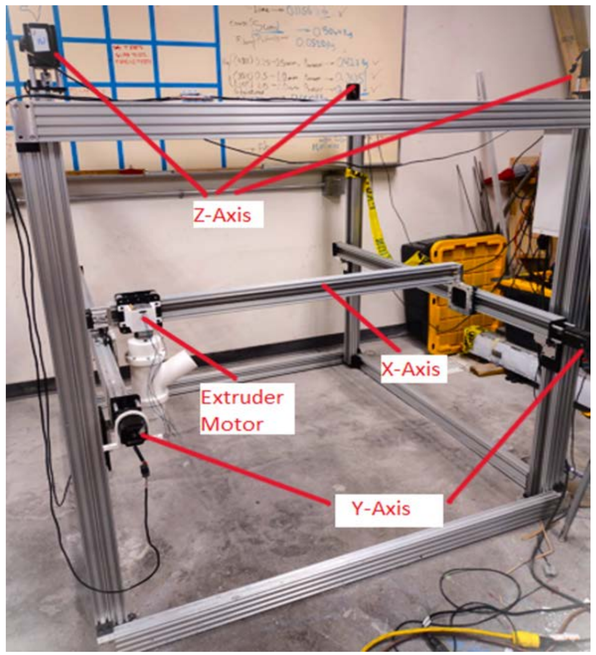
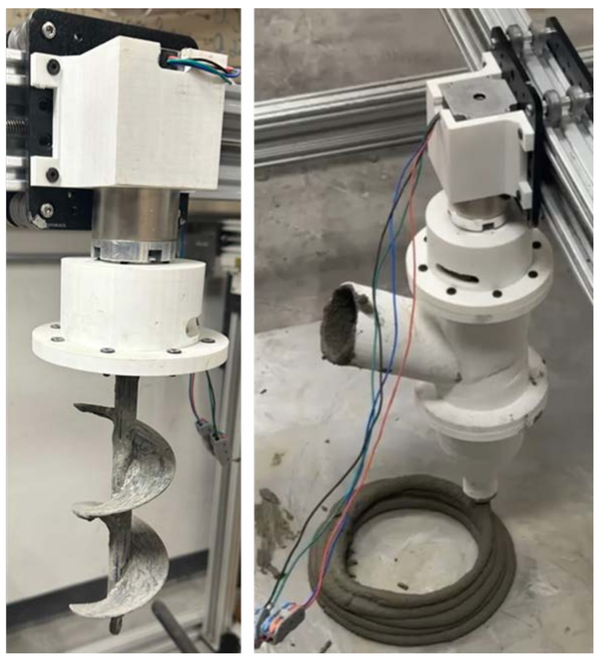
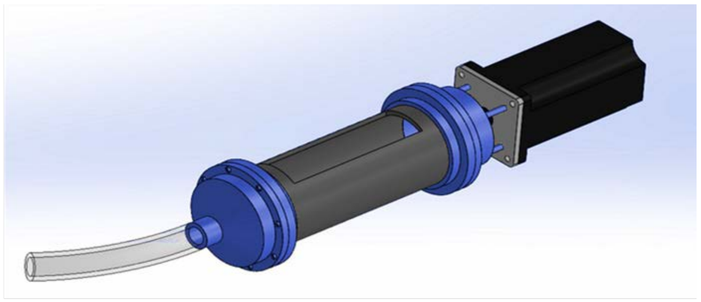
AUTONOMY RESEARCH CENTER FOR STEAHM

Autonomy for Manufacturing and Construction

Glass Fiber Reinforcement in 3D Printed Concrete







Synopsis

- Developed a specialized 3D printer for concrete integrated with glass fiber reinforcement.
- Aimed to construct lunar structures using in-situ resources.
- Focused on using local lunar materials to minimize Earth launch costs.
- Supported NASA's Zero Launch Mass (ZLM) strategy for sustainable space exploration.
- Incorporated sulfur in the concrete mix, eliminating the need for water.

Research Objectives

- Design a 3D printer capable of precise concrete extrusion for lunar applications.
- Develop a suitable pump system for sulfur concrete that includes heating capabilities.
- Formulate sulfur concrete mix to make lunar construction feasible.
- Explore the feasibility of glass fiber reinforcement in 3D printed concrete for lunar construction.
- Study the mechanical properties of 3D printed concrete with and without glass fiber reinforcement.

Research Approach

- Mechanical Structures: Uses a Cartesian system with FDM for precise, layer-by-layer construction.
- Extruder System: Develops an optimized extruder with heating capabilities for consistent sulfur concrete flow.
- Material Strength & Testing: Focuses on sulfur concrete with and without glass fiber reinforcement, testing its various strengths.

Research Results and Products

- The 3D printing system includes stepper motors, drivers, an MCU controller, and Marlin firmware.
- A pump system is currently being tested.
- A variety of sulfur concrete specimens will be printed.
- The strengths of sulfur concrete with and without glass fiber will be tested.

Commercialization and/or Societal Impact Opportunities

- **Application:** Lunar and Martian habitats, residential buildings, and other complex geometric structures on Earth
- **Key Value:** Construction of Lunar and Martian habitats using in-situ materials
- **Potential Customers:** NASA, contractors, and home developers

Team Names & Collaborators

ARCS Students:

Nikhil Sagar Dadem, Engr Management; Andrew Garcia, Mech Engr; Gevork Gazdzhyan, Mech Engr; and Mundkur Palguni Panduranga Kamath, Comp Engr

Faculty:

Dr. C. Shawn Sun, Department of Civil Engineering & Construction Management

Collaborator:

eConstruct.USA, LLC

Citations

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