Spring 2022 FSI Projects

## Sponsor: FSI / FSGC / NASA

## Mike.Conroy@ucf.edu

Background

The Florida Space Institute (FSI) and Florida Space Grant Consortium (FSGC) created a Student and Senior Design Program focused on the early development of space systems as well as the professional and academic development of the students involved. The goals are:

* To Provide products of use to NASA and the Space Industry
* To Provide meaningful STEM education, development opportunities and experiences for University students with a path to enable these experiences at the High School and Middle School level.
* To Help K-12 students realize that there is a path into STEM fields as well as where that path is and how they can follow it.

FSI and FSGC matured core rover capabilities to satisfy individual project needs and are ready to serve as foundational elements for more advanced projects. These include:

* EZ-RASSOR Robot Software
* EZ-RASSOR Swarm management system
* RE-RASSOR Robot
* RE-RASSOR Arm

Together these provide a ¼ cubic meter robot able to excavate, transport and dump regolith under human or autonomous control; with an arm able to manipulate construction materials necessary to pave roads or landing pads. Future projects can build on these both refine the capabilities and combine them into larger systems for Planetary Exploration and Development.

## The Projects

The 2022 projects build upon NASA RASSOR Technologies as well as the EZ-RASSOR software. For the first time, multiple independent teams working on the same project will be supported. Florida based teams may also apply to FSGC for funding; however, in the event of multiple teams choose the same project, it is possible that not all teams will be funded. Below are the FSI / FSGC Spring 2022 Project New Starts.

### Prototype Construction Robot for the Moon

The Robot will accept and place construction bricks for use on the moon. Precursor technologies include: the RE-RASSOR Robot (with Booms), the RE-RASSOR Arm, EZ-RASSOR software for the Robot, the Swarm Management software and the RE-RASSOR Computing Architecture. The team is expected to design a brick (nominally 300x150x100mm (w, d, h) suitable for both manipulation and assembly by the RE-RASSOR system as well as suited for autonomous assembly of both circular and rectangular structures. This project is for a Robotics team with Computer Science, Aerospace and Mechanical Engineering students. This project is expected to result in extensions and enhancements to the Arm, the Robot, the EZ-RASSOR Software and to provide a standard assembly brick for non-pressurized shelters on the Moon. At completion the team will provide:

* a simulation with four Rovers each placing 5 bricks in a common wall, under autonomous control
* a prototype able to lift and place 3 representative candidate bricks under human or autonomous control

### Heavy Hauler Robot for the Moon

The Robot will lift, carry and deposit heavy items on the moon. These may be construction materials, machinery, completed systems or anything else that needs to be moved. Precursor technologies include: the RE-RASSOR Robot, EZ-RASSOR software for the Robot, Swarm Management functions and the RE-RASSOR Computing Architecture. The team is expected to design the mechanical interface for the items being carried, the vehicle and payload interfaces to pick up and place the cargo and extensions to the EZ-REASSOR software necessary to complete the work. The candidate cargo elements are a 5 meter by .25 meter diameter support and a 2 meter by 2 meter cargo container. This project is well suited for a Robotics team with Computer Science, Aerospace and Mechanical Engineering students. This project is expected to result in extensions and enhancements to the Robot, the EZ-RASSOR Software and to provide a material transportation concept for the Moon. At completion the team will provide:

* a simulation with four Rovers cooperating to lift and place a large load in simulation under autonomous control
* a Prototype able to lift and place a representative load under human or autonomous control

### Lunar Shelter Construction System

The Shelter will provide 100 square meters of protected area with ceiling height of at least 4 meters and one 3 meter by 3 meter opening. The shelter will be constructed of materials of lunar origin, will NOT be pressurized and will provide protection from radiation and micrometeorites. This protection will be equivalent to 1.2 meters of lunar regolith except for in front of the opening. The team is expected to design the site preparation methods, construction components, tools, plans and assembly methods necessary to build the facility on a reasonably level, unimproved area. Construction components (bricks, flooring, supports, roofing) will be designed and prototyped along with the tooling and effectors required to manipulate and place the components. The robotic systems for shelter assembly as well as fabrication of the construction components from lunar resources is not expected, however requirements for each are deliverables. This project is well suited to Civil and Mechanical Engineering teams. The tools are expected to be utilized by individual or cooperating RE-RASSOR robots. At completion teams will provide:

* Prototypes for the construction tools, materials and relevant effectors. Teams will demonstrate these products with human operators in the place of the robotic elements
* Site preparation plans, Shelter components, tools and construction plans for the shelter