Vision Statement

- Support biomanufacturing for deep space exploration;
- Create an integrated, multi-function, multi-organism biomanufacturing system for a Mars mission; and
- Demonstrate continuous and semiautonomous biomanufacture of fuel, materials, pharmaceuticals, and food in Mars-like conditions.

Research Objectives

- Harness Mars atmospheric and regolith resources for downstream biological use;
- Create outputs like propellants and building materials that are fundamental enablers of any space mission;
- Synthesize food and pharmaceuticals *in situ*, to allow these long-duration space missions to be manned; and
- Perform space and complex systems engineering, to analyze, guide, test, improve, and integrate the above.

Team

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UBES

Center for the Utilization of Biological Engineering in Space

Approach

- Systems Design and Integration to optimally allocate and utilize Mars resources, to tightly integrate and automate internal processes, and to satisfactorily achieve performance per mission specifications;
- Microbial Media and Feedstocks to harness *in situ* resources, to decontaminate and enrich regolith, and to transform human/mission wastes to media and feedstocks for utilization by downstream processes;
- Biofuel and Biomaterial Manufacturing to produce propellants, biopolymers, and chemicals from media and feedstocks, to recycle products at end-of-life, and to use generated biopolymers in 3D-printing; and
- Food and Pharmaceutical Synthesis to engineer plants and microbes for use by astronauts.

Benefits

- Engineered microbes to convert limited, marginally accessible Martian feedstocks, such as atmospheric gases at low partial pressure and nutrients from contaminated/toxic land, into commodities.
- Novel biologically-coupled nanotechnologies to fix available carbon and nitrogen and to transfer energy into biosynthetic processes;
- Refined plants and plant microbiomes that grow in restricted space, light, water, and nutrients, and that can still provide substantial yields of nutritive foods;
- Biologically-produced pharmaceuticals, cellular treatments/therapeutics, and materials for on-demand diverse 3D-printing applications; and
- Optimized, integrated operation of these processes.