



SOCIETY FOR ADVANCED ROCKET PROPULSION

IN THIS ISSUE

LETTER FROM THE CHIEF

WHO ARE WE?

JANICKI TOUR

RESUME BOOKS

SUBTEAM HIGHLIGHT: AVIONICS

END OF YEAR SHOWCASE



EDITED BY KATHERINE BUTLER
2021-22 SARP PROJECT MANAGER

LETTER FROM THE CHIEF

Hello reader,

This quarter has been an exciting and unique one for SARP as we push towards launch readiness of *Pacific Impulse* and begin focus on design and tooling for our next 12" rocket. In January, the team redesigned our injector actuation system for improved reliability with the goal of unlocking launch this Spring. As we prepared for further testing, we discovered concerns related to operational liability which imposed a temporary halt on all test attempts and lab space use. As SARP uses this time to generate documentation and scrutinize risk, it is critical to emphasize the importance of investigating failure modes, building procedural safety, and communicating risk at every level of design and implementation. With a spectrum of pending approvals, it is difficult to say what impact this testing hiatus will have on *Pacific Impulse* launch, but the team remains prepared and committed to moving forward when permitted.

With some additional bandwidth, the team is shifting focus towards our next rocket. To reach space with a liquid bipropellant rocket, SARP must maximize the technical delta between our hybrid heritage and a system capable of delivering a payload to the Karman line. This translates to approximately 20x increase in altitude from our Spaceport America Cup champion *Moon Dawg*. Design work for our next rocket includes not only iterative optimizations such as diameter increase and weight reduction, but also transformative technical leaps such as regenerative engine cooling, active guidance research, and a redesign of our engine testing system from a vertical test stand (all three tanks and the engine) to a horizontal engine-only platform. As the team generates requirements and moves towards design reviews, we are excited to contribute to the technical and organizational growth that will push future generations of SARPers towards space.

With a new year approaching, we have selected the 2022-23 leadership team and they will be learning everything they need to be successful throughout spring quarter. I'm excited to see SARP's progress towards space in the capable hands of next year's team.

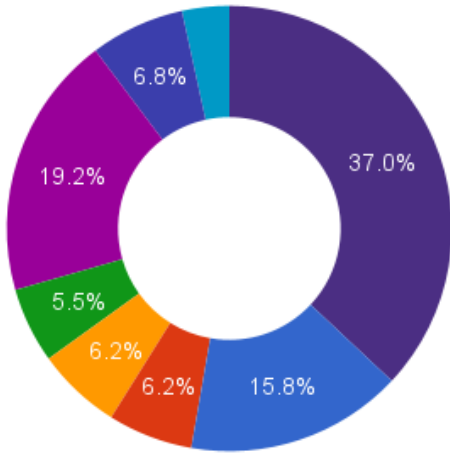


Hot Fire 3 Day 2: Despite the lack of technical success, the test crew is smiling and ready to do it all again! Photo: Josh Sherbrooke

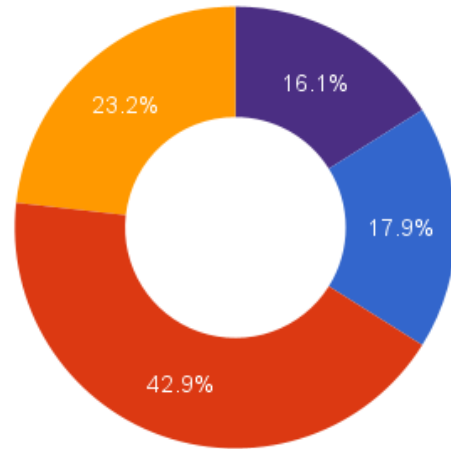


JOSHUA SHERBROOKE
2021-22 SARP CHIEF ENGINEER

WHO ARE WE?



- Aeronautics and Astronautics
- Mechanical Engineering
- Computer Science
- Electrical Engineering
- Engineering (Other)
- Engineering Undeclared
- Sciences and Math
- Business, Economics, and Design

