Embry-Riddle A.R.C.

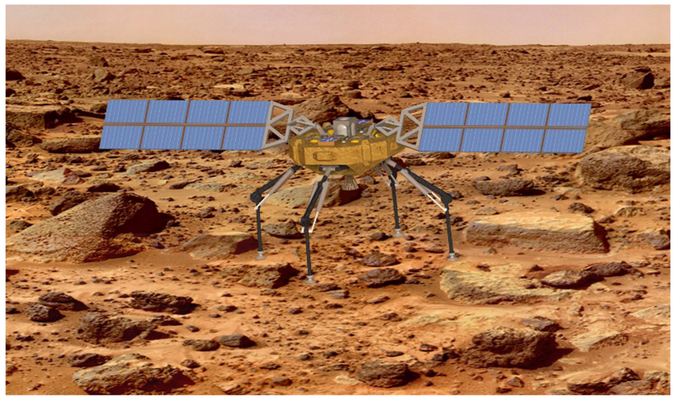
Autonomous Reconfigurable Craft (Spacecraft Prototype)

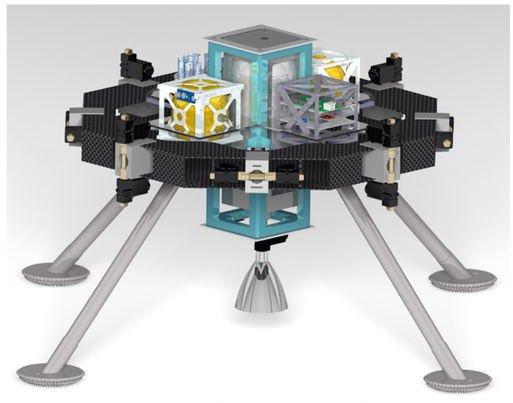
BEYONDARES TECHNOLOGIES, LLC

Faculty: Dr. Sergey Drakunov & Dr. Patrick Currier
Student Team Lead: Jonathon Nadeau
NASA Mentor: Micheal DuPuis

Student Team:
Francisco Pastrana, Patrick Serafin, Ankit Rukhaiyar, Diego Gonzalez, Ferdinand Boudreau, James Cornett, Christina Kor, & Collin Topolski

Abstract: The ARC (Autonomous Reconfigurable Craft) is a small modular spacecraft attitude control platform developed for the purposes of testing control theory, modularity, and specialized autonomous systems for various applications in space. The ARC consists of a carbon fiber base fitted with a pneumatic system and 16 solenoid valves for six degrees of freedom. An onboard Arduino manages the Simulink code for several different controllers to undertake maneuvers. The ARC was designed with modularity as the cornerstone and is capable of switching components based on the U-system that is currently used with cube satellites.



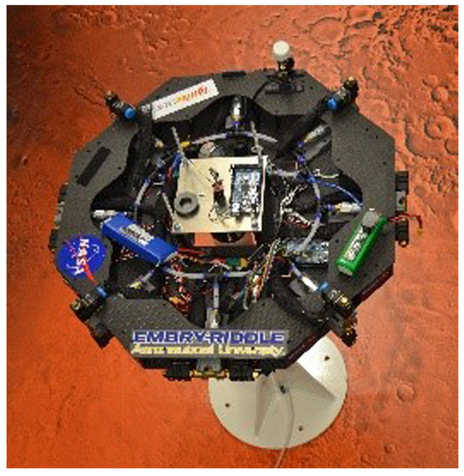


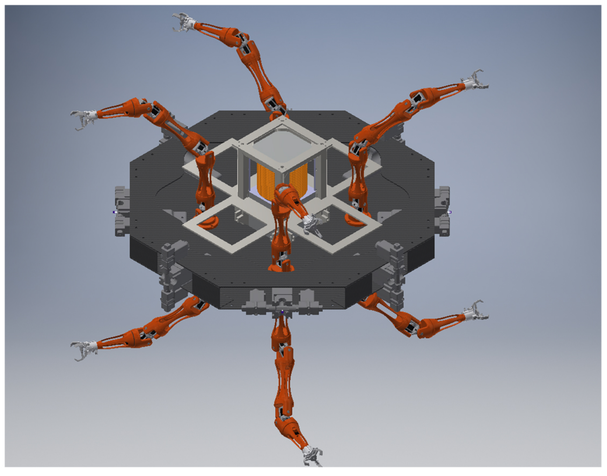
Above are two renderings of the ARC. On the left, a concept rendering of the spacecraft on a Martian surface is extending solar panels to charge its batteries. On the right is an engineering rendering of the structure of the most recent iteration.

Objectives:

- Test different control theories (PID, State Space, Quaternion, Dual Quaternion)
- Create a modular platform in which vital components and systems can be swapped to suit the mission requirements
- Integrate the aforementioned points to create an autonomous system that can carry out a wide variety of missions in a platform that can be rapidly produced at minimal cost.

Modularity: The goal of making the system modular is to help decrease the cost to space by providing a base structure that can then be outfitted in any way to suit the desired mission requirements. Some missions include orbital, lunar, Martian, and asteroid; the spacecraft could be customized to include scientific equipment, solar panels, additional computer systems, or different propulsion systems to fit these missions.





As seen in the photos above, the ARC prototype can be reconfigured to run with tools such as robotic arms, which could be used instead of EVA for spacecraft repair.

Results: At the current state of research, the ARC prototype is fully manufactured and rests on an air bearing. The system has fully controllable manual and autonomous control with the State Space and Quaternion controllers under review. Additionally, solutions for robotic arms, landing gear, solar panels, and power supply are being researched.

Acknowledgments:
Michael DuPuis
Jay D'Amico

Louisiana Steam Equipment Co.

ignite — CREATE • RESEARCH • CHANGE

NASA

EMBRY-RIDDLE Aeronautical University — DAYTONA BEACH, FLORIDA — COLLEGE OF ENGINEERING

College of Arts & Sciences
Embry-Riddle Aeronautical University