calculation of expected energy loads and takes into consideration the unique challenges of generating power on a Lunar Habitat.

University of Strathclyde
Strathclyde, United Kingdom



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© EPFL-ENAC-Habiter Mars

Virtual Reality 3D Model

3D Model of a Mars/Lunarbase for 100 inhabitants.

Topic Conception & structure

About An interactive installation will allow to virtually visit the interior spaces of a Mars/Moon-Base. Digital images, placed at different parts of the exhibition, will illustrate the ambiance of a space habitat.

A HABITAT IN ICE

EPFL
Lausanne, Switzerland

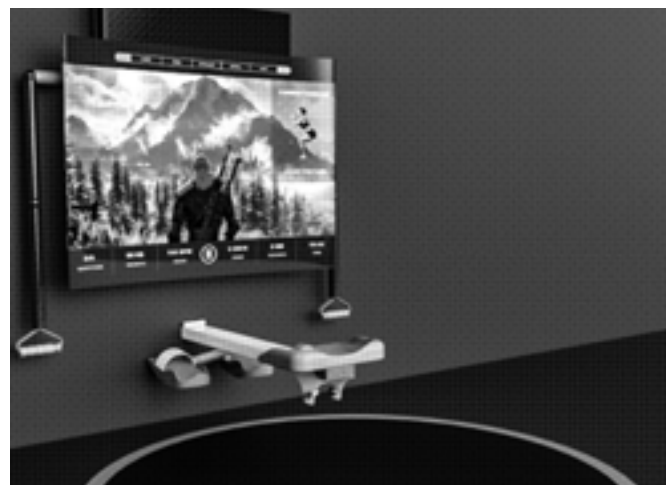
P20.1

Lunar Exercise and Activity Platform (LEAP) by Tallinn University of Technology, Estonia

Physical training design through a gamified physical routine experience.

Topic Human well-being

About LEAP uses serious games, virtual environments and physical accessories to create a gamified physical routine experience. Through physical exercise and body motions astronauts to interact and navigate the environment. It has resistance bands, bars, rowing machine and an omnidirectional treadmill. Allows for varied exercise.



Tallin University of Technology
Tallin, Estonia

P20.2

Holistic Lunar Fitness (HLF) by Tallinn University of Technology, Estonia

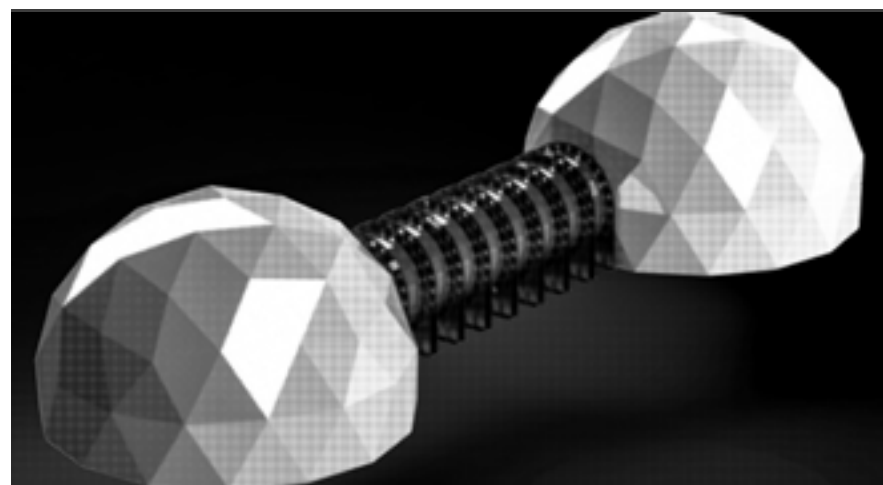
Multifunctional and modular training area design.

Topic Human well-being

About A solution for physical fitness that would fit the context of the lunar base.

Space for the astronauts to be at peak performance through mental and physical stimulation, so that they can produce the maximum value for the mission.

Space for competitive and group training and physical anaerobic exercises.





INFORMATION IGLUNA

IGLUNA, as a demonstrator pilot project, is aimed at supporting and accelerating the ESA_Lab initiative. The lessons learned from IGLUNA will help for the implementation of future ESA_Labs. The Swiss Space Center organises the overall project and serves as coordinator for the events and main systems engineering activities. IGLUNA is supported by the Swiss Space Office of the State Secretary of Education, Research and Innovation and the European Space Agency.

igluna@spacecenter.ch
www.spacecenter.ch/igluna



Ice images by C. Loretz

INFORMATION

SWISS SPACE CENTER

The Swiss Space Center is a national entity with offices in the Swiss Federal Institutes of Technology. The Swiss Space Center contributes to the implementation of the Swiss Space Policy. It provides a service supporting academic institutions, research and technology organisations and industries to access space missions and related applications, and promotes interaction between these stakeholders.

The Swiss Space Center has 25 collaborators including Professor and former ESA astronaut Claude Nicollier, as well as three PhD students and eight national trainees located at several sites of the European Space Agency ESA.

www.spacecenter.ch
info@spacecenter.ch



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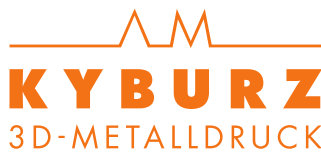
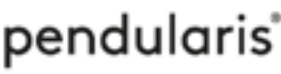
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IGLUNA

A HABITAT IN ICE