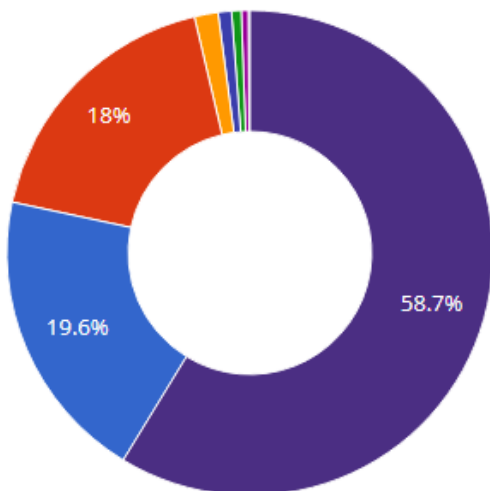


- Freshman
- Sophomore
- Junior
- Senior

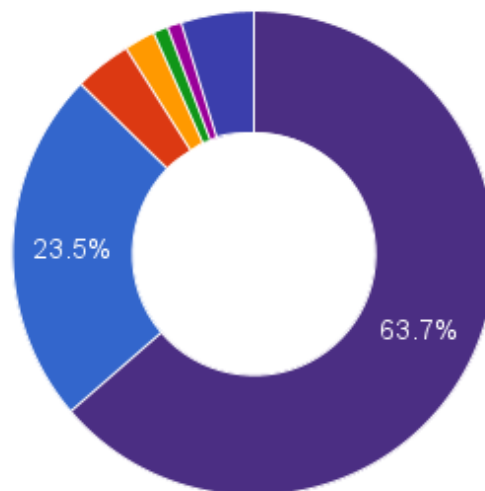
142 MEMBERS

600+ ALUMNI

UNIVERSITY OF WASHINGTON
COLLEGE OF ENGINEERING



SOCIETY FOR ADVANCED
ROCKET PROPULSION



- Employed Full Time
- Continuing Education
- Seeking Employment
- Employed Part Time
- Seeking Continuing Education
- Volunteer Service
- Not Seeking

JANICKI TOUR

In February, some SARP members traveled to Janicki Industries' facility in Hamilton, WA to receive a tour, present how we use composites on our rockets, and receive feedback on the manufacturing method for our next nose cone. Janicki specializes in custom composites manufacturing and during the tour we were able to see their state-of-the-art manufacturing in process. After the tour, SARP's structures subteam presented about our composites manufacturing and Janicki's engineers shared insight about new manufacturing techniques and gave advice on how best to use and manufacture composites for the nose cone, airframes, fins, and COPVs on SARP's rockets. Additionally, the nose cone team proposed a nose cone mold design for Janicki to review and potentially sponsor. This would be a female mold with fiberglass prepreg for a Von Karman nose cone 12 inches in diameter and 60 inches tall capable of being used at least 10 times. After the presentation, some SARP members interviewed for jobs and internships and several of them will be spending the summer at Janicki, learning manufacturing techniques and honing their engineering skills.



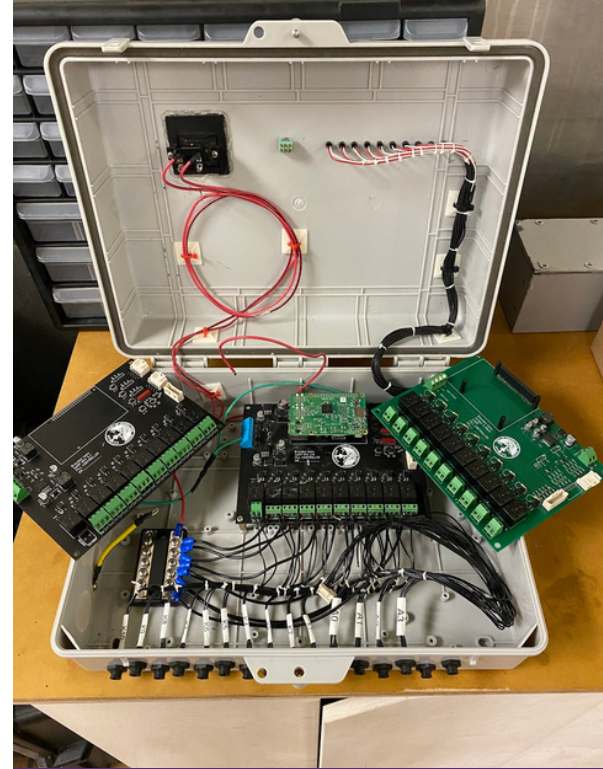
RESUME BOOK AND RECRUITING OPPORTUNITIES

ATTENTION POTENTIAL EMPLOYERS!

SARP has a history of creating excellent engineers that go on to work at some of the top engineering companies. If you want to tap into this vast technical experience for your company, send us an email at sarpuw@gmail.com for a copy of our resume book or to set up a recruiting event!

SUBTEAM HIGHLIGHT: AVIONICS

The Avionics team is responsible for all of the hardware and software that remotely controls the propulsion system, collects and visualizes rocket data, and communicates with the rocket prior to launch and in flight. This includes controllers for the actuators throughout the propulsion system, ground networks and radios, data collection for sensors on and off the rocket, and aggregating and visualizing this data at ground control. Concurrently, our autonomous recovery project is developing a system to land our rocket at a predetermined location, and our stability control project is developing an active control system for maintaining rocket stability in flight.



Fill control box and interchangeable controllers Photo: Ryan Hallgrimson



Jacob and Matthew demonstrate proper safety attire. Photo: Ian Minatani

BUT FIRST, A NOTE ON SAFETY

Safety is the driving force behind all design and development decisions we make on the avionics team because we are working with such an energetic pressurized system. This system is designed such that if any single aspect of the system fails at a given moment, we are able to depressurize the system. We have two actuator control boxes (the fill and propulsion controllers) that are each capable of venting our entire system independently. Additionally, each controller continuously verifies its connection with ground control and automatically vents the entire system if it is unable to connect to ground control for 10 minutes. Together with thorough testing of all our components both in isolation and as an entire system, we ensure that our team will not find itself in a situation where we are unable to remotely depressurize and safe our system.

