Recreational Spacecraft with Lunar Colonizing Capabilities

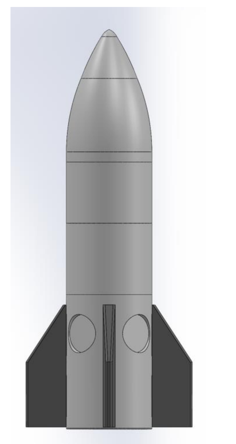
Team Members: Alfonso Acosta, Jazmyn Alcantar, Syle Anton, Elliott Cumming, Ian Jackson, Mohit Kumar, Saverio Masotto, Mario Ramirez
Advisor: Ahmad Bani Younes

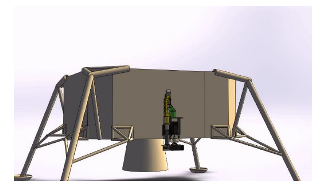
Our Mission (Abstract)

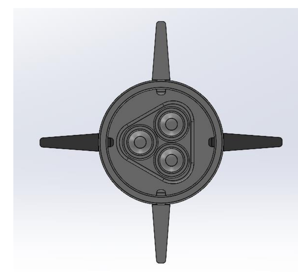
Safely transport humans to the moon and establish a base on the moon.

Landing on the lunar surface must also meet the following requirements:

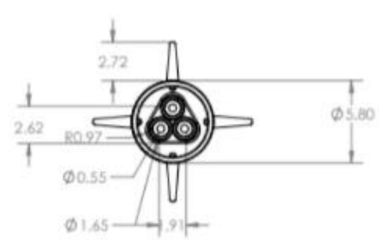
- Land on the lunar south pole.
- Establish the base on the lunar south pole.







Propulsion System



Three NSTAR Xenon thrusters will be implemented, each with the following specifications:

- 2.3 kW input power
- 3300 s specific impulse
- 92 mN Thrust
- 8.33 kg Thruster mass

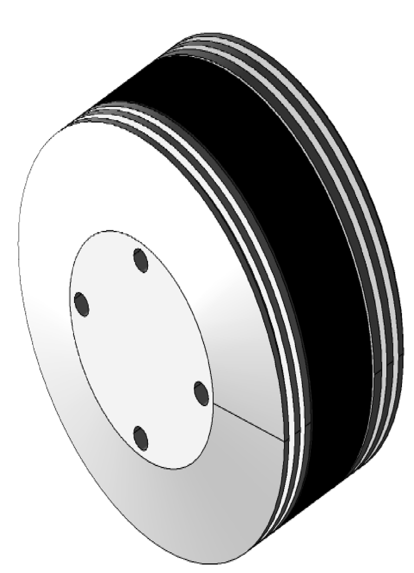
Corresponding to a delta velocity budget of 2.5 km/s, matching the expected budget for low thrust lunar missions lies in the theoretical range of 8 km/s.

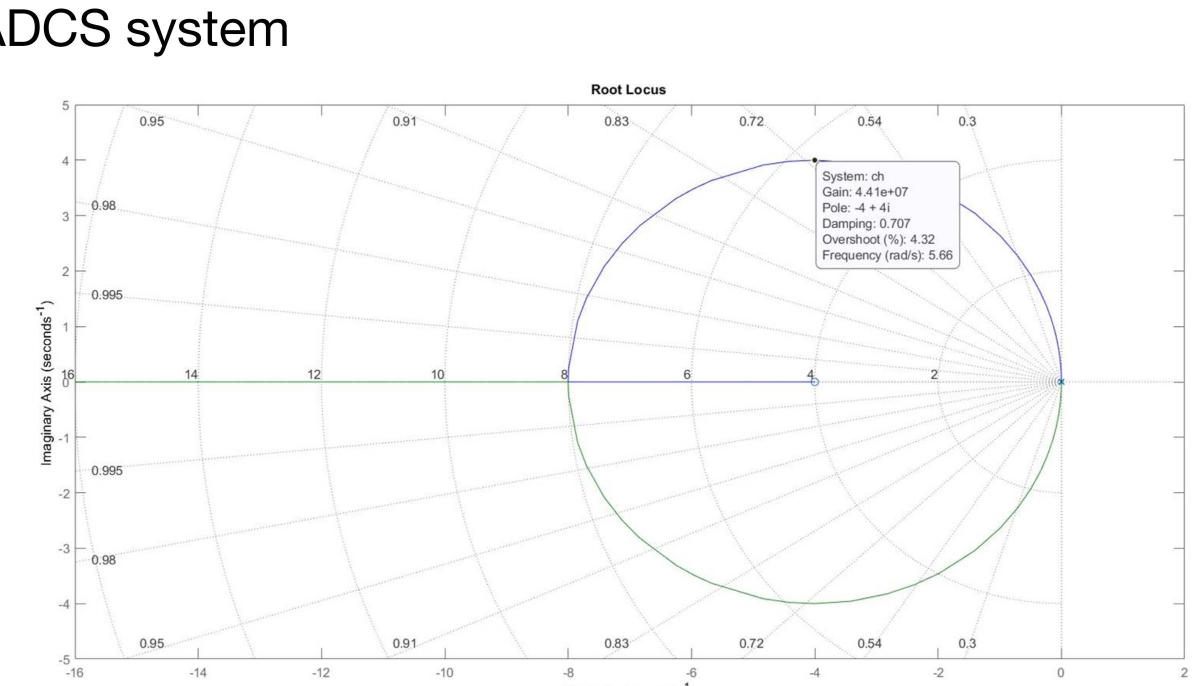
Attitude Determination and Control System

