Paper ID: 76660
student

34th IAA SYMPOSIUM ON SPACE AND SOCIETY (E5)
Simulating Space Habitation: Habitats, Design and Simulation Missions (6)

Author: Mr. Somayajulu Dhulipala
Massachusetts Institute of Technology (MIT), United States, dsom@mit.edu

Mr. Manwei Chan
Massachusetts Institute of Technology (MIT), United States, manweic@mit.edu

AGRITHRIVE: AN EMERGENCY PREPAREDNESS SYSTEM FOR PLANTS IN SPACE

Abstract

As humanity inches closer to setting up colonies on the Moon and Mars, locally grown food will be a big part of making this process sustainable. One risk that plants face in such harsh climates is the possibility of hull breach (i.e. system failure) leading to instantaneous death of the plants due to low temperature, pressure, and exposure to radiation. Thus, there is a need for systems that are able to protect the plants long-enough from these conditions so they can be procured and reseeded by astronauts. Projects like Nemo's garden have looked at developing enclosures to grow plants in non-ideal environments underwater where it is pertinent to keep the plants safe from hull breaches. However, when it comes to outer space there are additional problems such as low temperatures and hazardous radiation which could kill plants. Water wall architectures have also been explored for space application as potential thermal management systems and radiation shielding. Taking inspiration from these systems we developed AgriThrive, an emergency preparedness system for plants in space. Such a system would also find application for growing plants on Earth in low-resource harsh environments such as deserts and polar regions. In this project we developed and tested a plant habitat with active temperature control in an Martian analog mission in Svalbard. The plant habitat has a multilayered structure with air gaps and water that helps control the insulation and environmental shielding of the system. The plant habitat has temperature and light sensors on the inside that collect data necessary for determining survivability of plants. We then subjected the plant habitat to the outside temperatures in varying light conditions ranging from moderate light conditions to low light conditions during the civil twilight and nautical twilight (when the sun is close to the horizon and at a low elevation angle), which mimic the solar environment at the lunar/Martian poles. Sensors (temperature sensors, and light intensity sensors) measured conditions (temperature, and light intensity) inside and outside the habitat to test out the survivability of plants in the active system we designed to keep plants safe in case of a hull breach. AgriThrive is able to extend the amount of time the system stays in safe temperature range by almost 5x in low light conditions. Our system also tested out power-saving modes during plant growth in harsh conditions such as the Arctic.