INJECTOR REDESIGN

After Hot Fire 2, we completely redesigned the system propellant injection actuation system. Our previous system used a chain linkage between a vane actuator and the ball valves, which often seized and got stuck. The new design uses a linear solenoid to release a spring loaded lever arm. When the solenoid is actuated, the solenoid pin retracts, allowing the lever arm to swing under the tension of the spring.

HOT FIRE 3

DAY 1

Day 1 started off on a good note, with setup going faster than expected. The rocket was configured for pressure checking and validation of the new injector actuator, and leak checks were completed without issue. However, during the actuation testing, it was determined that the actuation rate was slower than expected. It was believed that the ball valve was experiencing excessive internal friction, which we attempted and failed to replicate on campus. The ball valve was serviced and the rocket was reassembled for another attempt on Monday.

DAY 2

Again, setup was exceptionally quick and with few issues. The rocket was prepared and ready for pressure testing at 10am, the earliest we have been configured for pressurized testing. However, during actuation checks, the ball valve was still found to actuate at a rate slower than tolerable and we decided to return to campus to further troubleshoot the issue.

DEBRIEF

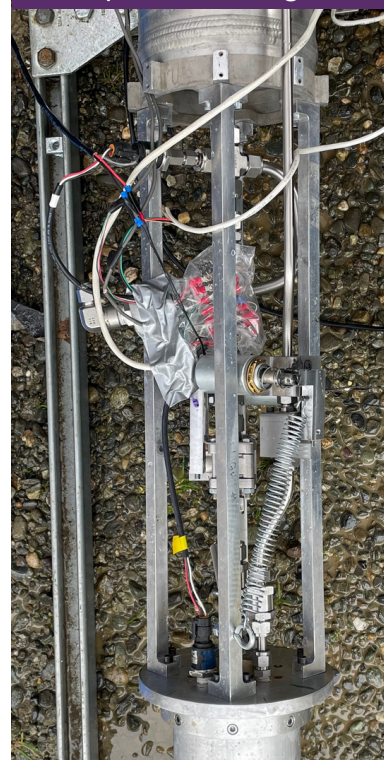
Upon further investigation, we discovered the prior on campus testing did not provide the necessary pressure against the ball valve throughout the duration of actuation (from fully closed to fully open). This was rectified by increasing the volume of gas restrained by the ball valve, which in turn allowed us to select an appropriately tensioned spring.

PACIFIC IMPULSE CLOSEOUT

In addition to supporting large scale testing like static fires, our team has continued to work towards completing everything needed to launch our *Pacific Impulse* rocket. Our Flight Data, Launch Ops, and Netcomm teams have updated our controller PCB's, developed the rocket wire harness, completed full range radio testing, improved PCBA redundancy by manufacturing spares, developed mounts for our on-rocket electronics, and created a live onboard rocket camera feed. This hard work from our team members helps to prepare us so we are ready to launch *Pacific Impulse* at any moment.



Original Motor/Chain/Sprocket Design



New Solenoid/Lever/Spring Design

WHAT'S NEXT FOR AVIONICS?

As a whole we are working to build a platform that we can build off of from year to year without the need to redevelop similar pieces each design cycle. To do this we are working on standardizing testing practices, improving system reliability and documentation, and designing our hardware and software to easily accommodate the growing needs of the team as we create more complex systems. These improvements will allow us to build up rather than building over, and stretch our systems capabilities faster and further each year.

Simultaneously we are working on several research projects to prepare us to push for space. Our autonomous recovery experimental system (ARES) team is designing a system to autonomously guide the rocket during recovery using a parawing. This will allow us to predetermine a landing spot for our rocket and safely guide it there. This helps reduce the distance the rocket can travel during recovery so that as we fly higher we aren't traveling farther to recover our rocket. Our Netcomm team is researching longer range radio communication methods to ensure we are able to receive telemetry data from our rocket through its entire flight even as we reach for higher altitudes. Finally, our stability control team is working in conjunction with propulsion's advanced controls team to develop active control mechanisms for our rocket to ensure stable flight through longer burn times. Since our passive stability elements become less effective as the atmosphere thins, we will need a method to ensure we continue to fly straight up through our entire burn duration. Avionics is working hard to ensure that we are prepared for the challenges ahead as we come closer to achieving our long term goals.



RYAN HALLGRIMSON

2021-22 LEAD AVIONICS ENGINEER

END OF YEAR SHOWCASE

Join us on Tuesday, May 24th at 5:30pm in Guggenheim Hall, Room 220 for a presentation of SARP's accomplishments during 2021-22 and to see *Pacific Impulse* fully assembled. Additionally, you are welcome to attend via zoom at washington.zoom.us/j/98926516206.