The propulsion system will be combined with the following hardware:

Reaction Wheels

- With a performance range of 0.01-1 Newton-meters, well within the range of the maximum disturbance of 0.02 through solar radiation
- The calculated values for settling time and percent overshoot lie around 10 seconds and 5% respectively, well within the range of a damping ratio of 0.707 employed on spacecrafts using this type of ADCS system





Internal Payload for Recreational Atmosphere

Environmental Control and Life Support Systems (ECLSS), Air Revitalizing Systems, and **Thermal Control Systems** are needed for crew members to inhabit the spacecraft.

Water Recovery System (WRS)

- Capable of storing 3000 liters (1587 kg) of water to sustain a four person crew for 6 months.

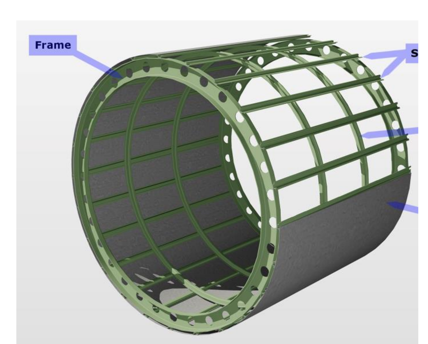
Oxygen Generation System (OGS)

- Water electrolysis as a source for oxygen.
  - 756 kg of water used for 6 months of oxygen.

Food:

- Minimum of 1,793 kg of food required.

