Northeastern University PARSEC

Percussive And Rotary Surveying & Extracting Carousel

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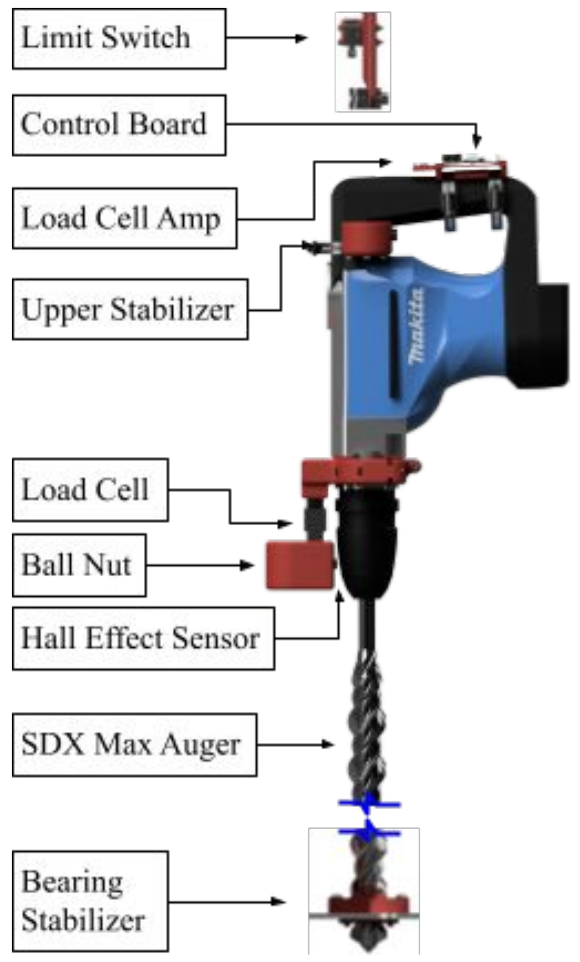
Drilling



PARSEC uses a rotary-percussive drill with a masonry auger to bore through regolith and ice.

A tachometer, load cell, current sensor, and two microphones provide data for evaluating digital core layers.

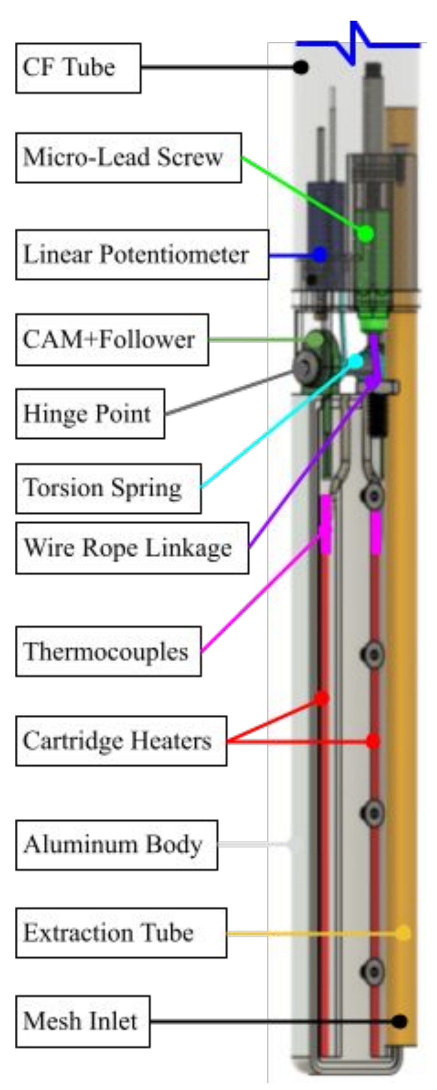
Upper and lower stabilizers mitigate vibrations and prevent the bit from walking.

