Oregon NASA
Space Grant Consortium

2017 Student Symposium
Proceedings
November 9, 2017
9:00 am - 6:30 pm

LaSells Stewart Center
Ag Production/Ag Leaders Rooms
Oregon State University

featuring presentations from
NASA student interns, fellows, research scholars and student teams

2017 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
November 9, 2017

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Presentation Schedule

8-9am	**POSTER SESSION SET-UP** - Breakfast provided for presenters
9-9:30am	**OPEN POSTER SESSION**
9:30-10am	**KEYNOTE SPEAKER** - Mr. Torry Johnson, Assistant Deputy Director, Hydrosphere & Biosphere Science NASA Goddard Space Flight Center

TIME	Presenter
10:00am	**Caleb Turner -** Portland State University - NASA Marshall Space Flight Center Internship Title: *Propulsion Analysis of Lunar Lander Concept*
10:20am	**James Benbrook, Ryan Domres, Dagim Gebretsadik, Chloe Jordan, and Justin Luc -** Oregon State University OSGC Undergraduate Team Experience Award Program Title: *Oregon State Rocketry Team ESRA Spaceport America Cup Competition*
10:40am	**Sam Colosimo -** University of Portland - NASA Goddard Space Flight Center Internship Title: *Silicon X-Ray Optics Manufacturing*
11:00am	**Amy Caldwell** - Oregon State University - NASA Marshall Space Flight Center Internship Title: *Creating the Acquiescent Rail Translator Equipment for Mass and Inertial Support (ARTEMIS)*
11:20am	**Bertrand DeChant, Mark Musil, and Jacob Tiller** - Portland State University - OSGC Undergraduate Team Experience Title: *Portland State Aerospace Society Liquid Fuel Engine Test Stand (LFETS)*
11:40am	**Matthew Lucas and Audrey Vaughn -** Linn-Benton Community College - Higher Ed Research Award Title: *Launch Procedures for Offshore Flights*
12:00pm	**LUNCH/NETWORKING/POSTERS** - Food and refreshments provided for presenters
1:00pm	**Levi Willmeth -** Oregon State University - NASA's Independent Verification & Validation Facility Title: *Adapting NASA Avionics Software Commonly Used on Rockets and Satellites, to Control a Commercially Available Drone*
1:20pm	**Louis Detweiler** - Southern Oregon University **-** NASA Ames Research Center Title: *Tool Support for UAS Hazard Risk Assessment*
1:40pm	**Michael Polander -** Oregon State University - OSGC Undergraduate Team Experience Award Program Title: *OSU 2017 RockSat-X Program - Hephaestus*
2:00pm	**Diane Demchenko -** Portland State University - OSGC Undergraduate Research Fellowship Title: *Creating a General Antiviral: Testing the Inhibition of Spindle-Shaped Virus 1 and Yellow Fever Virus by Silver Nanoparticles*
2:20pm	**Matthew Morse -** Oregon State University - NASA Marshall Space Flight Center Internship Title: *Orbital Class Nanosatellite Launch Vehicle Spin-Stabilization System*
2:40pm	**Nina Cox, Daniel Folkerts, and Savannah Grey -** Oregon Coast Community College - Higher Ed Research Award Title: *Using Radiosondes to Detect Atmospheric Changes During the Total Solar Eclipse*
3:00pm	**BREAK**
3:20pm	**Alex Farias -** Portland State University - OSGC Undergraduate Team Experience Award Program Title: *Portland State Aerospace Society Composite Cryogenic Fuel Tank*
3:40pm	**Charity Woodrum -** University of Oregon - OSGC Faculty Research Award Program Title: *Evolution in Solitude: Field Galaxies from Half the Age of the Universe to the Present*
4:00pm	**Miles Curry** - Oregon State University - OSGC Internship: Oregon Sea Grant Seacast Project Title: *Seacast - A Python Web Application to Display High Resolution Weather and Ocean Forecast Models for Ocean Consumers*
4:20pm	**Alexander Chabert, Thomas Manfredonia, and Savon Sengsavanh -** University of Portland OSGC Undergraduate Team Experience Award Title: *Micro-Radial Jet Engine*
4:40pm	**Austin Gulstrom -** Oregon State University - NASA Goddard Space Flight Center Internship Title: *Analytical Software Validation for Composite Technology*
5-6:30pm	**RECEPTION/NETWORKING/POSTERS** - Food and refreshments provided

