OASIS

Obtaining Access to Subsurface Ice Sources

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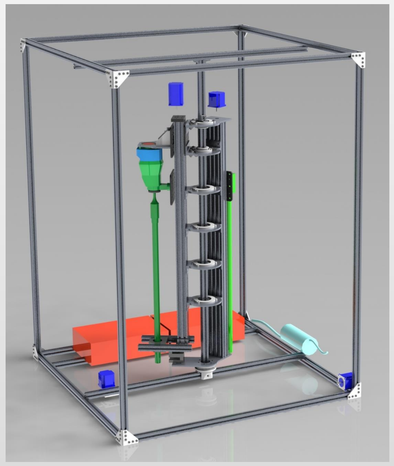
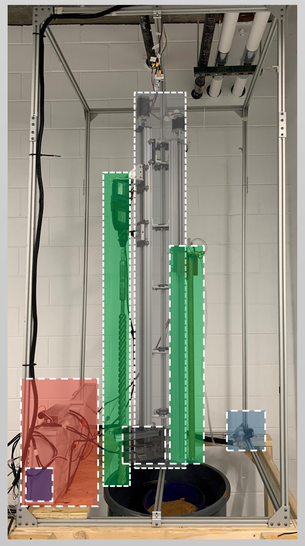
Overview

OASIS effectively drills and extracts water on Earth, but the Moon and Mars have distinct characteristics that make drilling and extracting water more complex. OASIS can be broken down into six subsystems that all serve an important purpose. Each subsystem can be modified to be ready for use on the Moon and Mars.



Full System

OASIS contains the following subsystems: Fabrication, Extraction, Control & Telemetry (C&T), Electrical, Filtration, and Prospecting.



Fabrication

Extraction

C&T

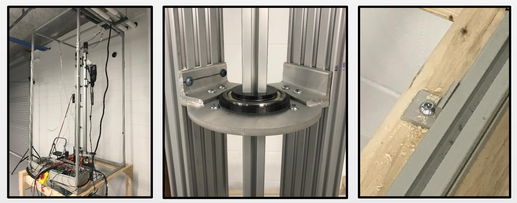
Electrical

Filtration

Prospecting

Fabrication

- **6105-T5 Aluminum chassis**
  - Strong, lightweight
- **Rotating Mirage**
  - Maximizes drilling area with reduced complexity
- **Mounting with four "L" brackets**
  - Simple and effective

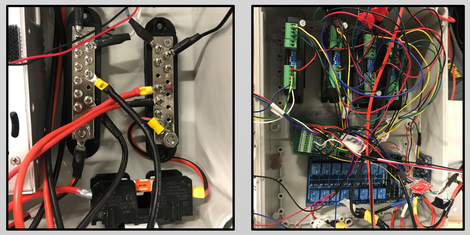


Path to Flight Changes:

- **Remove 6105-T5 Aluminum anodized layer**
  - Prevent out-gassing
- **Replace rubber Mirage belt with gear system**
  - Prevent freezing and wear of rubber
- **Implement mechanism to hold frame to ground**
  - Increased Weight On Bit potential despite lower gravity

Electrical

- **Bus bars supply up to 9A, 120V AC power to OASIS' components**
  - Four stepper motors & drivers, drill, heating element, Arduino & sensors all powered
- **Variable power module for drill and heating element**
  - Control drill speed and heater temperature

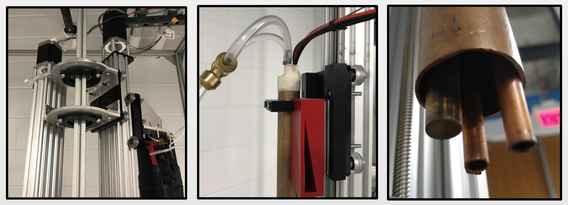


Path to Flight Changes:

- **Power OASIS from a Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) and solar panels**
  - MMRTG used widely on Mars
  - Solar panels provide additional and backup power
- **Store excess energy in Lithium-Ion batteries**
  - High energy density and power efficiency
- **Implement software to budget and distribute power efficiently**
  - Critical for utilizing low amount of power production
- **Seal electrical components in static-proof box with a vent and heater for use on Mars or with a refrigeration cycle for use on the Moon**

Extraction

- **Independent vertical actuation of drill and extraction tube**
  - Can drill and extract simultaneously
- **Temperature controllable 400W cartridge heater**
  - Thermocouple enables closed loop temperature control
- **Two Refrigeration tubes for water extraction**
  - Continuous function in case of a clog
- **Peristaltic Pump**
  - Reliable and speed controllable



Path to Flight Changes:

- **Create a sealed, pressurized enclosure around hole opening**
  - Prevent sublimation of water
- **Replace peristaltic pump with centrifugal pump**
  - Can withstand Martian soil composition and harsh environments
- **Replace plastic tubing with titanium or nylon tubing**
  - Rated for space applications
- **Replace cartridge heater with microwave emitting tip**
  - Increases radiative heating rate

Prospecting

- **OASIS uses two S-Beam load cells to measure Weight on Bit (WOB)**
  - Innovate design enables load cells to experience full WOB of Drill Bit
- **Digital Core formed from Mechanical Specific Energy (MSE) data**
  - MSE accounts for WOB, Area of drill bit, Torque of drill (found from Voltage and Current), Rate of Penetration (ROP), and RPM of drill
- **Current sensor is installed to measure drill current**
- **Hall effect sensor used to measure RPM**

$$MSE = \frac{WOB}{Area\ of\ Drill} + \frac{Torque * RPM}{Area\ of\ Drill * ROP}$$

Path to Flight Changes:

- **WOB measurements need to be tared with respect to gravity**
  - Mars' gravity is 37.5% of Earths, the Moon's gravity is 16% of Earths

Filtration

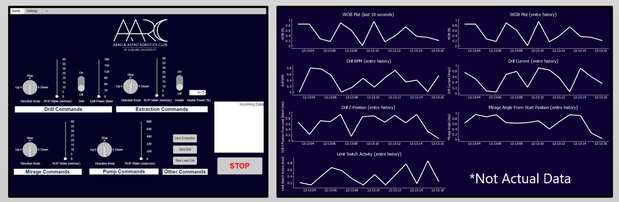
- **Mesh filter on tip of extraction tube**
  - 1mm holes stop large particles from entering
- **Settling tank with clean-out**
  - Allows medium sized particles to settle and be disposed of
- **Life-straw**
  - Removes all small particles and produces clear water

Path to Flight Changes:

- **Implement a distillation filtration system**
  - Reliable and long lasting
  - Easy cleaned with a blowout or acid solution

Control & Telemetry

- **OASIS utilizes an Arduino MEGA for controls**
  - Sends and receives data via Serial Communication
  - Talks to all on board sensors and stepper drivers
- **OASIS' GUI is powered by MATLAB App Designer and PyQtGraph**
  - View telemetry in real time
  - View entire history by scrolling



Path to Flight Changes:

- **Install high gain antenna for communications**
  - Due to low data rates, send only pertinent data both ways
- **Replace Arduino with radiation hardened computer**
  - Mars sees ~50x the radiation on Earth and Moon sees ~200x
- **Program a more robust and advanced autonomous control algorithm**
  - The moon and Mars requires more autonomy since signals take ~1.3 seconds and ~12.5 minutes to travel respectively