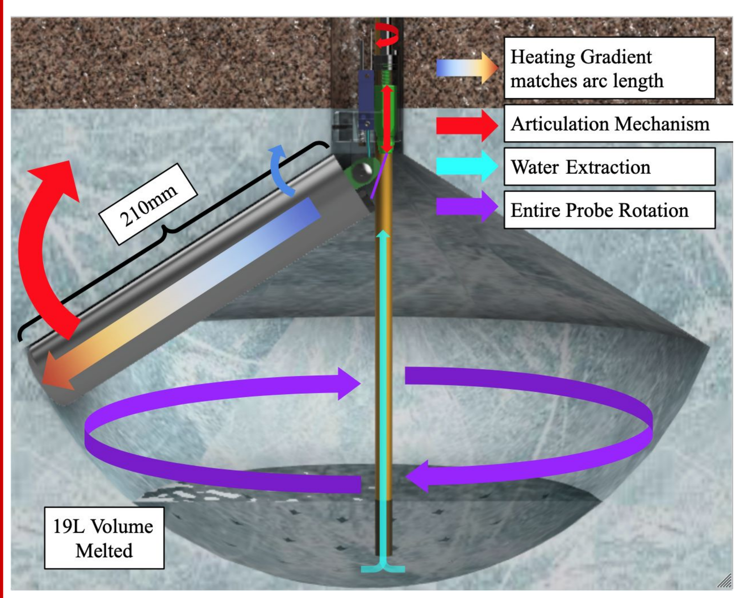
The drilling system creates a hole used by the melting system to access the ice.

Melting

PARSEC uses an articulating and rotating melting tool to reach a maximum volume of ice.

Heating is provided by cartridge heaters and monitored by a pair of thermocouples. A stationary tube extracts water as it is melted.



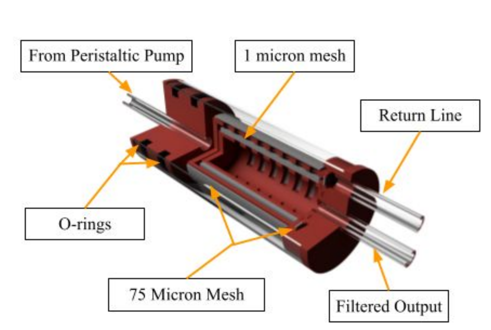


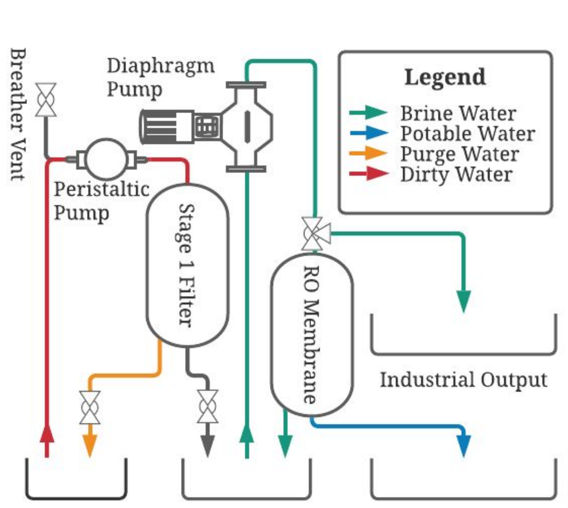
Filtration

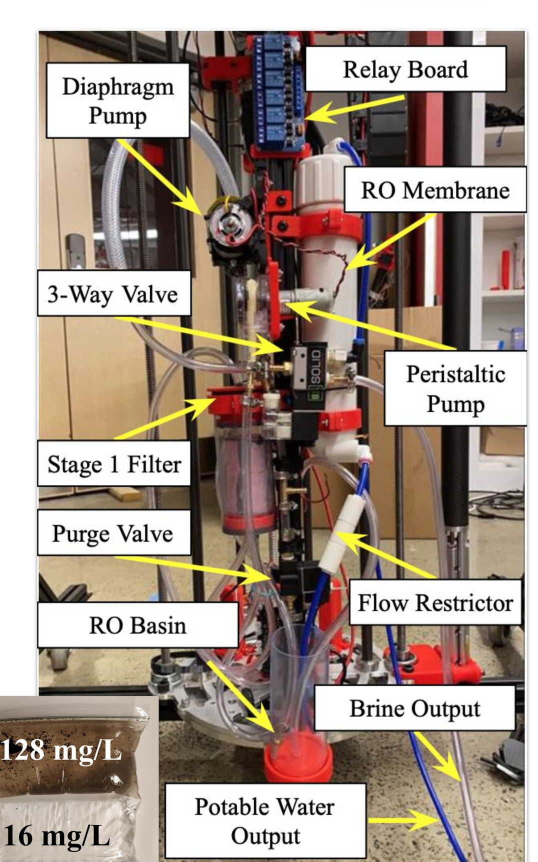
PARSEC uses a two stage filtration process to produce drinkable water.