Keynote Address

Torry A Johnson
Assistant Deputy Director for Hydrosphere, Biosphere, and Geophysics, Earth Sciences Division
NASA Goddard Space Flight Center

Mr. Torry Johnson has worked at Goddard Space Flight Center since 2003. Currently, Mr. Johnson serves as the Assistant Deputy Director for Hydrospheric and Biospheric Sciences within the Earth Sciences Division. In this role, he oversees the fiscal and operational matters of the organization. In addition, Mr. Johnson function as the Agency's Activity Manager for the Tribal College and University Project. This project intersects with the Office of Education and seeks to provide opportunities to engage American Indian and Alaskan Native students/faculty in STEM endeavors, building upon NASA's unique assets.

Mr. Johnson's special area of interest is Public Outreach and Engagement and has worked with projects such as Know Your Earth, a nationwide, multi-mission education & public outreach effort that seeks to expose the public to Earth Science via mass media (billboard campaigns and movie theater PSAs) and Adopt a Pixel, a "citizen-science" effort aimed at getting the public involved in the collection of land cover images. He also likes to serve as a science fair judge and mentor high school and undergraduate students. Mr. Johnson currently serves as an advisor for the NSF funded Integrated Geospatial Education and Technology Training (iGETT), which helps two-year colleges meet the growing workforce need for geospatial skills.

Abstracts

James Benbrook, Ryan Domres, Dagim Gebretsadik, Chloe Jordan, and Justin Luc
Oregon State University
OSGC Undergraduate Team Experience Award Program
Oregon State Rocketry Team ESRA Spaceport America Cup Competition

The Spaceport America Cup (SAC) is an intercollegiate rocket engineering competition that provides a platform for schools around the world to design, build, and launch sounding rockets. The 2017 Oregon State Rocketry (OSR) team entered into the student researched and designed advanced category. The goal was to reach a target altitude of 30,000 ft. above ground level while carrying a scientifically relevant payload, and to recover the rocket and payload after launch.
The team is comprised of mechanical, electrical and computer science engineering sub teams. The mechanical sub-teams were responsible for the design and construction of the air vehicle structure, motor, propellant, recovery system and payload. The 2017 rocket has a carbon fiber body, solid propellant motor, and dual stage CO2 parachute deployment. The payload is a fixed wing glider that is ejected at apogee, unrolls its wing, and collects CO2 data as it descends. The electrical and computer science sub-teams collect and telemeter flight data back to the ground station.
Two test launches were performed prior to competition. Each test launch had failure modes, but each one was addressed and mitigated prior to the final launch. On June 22nd at Spaceport America the rocket reached 25,283 ft. AGL. The rocket and payload were found in relaunch condition; however, the payload wing was still rolled so the functionality of the guidance system was inconclusive. The CO2 detector functioned nominally throughout the flight. The OSR Team placed 3rd in the 2017 SAC.

Amy Caldwell, Oregon State University
NASA Marshall Space Flight Center
Creating the Acquiescent Rail Translator Equipment for Mass and Inertial Support (ARTEMIS)

At NASA's Marshall Space Flight Center, the 86 square-meter solar sail, its deployer, and the mass translation table of the Near-Earth Asteroid Scout Cube Satellite are in their final stages of design and testing. This cube satellite and its components are designed to operate in zero gravity, making it challenging to test any of their functions on Earth. However, due to its fragility, the mass translation table is the most difficult to test because it would sustain a lot of damage if it was operated on the surface of Earth. Therefore, the project of designing and creating a custom set up to allow for the testing of this component was created. Over the term, a machine named ARTEMIS, an acronym for Acquiescent Rail Translator Equipment for Mass and Inertial Support, was designed, drawn, and analyzed in the computer-aided design software PTC Creo. ARTEMIS was then constructed on-site in the Fabrication Laboratory. The final product at the end of ten weeks was a functional machine that removes the mass load from the translation mechanism. The machine also allows for movement in the x and y directions at the discretion of the translation table with negligible resistance. Future developments of ARTEMIS will allow for the mass translation table to be tested under vacuum conditions with varying temperatures and translation rates.