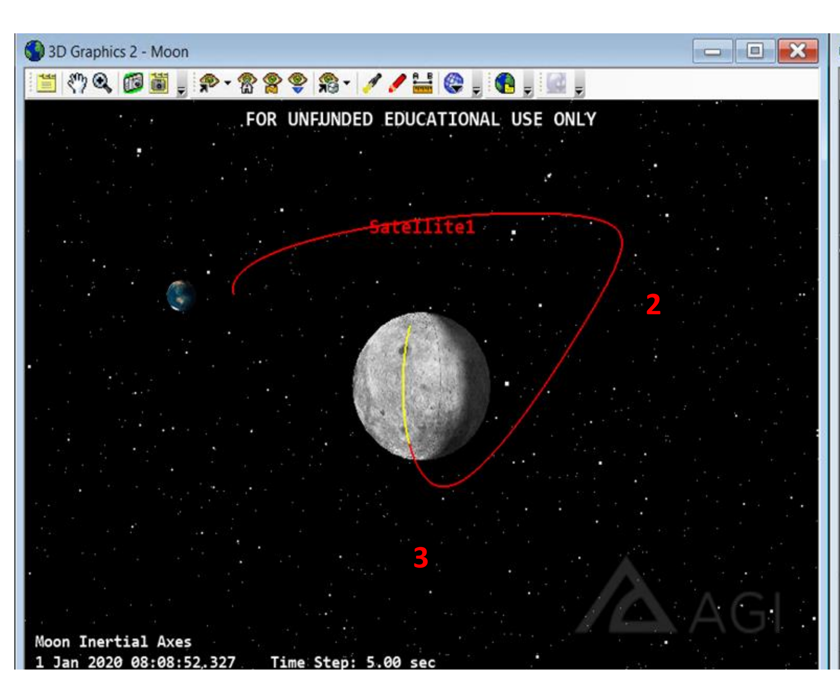
Materials & Structure of Spacecraft

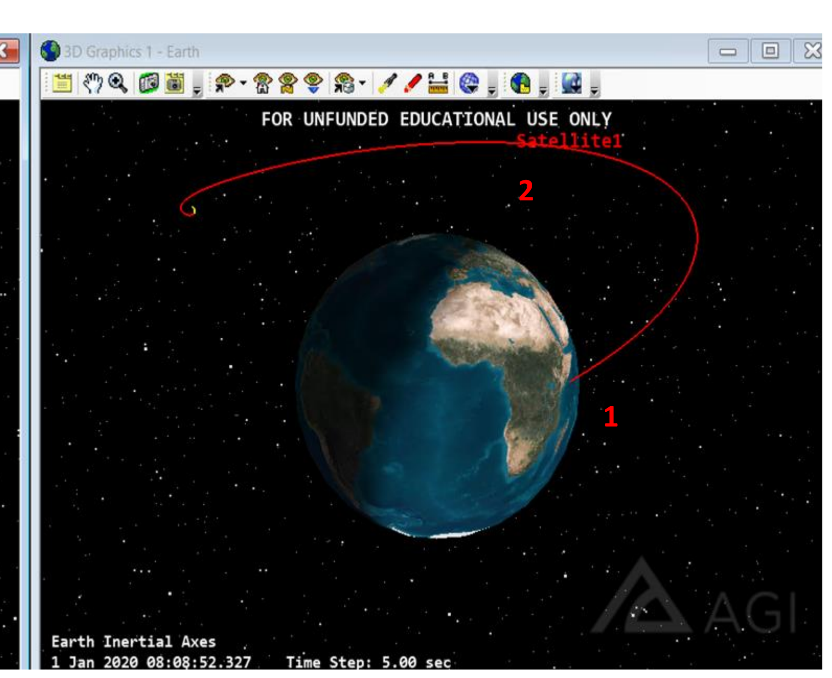


- The interior of our spacecraft would have a semimonocoque structure with bulkheads and spars, similar to airplanes, made of carbon fiber.
- The main body of the spacecraft would be made of stainless steel, similar to SpaceX's Starship rocket.
- The interior of the spacecraft would be pressurized with breathable oxygen.
- The windows and glass dome on the top of our spacecraft would be made of bulletproof glass.
- All the entrances and exits of the spacecraft would be vacuum sealed and easy to open.
- The exterior of the spacecraft would have multi-layer insulation (MLI) to keep the crew and electrical components shielded from radiation.
- Our spacecraft would undergo many tests to ensure that it is ready for operations. These include compression, vibration, and impact testing.

Mission Phases

1. Earth to Leo
2. Leo to Moon Orbit
3. Descent to target

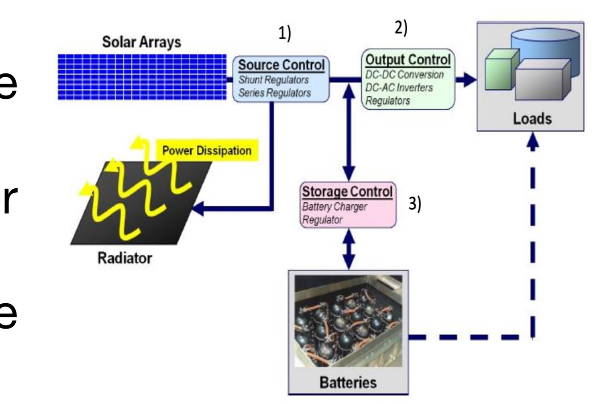




Communication and Electrical System

Electrical System Design

- Nickel-Hydrogen batteries to store energy when base is not in sunlight
- Direct Energy Transfer architecture for output control
- Sun-regulated bus for controlling the voltage



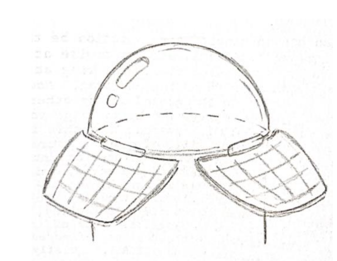
The **Communication System** will allow for high data collection and low latency data relay

- Aluminum gold alloy used to protect onboard computers and Electrical Power System (EPS) from radiation and temperature gradients
- Polarization techniques will be used in order to minimize interference and maximize transmission
- Ku band and S band systems for transponders

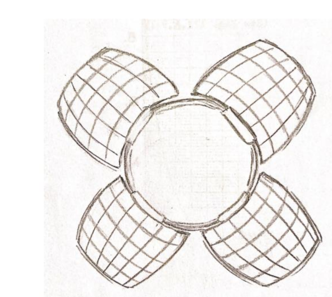
Power Budget and PV System

Once on the moon, the nose cone of the spacecraft will unfold to expose an array of solar panels. The base requires **80.84 kW** of power to sustain all electrical components. This power budget is sufficient to support the lives of 4 astronauts. The solar array has the following specifications:

- Crystalline silicon PV cells
- 25% cell efficiency
- Array power input per square meter = 340 W
- Total required area: 262 square meters



Dome side view



Dome top view

Conclusion: Moon Base Benefits

Having a moon base will allow for research, economic opportunity, and a medium for deeper space exploration.

- **Scientific Purpose**: Scientists can conduct experiments
- **Commercial Purpose**: Companies and individuals can pay to stay on the moon, paving the way for the future of space tourism
- **Deeper Space Exploration**: For future missions to Mars and other destinations, the moon base serves as practice for developing self-sustaining outposts away from Earth

Acknowledgements

This project was conducted under the supervision of Dr. Ahmad Bani Younes. Lectures were prepared and delivered by Dr. Younes who guided Flat Earth Co. to produce the spacecraft design presented in this poster.