The first stage, a purgeable sedimentary filter, removes larger particulates from the water.

The second stage, a reverse osmosis membrane, removes particles as small as 0.1 nm.

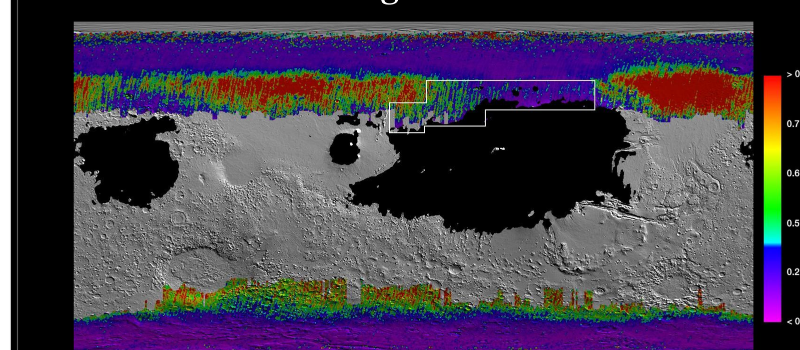






MARS

Selecting a Location



PARSEC is designed to reach ice up to a meter under the surface, which makes the poles ideal for water extraction. The map above illustrates water ice depths on Mars. The white box encloses the ideal location for landing as ice depths are shallow.

PARSEC would temporarily store water and deliver it to pressurized regional tanks on Mars. Doing so will reduce system weight and allow astronauts to access water off-site from drilling operations.

Environmental Conditions

TEMPERATURE -173°C night; 125°C day
- Electronics kept within ideal operational range in insulated housing
- Materials with low thermal expansion used

ATMOSPHERE ~3% of Earth's
- Drilled holes will be pressurized while melting to maintain liquid state of water

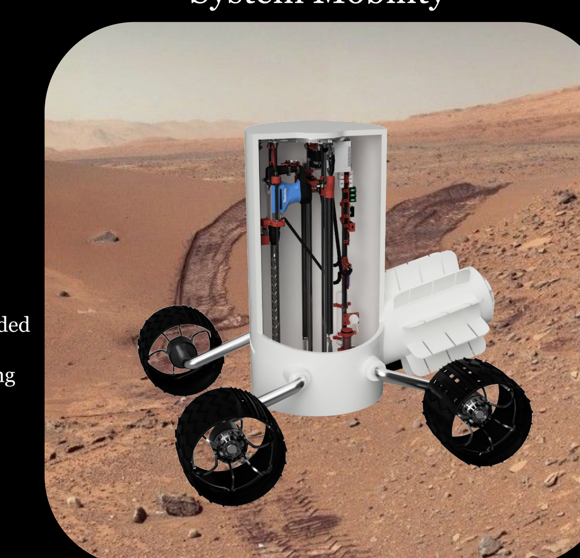
RADIATION 30 µSv/hr
- Exposed components to be radiation-hardened or shielded
- Electronics casing
- Lead alloys used for shielding

Extreme wind speeds during dust storms
- Tethering system to stake robot to the ground

Dust can clog systems and block light
- Motion components shielded with bellows
- Wrap with "cape"
- RTG used for power rather than solar