Alexander Chabert, Thomas Manfredonia, and Savon Sengsavanh, University of Portland
OSGC Undergraduate Team Experience Award Program
Micro-Radial Jet Engine

The University of Portland Micro Radial Jet Engine Team (MJET) designed, manufactured and tested a small-scale jet engine for ongoing use as a university laboratory experiment. The team of four Mechanical Engineering students (Alexander Chabert, Jake Johnston, Thomas Manfredonia and Savon Sengsavanh) started with an overarching analysis of the Brayton cycle and broke down design and development criteria into five key elements: diffuser, compressor, combustor, turbine and nozzle. The goal was to make the engine self-sustaining and achieve approximately 20 pounds of thrust. Integral to project success was the division of labor and specialization to both increase speed of the process as well as allow the team to acquire a wide breadth and depth of knowledge. Each member was assigned a specific section of the jet with design and manufacturing responsibilities for that element. Utilizing University of Portland resources as well as benefiting from industry expertise and contributions, most notably Boeing Gresham, Blount and Precision Castparts, the team was able to construct and test the engine. Subsequent design teams will attempt to push the engine into full operation. The project was an amazing opportunity to gain real world design experience within aerospace. The project would not have been possible without The University of Portland and OSGC's assistance. Three of the four members have graduated, two are pursuing careers in aerospace, one is attending the Colorado School of Mines PhD program specializing in Thermal Fluid Sciences and the fourth is in ROTC with military career plans.

Sam Colosimo, University of Portland
NASA Goddard Space Flight Center
Silicon X-Ray Optics Manufacturing

The advancement of X-ray astronomy largely depends on technological advances in the manufacturing of X-ray optics. Future X-ray astronomy missions will require thousands of nearly perfect segments to produce an X-ray optical assembly with < 5 arcsecond HPD (half-power diameter) resolving capability and a large photon collecting area, a feat impossible to accomplish with traditional glass mirrors. To meet these requirements, research has been done in developing time-efficient and cost-effective processes to manufacture single-crystal silicon mirrors. Single-crystal silicon is preferred over glass as a mirror substrate due to its stiffness, lack of internal stress, lower CTE (coefficient of thermal expansion), and higher thermal conductivity. The performance of the telescope is not only dependent on high quality mirrors, but also the focus of the mirror assembly. This poster details improvements to some of the sub-processes or mirror manufacturing, as well as the alignment of the mirror assembly.

Nina Cox, Daniel Folkerts, and Savannah Grey, Oregon Coast Community College
Oregon Space Grant Higher Education Research Award
Using Radiosondes to Detect Atmospheric Changes During the Total Solar Eclipse

The purpose of our project was to identify any meteorological anomalies in the atmosphere during the August 21, 2017 total solar eclipse. We collected data using latex balloons filled with helium, several of Graw's DFM-09 radiosonde weather sensors, and Graw's GS-U ground station. Our equipment took meteorological readings of temperature, dew point, and pressure, as well as wind speed and direction. In the weeks leading up to the eclipse we performed multiple test launches to ensure the integrity and accuracy of our equipment. On the day of the eclipse, we launched two radiosondes before and two after totality to monitor any changes in the atmosphere that may have been caused by the astronomical event. Our results indicated that there were no significant meteorological changes as a result of the eclipse. The data remained relatively stable shortly before and after totality, although there were slight changes in the locations of the surface inversion and tropopause. This was unexpected as terrestrial conditions had appeared to change dramatically during the eclipse, in terms of temperature. This overall project will add to the budding science of the study of total solar eclipses and will hopefully contribute to the sophistication of an international standard for studying such cosmic events.

