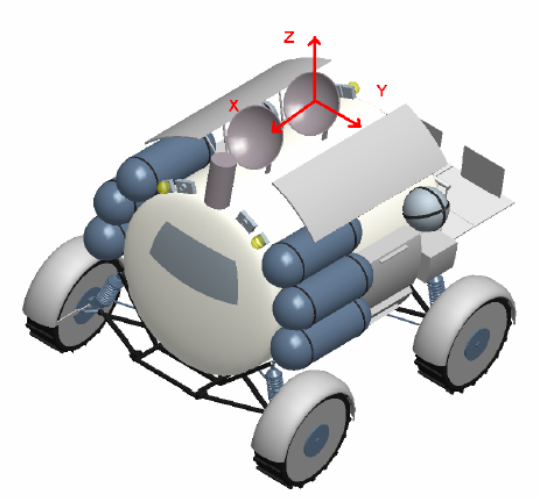
Project TURTLE: Terrapin Undergraduate Rover for Terrestrial Lunar Exploration. David Berg, James Briscoe, Kanwarpal Chandhok, Enrique Coello, Joshua Colver, Aaron Cox, Stuart Douglas, Andrew Ellsberry, Sara Fields, David Gers, Zohaib Hasnain, Ali Husain, Madeline Kirk, Jason Laing, May Lam, Jason Leggett, Michael Levashov, Ryan Levin, Joseph Lisee, Omar Manning, Thomas Mariano, Jessica Mayerovitch, Brian McCall, David McLaren, Adam Mirvis, Ryan Murphy, Aleksandar Nacev, Hasan Oberoi, Ugonma Onukwubiri, Stephanie Petillo, Tiffany Russell, Matt Schaffer, Ali-Reza Shishineh, Jacob Zwillinger. University of Maryland, College Park.

Introduction: The Constellation program is the current driving force behind NASA's future manned space program. In the quest to return to the moon, NASA is focusing its attention to developing a permanent lunar outpost, and focusing its entire infrastructure at that site. However, many of the scientifically interesting sites will not be within surface access distance from the outpost, and can be reached only via a dedicated sortie-mode exploration mission.

The Terrapin Undergraduate Rover for Terrestrial Lunar Exploration (TURTLE) concept is designed to complement and enhance the Constellation program, by exploring the minimum size and mass limits for a pressurized rover while developing a concept of operations that allow the rover to be deployed to the sortie landing site independent of the Altair lander. The TURTLE concept will augment sortie missions on the moon by providing increased exploration range for astronauts. It allows a pair of astronauts to venture up to 25 km away from the lander during a three-day traverse, and supports two such traverses during the sortie mission. This represents a twelve-fold increase in exploration area and duration as compared to an Apollo-style unpressurized rover, without requiring additional Ares V launches; the resultant lunar exploration program is significantly enhanced without impact to the development of the baseline Constellation architecture.



Design: Throughout the development of the TURTLE concept, great attention was paid to designing a complete lunar rover. The cabin pressure shell, sized to provide crew comfort with minimal mass, has an outside diameter of 1.8 m and is 2.4 m long. It consists of two layers of graphite epoxy, wrapped around an aluminum-alloy frame. The rover is 3.4 m long between the tip of each wheel, 3.2 m wide, and 2.9 m high. Ingress and egress for the astronauts are provided by a pair of suitports on the back of the cabin which are accessible via an adjustable external platform, which also provides a control station for driving the vehicle externally during an EVA. Rover structures are sized to have positive margin of safety for launch (6g axial, 2g lateral), landing, and suspension loading cases.

Mobility is provided by a DC brushless magnetic motor in each of the four wheels, which powers TURTLE to a top speed of 15 km/hr. The rover is able to clear a 0.5 meter obstacle, and can traverse a 20 degree slope in any direction in all expected loading configurations.

Mock-up Rover: To perform human factors testing and design an optimal cabin interior, a full-sized mock-up version of the rover was constructed. The pressure shell is a repurposed water storage tank and the interior simulates the planned cabin. The mock-up allowed for testing while designing the cabin layout, as well as determining the feasibility of many interior components. A low fidelity suitport system was also incorporated to allow for simulations of astronaut ingress and egress. After construction was completed, the mock-up rover was incorporated into the research team's outreach effort; the mock-up was presented as a visual aid during design reviews, and was used for tours during publicity events at the University of Maryland.

Project TURTLE was designed by the University of Maryland Space Systems Design capstone course during the Fall 2007 and Spring 2008 semester with advisors Dr. David Akin and Dr. Mary Bowden.