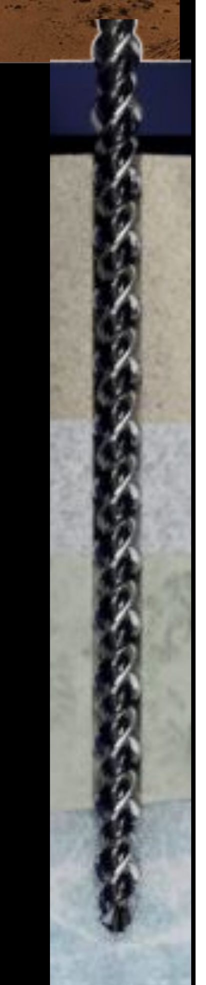
TIME DELAY 4-24 minutes
- Full autonomous operation
- Error detection
- Live core processing to detect ice layers & swap tools

System Mobility

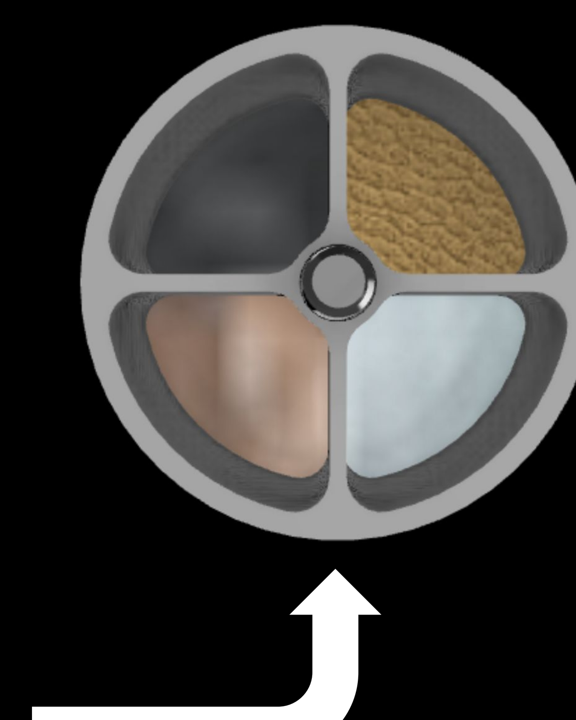


PARSEC will be mounted to a rover that autonomously traverses to pre-planned locations ideal for prospecting and water extraction.

The carousel will be shielded from dust and radiation within a 0.7 m diameter cylinder. The onboard RTG will provide continuous power and heating.



MOON



Sample Collection

CAT can provide invaluable insight into the geology of both the Moon and Mars. With further development, PARSEC could autonomously collect samples and test them for toxins like perchlorates that may leech into the collected water. These samples could also be collected and analysed under a microscope for life or material structures.

Environmental Conditions

GRAVITY 1.63 m/s²
- Drill without percussive motion unless necessary
- Robot will be tethered to the ground

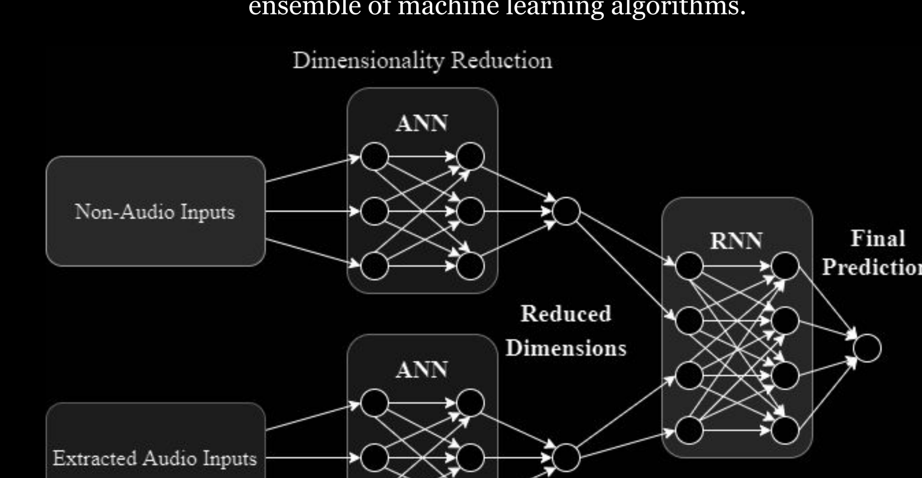
TEMPERATURE -153°C night; 107°C day
- Electronics kept within ideal operational range in insulated housing
- Materials with low thermal expansion used