Miles Curry, Oregon State University
Oregon State University Sea Grant Seacast Fellowship
Seacast - A Python Web Application to Display High Resolution Weather and Ocean Forecast Models for Ocean Consumers

Seacast is a web application that displays forecasted ocean and weather models of the Oregon Coast and parts of the California and Washington Coast via mobile and desktop browsers. Two of the models currently used are produced at Oregon State by faculty of the College of Earth, Ocean and Atmospheric Sciences (CEOAS) and are the highest resolution for their type and domain. Local Oregon fisherman account for the user base and frequently use the site to locate potential fishing areas. Interns are tasked with maintain and updating the site with new features. This summer's improvements included: support for models with lower resolution, but larger forecasted date ranges, to extend current base models; increase site stability by creating more reliable download functions; improving applications logs; and a large refactor of the code base and documentation to increase developer readability. Presentation will present on these new features as well as discuss the site as a whole.

Bertrand DeChant, Mark Musil, Tara Prevo, and Jacob Tiller, Portland State University
OSGC Undergraduate Team Experience Award Program
Portland State Aerospace Society Liquid Fuel Engine Test Stand (LFETS)

Testing is a critical part of developing a new liquid propellant engine. When the Portland State Aerospace Society (PSAS) decided to switch from solid to liquid propellants for their high altitude amateur rockets, the need for a sophisticated but reliable test stand became a critical path project. The Liquid Fuel Engine Test Stand (LFETS) will serve as a testing platform for PSAS' liquid propellant rocket motor hardware development. Designed to be scalable to a maximum engine thrust capacity of 10 kN (2250 lb), initial motor testing will be on a 3D printed, 2.2 kN proof of concept engine design. The test stand has four systems: a high-pressure Nitrogen pressurization system, a cryogenic liquid oxygen system, an isopropyl alcohol compatible fuel system, and a spark torch ignition system. Plumbing systems have been designed for maximum reliability with built in fail safes. A custom electronics system is being built based on the Marionette open source data acquisition system. In the future, the LFETS will also act as a test bed for integrating future technologies, including an electric propellant pumping system and a cryogenic-compatible composite propellant tank. Besides providing critical test infrastructure for PSAS, LFETS provides an outstanding learning opportunity for the students involved due to its collaborative, open source, interdisciplinary, safety critical, and demanding nature.

Diana Demchenko, Portland State University
OSGC Undergraduate Research Fellowship
Creating a General Antiviral: Testing the Inhibition of Spindle-Shaped Virus 1 and Yellow Fever Virus by Silver Nanoparticles

Broad-spectrum antivirals will probably be essential for long-duration manned space travel. Recently, silver nanoparticles (AgNP), were shown to reduce the infectious ability of a number of viruses and resistance is unlikely to develop. Previous research has explored the inhibition effects of AgNP on *HIV-1, Monkeypox virus, Tacaribe virus,* and *Hepatitis B*, and all of them have concluded that silver blocks the infectious ability of each virus. Using quantitative plaque assays, I have tested the effects of different AgNP on two very different viruses, the extremophile Spindle Shaped Virus 1 (SSV1) and the Yellow Fever Vaccine (YFVax). SSV1 is inhibited by AgNP. The method of inhibition is still unknown. Further studies will explore the mechanism or mechanisms of inhibition. The effects of modified AgNPs on these viruses will also be tested.

Louis Detweiler, Southern Oregon University
NASA Ames Research Center
Tool Support for UAS Hazard Risk Assessment

To enable unmanned aircraft systems (UAS) operations in the national airspace system, demonstrating compliance to federal aviation regulations (FARs) is required. Compliance to the FARs can be shown by a safety case, which is an engineering artifact presenting the justification for system safety and evidence of safety risk management. Safety arguments form a core component of safety cases; however, their production can be cumbersome and time consuming as they must be thorough and comprehensive. NASA Ames Research Center has been developing the AdvoCATE toolset to provide automation support for the production of aviation safety cases. The main focus of this internship is to advance AdvoCATE by implementing hazard and requirements analysis table editors. Hazard and requirements tables are a necessary component of a safety case as they provide a way to document and display the relevant safety hazards and their posed risks to UAS operations. The content of these tables also include hazard causes and consequences, likelihoods of hazard occurrence, consequence severity, residual likelihood, initial and residual risk levels, along with hazard control and mitigation requirements developed at varying levels of detail. Prior to this internship, such tables were created outside of AdvoCATE due to which keeping the safety case content consistent with the hazard analysis and the corresponding requirements was a challenge. The addition of this capability is a step towards closing this gap, which, in turn, will contribute to easier and more efficient development of aviation safety cases.

