RIT Space Exploration Participation in the Intercollegiate Rocket Engineering Competition

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***Abstract*—The Intercollegiate Rocket Engineering Competition is a well-known competition among those interested in amateur rocket engineering as well as those who do so professionally. With over 110 participating teams, it is the world's largest university rocket competition. Every year, more and more organizations are getting involved such as the Space Dynamics Laboratory who sponsors the SDL Payload Challenge. By cooperatively partnering with RIT Launch Initiative and their rocket-manufacturing experience, SPEX has an incredible opportunity to display engineering design proficiency and an extreme passion for space by creating a custom scientific payload to integrate with Launch Initiative's custom rocket.**

NOMENCLATURE

ESRA	Experimental Sounding Rocket Association
IREC	Intercollegiate Rocket Engineering Competition
LI	Launch Initiative
PDD	Project Design Document
RIT	Rochester Institute of Technology
SDL	Space Dynamics Laboratory
SPEX	RIT Space Exploration

I. INTRODUCTION

The Intercollegiate Rocket Engineering Compeition is an annual event hosted by ESRA for student rocketry teams from across the USA and around the world. Beginning in 2017, IREC became the flagship activity of a new annual event called the Spaceport America Cup which is held in June in the New Mexico desert. The competing rockets are typically seen with a diameter of 4 to 8 inches, a length of anywhere from 8 to 20 feet, and will travel to an altitude of either 10,000 or 30,000 feet depending on whether or not the competing team opts to enroll into the basic or advanced category. The Space Dynamics Laboratory sponsors a separate competition at the Spaceport America Cup called the SDL Payload Challenge where scientific payloads integrated into the IREC rockets are judged based on criteria such as scientific relevance and technical execution.

By cooperating with Launch Initiative, SPEX would like to enter IREC in the basic category. LI will provide the rocket body and the rocket engine while SPEX will focus on the integrated scientific payload with the intent of competing in the SDL payload challenge.

II. PRIMARY OBJECTIVE

The primary objective of SPEX's involvement in this competition is to work with RIT researchers to develop and deliver a functioning scientific payload that integrates with Launch Initiative's rocket structure and successfully performs in the competition. Successfully meeting this primary objective implies that multiple supporting objectives have been achieved as well. These objectives include developing a design to meet set criteria, working with professional researchers, communicating and integrating with a separate team, and meeting deadlines through proper design and development flow. Participating in this event provides room to grow academically and professionally for every student involved.

III. BENEFIT TO SPEX

SPEX's involvement in this globally-identified compeition will serve to provide exposure and merit to the team as a whole. Individual students engaged in this endeavor will also benefit by improving technical knowledge and abilities while participating in a major event which can be used to improve their resumes.

A. Benefit to RIT

By attending the event and competing against top universities, RIT will be able to use this as an opportunity to showcase how passionate and involved their students are in space exploration. This involvement can be used in media as a tool for achieving more funds and attracting new students to the University. The media that results from the competition will provide exposure to SPEX and can be used when negotiating with the university when support is required like obtaining more work space or additional tools and equipment.

B. Partnership with Launch Initiative

Since the founding of SPEX, there has never been a strong relationship with the Launch Initiative team. By cooperatively participating in this event, a great opportunity is presented to create a good relationship between two of the largest space-related teams on campus. In the future, united efforts between the two teams could result in more advanced projects which will provide even more exposure to the RIT space teams.

IV. Implementation

Due to a few meetings which occurred over the summer and at the beginning of the semester with students from both SPEX and LI involved, the project has already entered the initial phases. Multiple emails have been sent out to various department heads inquiring about any researchers who may be interested in working with SPEX to participate in the competition. A few meetings have resulted from those emails and although no single researcher has offered an idea with corresponding support, almost all have offered to be of assistance in a limited capacity. Although the hunt continues for a faculty member who is willing to get very involved, a healthy list of potential payload ideas has begun to form already.

A. Timeline

Since the research and development is dependent on the payload chosen and the project is still in the brainstorming phase, the timeline has been the major guide thus far. It is as follows:

- September 1st: Begin narrowing down payload ideas using a decision matrix based on the SDL Payload Challenge rubric
- September 8th: Settle on the specific payload and make a plan of action for research and design
- September 30th: Present a preliminary design with estimates for size, cost, and weight
- November 1st: Mechanical design and delivery date to LI. No changes to the body can be made after this point
- Semester's End: Final hardware design completed and materials ordered

This timeline provides roughly 1 month until a preliminary design is created. After this, there will be another month to refine the design before the final size and interface details must be provided to LI. After this point, there will be more internal hardware design and development for the remainder of the semester with a goal of purchasing all materials by the semester's end. If this timeline can be adhered to, then the entire spring semester and summer months leading up to the competition can be used for manufacturing, programming, testing, and characterization.

B. Deliverables

The first deliverable will be the preliminary design and bill of materials with a corresponding estimate of size, weight, and cost. If it is found that additional funds need to be raised, then the preliminary design can be used in fundraising requests so that businesses and investors know that sufficient research and development has already been put into the project. After the preliminary designs, the next deliverable will be the final external dimensions and interfaces so that LI can proceed with their construction of the rocket. Finally, the actual payload will need to be delivered by the competition date although it will be provided much earlier than that due to the necessity of integration and testing.

V. Externalities

A. Prerequisite Skills

To participate in this endeavor, there are no prerequisite skills. However, for the project to succeed, there will need to be individuals who are proficient in computer-aided design and analysis for the mechanical structure of the payload. There will also need to be individuals proficient in electronic design, specifically with respect to printed circuit boards. Additionally, individuals proficient in programming will be required for embedded systems design and ground-station interfaces. Finally, there will need to be some individuals who are willing to spend time researching IREC rules, previous related payload missions, and acting as a resource to those designing the hardware and software.

B. Funding Requirements

Without knowing the target payload, it is difficult to give an accurate funding requirement. However, for ease of financial planning and design constraints, the target value is 500 dollars. If additional funding is needed after a sufficient effort has been provided, then the SPEX admin team will be contacted and steps will be taken to close the gap and secure the necessary funding.

C. Faculty Support

Faculty support will be consistently saught after during the design and manufacturing of the payload. Although, as discussed before, no faculty have yet been willing to dedicate a large block of time to assist this project. There have been multiple offers to provide guidance in a limited capacity. Although this project can succeed solely with SPEX members, this is a great opportunity to cooperate with RIT professors and researchers who can provide their knowledge and experience.

D. Long-Term Vision

The long-term goal of this project is to establish a relationship between LI and SPEX in which the teams can continue to cooperate in future IRECs and other multi-team projects. By working off of past successes, SPEX and LI can grow together and eventually compete in the advanced category against the leading schools. The other long-term goal is to show that SPEX is a strong team with a lot of hard-working individuals who are extremely passionate about space.

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