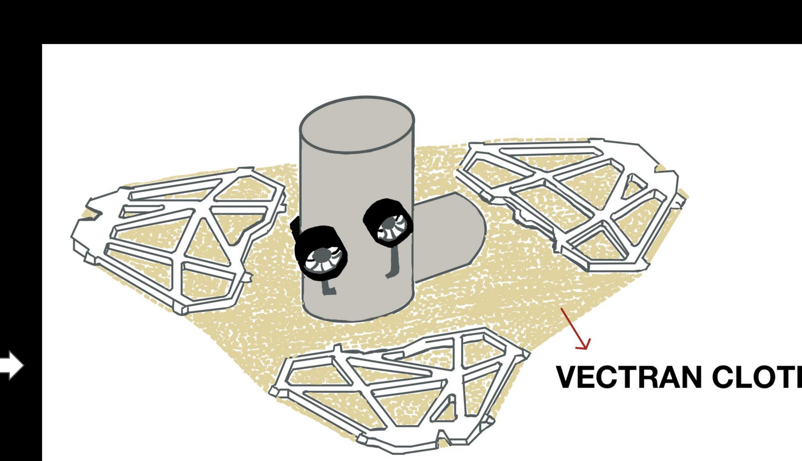
COMMUNICATION
- PARSEC will include antenna, connecting it to the NASA Deep Space Network
- System receives instructions from Earth and sends findings back to Earth

LANDING METHOD
- The lander module will come equipped with three petal shields
- Petals attached to a Vectran cloth rug
- Protection from rough terrain

Prospecting on the Moon

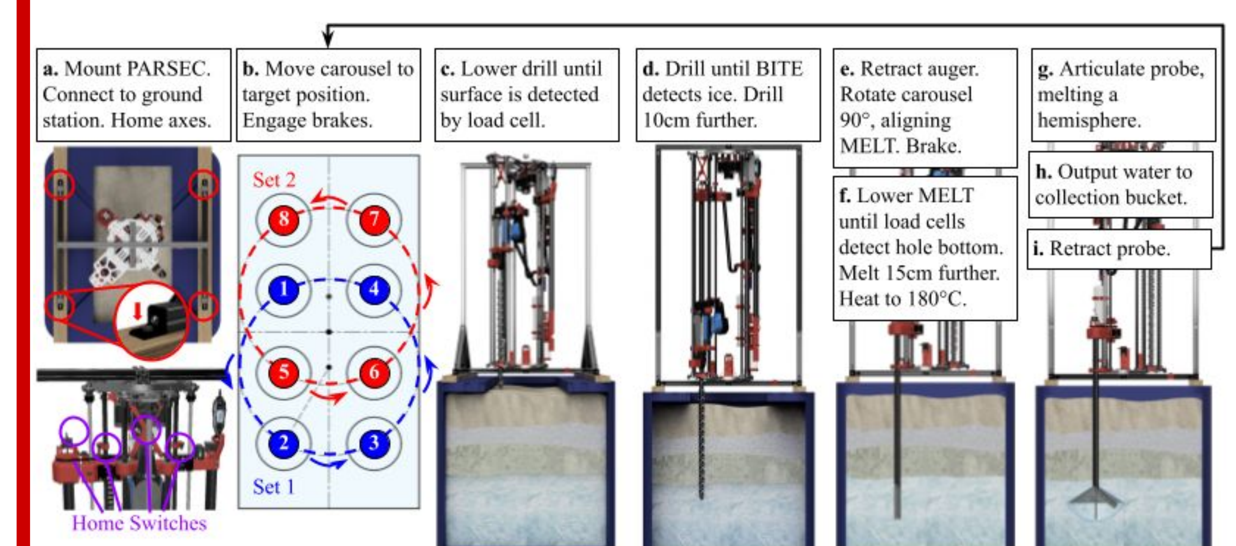
PARSEC's drilling system collects data that is sent to an ensemble of machine learning algorithms.