Alex Farias, Portland State University
OSGC Undergraduate Team Experience Award Program
Portland State Aerospace Society Composite Cryogenic Fuel Tank

Over the past two years, the Portland State Aerospace Society (PSAS) has developed technology for a liquid fuel, high altitude amateur rocket. The transition from solid to liquid propellant required the development of a prototype fuel tank that could hold a cryogenic propellant such as liquid oxygen. Traditionally, propellant tanks were fabricated out of metal. The goal of this project was to design a tank using composite material to improve the rocket's performance by reducing its dry mass. The tank was manufactured using a compression molding technique in which layers of carbon fiber, structural adhesive, and honeycomb core material were laid up onto aluminum mating rings lined with a thin fluoropolymer liner to form a cylindrical module. The composite sandwich is layered so the carbon fiber provides the tank with strength in the axial and tangential directions, while the honeycomb core provides strength in the radial direction. The fluoropolymer liner acts as a barrier to prevent the propellant from leaking into the composite layers. End caps were shrink-fit onto both ends of the module, compressing the liner and creating a seal. Preliminary hydrostatic burst test confirmed that the tank can perform at the desired operating pressure of 45 psi. Compression test determined that a 3'' diameter module can withstand a 9600lb axial load at -190°C. In the future, pressurized tests with liquid nitrogen will be conducted to test the cryogenic tank at the combined thermal and pressure load expected during operation.

Austin Gulstrom, Oregon State University
NASA Goddard Space Flight Center
Analytical Software Validation for Composite Technology

Composites are two or more materials combined on a macroscopic scale, remaining distinct in the final product, and inheriting many of the best features of its constituents. One of the key features of composites are their material properties, such as tensile strength or modulus of elasticity. Unfortunately, these can be hard to accurately determine without extensive testing of coupons. DIGIMAT, specifically DIGIMAT-Virtual Allowable (VA), is a relatively new software whose purpose is prediction of laminate composite material properties through a variety of user inputs such as layup, environment, and lamina properties. The purpose of this study was to test the accuracy and precision of DIGIMAT at making these theoretical predictions, specifically when the material in question possessed a high void content. Several panels were previously fabricated at low vacuum to ensure existence of voids, while others remained free of flaws. From these panels test coupons for fiber volume, tension, compression, and shear were manufactured to be tested and compared against DIGIMAT predictions. Upon completion, results should provide statistical information as to how well DIGIMAT performs with the presence of these voids and under ideal circumstances.

Rachel Hausmann, Oregon State University
NASA Jet Propulsion Laboratory
Creation of the Final Hazard Maps for the Next Mars Mission: InSight Landing Site, Elysium Planitia, Mars

InSight will send a geophysical lander to Elysium Planitia, Mars, in 2018. We produced hazard maps derived from surface characteristics to quantify landing success. Probability of success is constrained via landing simulations based on the engineering constraints and final hazard map. Geospatial datasets were georeferenced in order of increasing resolution: MOLA elevation maps, 463 m/pixel; HRSC data, 12.5 m/pixel; CTX 5–6 m/pixel; and HiRISE 0.25–0.3 m/pixels. Rock and photoclinometry derived slope maps covering the final landing ellipse were produced and georeferenced using the HiRISE NoMAP tie points. Since the initial launch plan in 2016, more surface data was collected and new mosaicking methods were used to make the georeferencing process more efficient. These new methods will be applied to the production of Mars 2020 hazard maps and future Mars missions.

Matthew Lucas and Audrey Vaughn, Linn-Benton Community College
Oregon Space Grant Higher Education Research Award
Launch Procedures for Offshore Flights

The Linn-Benton Community College Space Exploration Team held two successful offshore high-altitude balloon launches from the deck of the research vessel Pacific Storm. The payload filmed the umbra casted by the total eclipse as it passed across the Oregon coastline on August 21, 2017. Assigning roles and having a set procedure made the launch process operate more efficiently. Approximately ten onshore launches were conducted to rehearse procedures in preparation for the launch. During these launches, members became more familiar with their roles and the roles of others on the team to prepare for any and all situations that may occur. Completing an offshore flight differs from a standard onshore launch given that the sea produces various weather conditions such as; sizable waves, increased chance of precipitation, higher wind speed, and the possibility of limited visibility. Seasickness, internet accessibility, and offshore communication are among other factors. A sudden change in wind direction caused a tear in the latex of the balloon which caused the payload to not achieve the desired altitude. The launch did not achieve 80,000 feet, however the team learned from its successes and failures, and anticipate that the next launch will be successful.

Matthew Morse, Oregon State University
NASA Marshall Space Flight Center
Orbital Class Nanosatellite Launch Vehicle Spin-Stabilization System

Cost-effective small launch vehicles are highly desired by organizations that wish to place CUBESATS into low Earth orbits (LEO) without piggy backing off larger payloads. Spyder—a four stage small launch vehicle—is currently under development. In order to keep costs down, Spyder will avoid complex and expensive avionics and instead implement a robust spin-stabilization system. This project focuses on the design and development of Spyder's 3-4 stage spin-up mechanism using standard hobby solid rocket motors (SRMs). Motor sizing analysis shows that a total impulse of 170-220 Ns is required to achieve the desired spin rate of 4 Hz. Due to inherent layout concerns, simultaneous ignition of the SRMs is crucial to prevent mission failure precession and nutation angles. MATLAB simulations show that a motor firing delay no greater than 20 ms ensures that maximum nutation angles remain less than 10 degrees. Current development of a scaled Space Shuttle-derived ignition circuit is underway. Testing procedures will involve use of a passive hemispherical air bearing with mass moments of inertia matching those of Spyder. A myRIO unit will control the ignition circuit and collect motion data from various instruments. The results of the test are expected to match closely with those derived from the MATLAB simulation. Manufacturing options for the final design are also under consideration to ensure the product remains light and cost effective.

Lindsey Oberhelman, Laura Queen, and Jonah Rose, University of Oregon
OSGC Faculty Research Award with Dr. Scott Fisher/UO
Scientific Commissioning of the Robbins for Undergraduate Research

We present the continuation of our work and research related to the commissioning and operations of a new telescope system at Pine Mountain Observatory (PMO). Throughout this past summer, our team installed new SLOAN filters on the "Robbins," a 14-inch Meade Cassegrain telescope. The telescope uses a research-quality CCD camera with a focal length of 2.56 cm, the system has a field-of-view of 35x35 arc minutes and a pixel scale of 0.7.

Building on our work from last season, we observed remotely with the Robbins telescope from the University of Oregon campus in Eugene for the first time. This improvement coupled with the installation of the new filters has allowed us to begin collaborating with NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA). We provided optical photometry of the Herbig stars AB Aurigae and MWC 758 to compare to infrared observations made with SOFIA. We performed differential photometry and absolute photometry, using several standard stars to calculate our zero point offsets. To accomplish this task our team learned how to how to reduce and stack images with the professional software packages IRAF and Astroconda. In addition, we are currently developing our own image stacking software using the programming language, Python.

Michael Polander, Oregon State University
OSGC Undergraduate Team Experience Award Program

OSU 2017 RockSat-X Program - Hephaestus

The 2017 OSU RockSat-X team sought to demonstrate that an autonomous robotic arm could survive harsh launch conditions and still perform complex operations in the space environment.

To achieve this goal, the 12 members of the team were divided into 4 subteams. Structures, for material selection and to design supports for the payload to endure launch conditions. Robotics, to design the mechanical components of the robotic arm. Electronics, to design the microcontroller that connects the payload components. Software, to program the microcontroller to run the payload.