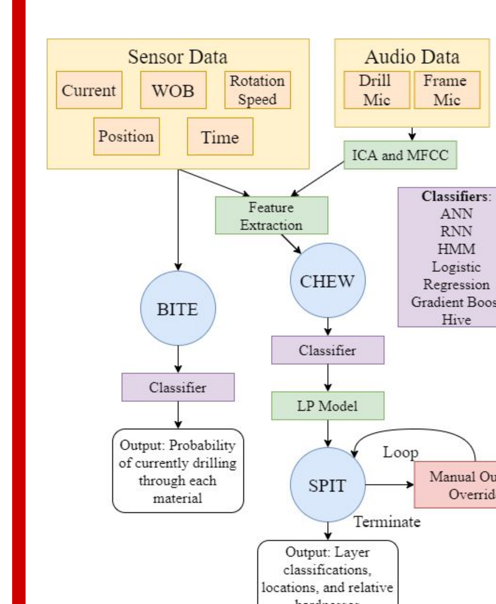


The Northeastern University Percussive And Rotary Surveying & Extracting Carousel (PARSEC) has been developed to overcome one of the largest obstacles in Martian and Lunar colonization: in-situ water extraction. PARSEC is capable of exposing, melting, extracting, and filtering subsurface ice, while providing geological insight.

Competition Procedure

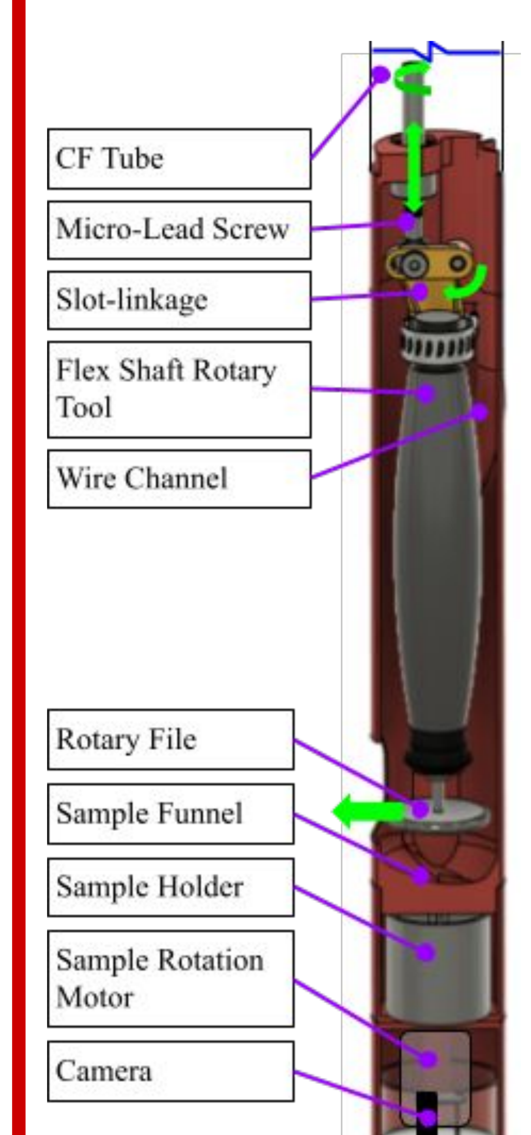


Digital Core



PARSEC generates a digital core using three separate algorithms; BITE, which classifies regolith in real time during drilling using a Hidden Markov Model, CHEW, which classifies regolith after drilling using various machine learning models including neural nets, recurrent nets, gradient boost and logistic regression, and SPIT, which aggregates and ranks the layers by hardness.

CAT



The Core Analysis Tool takes advantage of the unique opportunity to access exposed Martian and Lunar subsurface layers to collect samples for research purposes beyond digital core synthesis.

This is done using an articulating rotary file and a revolving sample holder.