On August 21st 2017, the rocket with the OSU payload was successfully launched and retrieved. Prior to launching it was discovered that the timer event line had burned out on the microcontroller, preventing the team from activating the arm during flight. In an effort to salvage mission objectives, a code was written to activate the camera to periodically take video when power was provided to the rocket.

Upon retrieval, the camera remained functional and several video clips were recorded on the cameras SD card. Before the camera lost power, it was able to capture two short clips of interest. One during launch and one while in flight. The structural components of the payload all returned with no observable damage. The microcontroller and motors all retained functionality.

It was concluded that the timer event lined failed due to repeated testing without proper protection of the circuit. All other components chosen for the rocket performed to expectations and would be good selections for future missions.

Caleb Turner, Portland State University
NASA Marshall Space Flight Center

Propulsion Analysis of Lunar Lander Concept

Routine access to the lunar surface for payloads has been identified as a joint NASA and commercial space flight mission statement moving into the future. Venturing into public and private partnerships for this end goal should allow a more affordable market for lunar space travel and scientific inquiry. Initial design of a propulsion system to support these robotic lander concepts has been undertaken by ER21 (Liquid Propulsion) utilizing the ROCETS (ROCket Engine Transient Simulation) software for the sizing of components based on customer requirements, as well as specific hardware analysis and design using CAD modeling software and 3D print technology. Through constructing two propulsion models, 8k lbf thruster and 4x2.5 klbf thruster, the initial constraints of this venture can be better understood to aide in the joint development of the robotic lunar lander concept. Purely analytical models were generated to give a baseline steady state response of the propulsion system.

Levi Willmeth, Oregon State University
NASA's Independent Verification & Validation Facility
Adapting NASA Avionics Software Commonly Used on Rockets and Satellites, to Control a Commercially Available Drone

NASA launches a lot of rockets and satellites, most of which perform similar tasks such as sending back telemetry or experimental data, performing experiments or maintenance tasks on a regular schedule, or making attitude adjustments. Instead of rewriting the software that controls these common tasks from scratch for every launch, NASA began using a set of programs commonly called the Core Flight System (cFS) software.

The cFS software includes a set of files that define the current computer and mission hardware, and another set of modular 'apps' that are specific to the current mission. This allows NASA to run similar software on everything from sounding rockets, to CubeSats, or even the James Webb Space Telescope.

The goal of this intern project was to adapt cFS to control a commercial hobby-grade drone. The specific drone used ran on linux, included a wifi connection, and the manufacturer supported an application programming interface (API) to interact with the hardware, but the same principles could be applied to other models of drone. This was the continuation of an earlier research project that began at Johnson Space Center.

Charity Woodrum, University of Oregon
OSGC Faculty Research Award with Dr. Scott Fisher/UO
Evolution in Solitude: Field Galaxies from Half the Age of the Universe to the Present

We analyze the stellar populations and evolutionary history of bulge-dominated field galaxies at redshifts $0.3<z<1.2$ as part of the Gemini/*Hubble Space Telescope* (*HST*) Galaxy Cluster Project (GCP). High signal-to-noise optical spectroscopy from the Gemini Observatory and imaging from the *HST* are used to analyze a total of 43 galaxies, focusing on the 30 passive galaxies in the sample. Using the size–mass and velocity dispersion–mass relations for the passive field galaxies we find no significant evolution of sizes or velocity dispersions at a given dynamical mass between $z\sim1$ and the present. We establish the Fundamental Plane and study mass-to-light (*M/L*) ratios. The *M/L* versus dynamical mass relation shows that the passive field galaxies follow a relation with a steeper slope than the local comparison sample, consistent with cluster galaxies in the GCP at $z = 0.86$. This steeper slope indicates that the formation redshift is mass dependent, in agreement with "downsizing," meaning that the low-mass galaxies formed their stars more recently while the high-mass galaxies formed theirs at higher redshift. The zero-point differences of the scaling relations for the *M/L* ratios imply a formation redshift of z_{form}=1.35(+0.10)(-0.07) for the passive field galaxies. This is consistent with the $(H\delta_A+H\gamma_A)'$ line index which implies a formation redshift of z_{form}=1.40(+0.60)(-0.18).