Oregon NASA Space Grant Consortium

2019 Student Symposium Proceedings

November 15, 2019
9am – 6:30pm

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

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

2019 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
November 15, 2019

Oregon Space Grant Consortium
92 Kerr Administration Building
Corvallis, OR 97331-2103

Phone: 541.737.2414
Fax: 541.737.9946
spacegrant@oregonstate.edu

Presentation Schedule

8-9am	**POSTER SET-UP** - Breakfast provided for presenters	
9-10am	**OPEN POSTER SESSION**	
10-11am	**WELCOME/KEYNOTE ADDRESS** **José-Antonio Orosco, Ph.D.** Oregon State University ***Boldly Going: Science Fiction and the Transformative Imagination***	
11-11:10am	Transition to Presenters	
	SESSION A - Ag Production Room	**SESSION B - Ag Science Room**
11:10am	**Rosemary Williams** **1A** Oregon State University NASA Marshall Space Flight Center Internship ***Designing a Uranium Injection System for a Nuclear Propulsion Rocket Concept***	**Erin Campbell** **1B** Eastern Oregon University NASA Stennis Space Center Internship ***The Development of Valve Models in a Liquid Nitrogen System***
11:30am	**Kevin Lee** **2A** University of Oregon Jet Propulsion Laboratory/California Institute of Technology Internship ***Improving MSL's Operational Efficiency by Re-examining Margining Policies***	**Tanner Fromcke** **2B** Oregon State University NASA Ames Research Center Internship ***Creating Standardized Models in OpenVSP***
11:50am	**Devon Burson, Olivia Clark, Austin Gulstrom, Colt Harms, Adam Ragle** **3A** Oregon State University OSGC Undergraduate Team Experience Award ***Liquid Propulsion Test Stand Design and Analysis***	**Parker Southwick** **3B** Portland State University OSGC Undergraduate Team Experience Award ***Thermal Analysis of a 2U CubeSat***
12:10pm	**Madison Davis and Tyrone Stagner** **4A** Southwestern Oregon Community College OSGC Undergraduate Team Experience Award ***Upper Empire Lake Nutrient Map***	**Thayne Covert, Quinn Dickenson, Chloe Gan, John Haas, and Alex Schendel** **4B** University of Portland OSGC Undergraduate Team Experience Award ***NASA 2019 Robotics Mining Competition***
12:30-2pm	**LUNCH/ROUND TABLE DISCUSSIONS/POSTERS – Ag Leaders Room-** Food and refreshments provided for presenters Student presenters are invited to join one of the following round table discussions over lunch: 1) Promoting STEM to the Next Generation – Table Lead: Nancy Staus, PhD 2) Rocketry and the Aerospace Industry – Table Lead: Nancy Squires, PhD 3) Science of Science Fiction – Table Lead: Randall Milstein, PhD 4) Transitioning from Undergraduate to Graduate: What you Should Know – Table Lead: Isabel Rodriguez 5) Nuclear Propulsion and the Future of Space Exploration – Table Lead: Jack Higginbotham, PhD	

Afternoon Sessions		
	SESSION A - Ag Production Room	**SESSION B - Ag Science Room**
2:00pm	**Keenan Siminski** **5A** University of Oregon NASA Marshall Space Flight Center Internship ***Pump-Fed Reaction Control Systems for Future Lunar Landers***	**Gabriel Sutherland** **5B** Oregon State University OSGC Undergraduate Research Fellowship ***Spacecraft for Autonomous Space Debris Remediation Utilizing Multi-Modal AI and Experimental Propulsion***
2:20pm	**Holly Manjarrez** **6A** Oregon State University NASA Ames Research Center Internship ***Characterizing the Flow in a Subsonic, Closed Loop Wind Tunnel at Low Reynolds Numbers and Martian Pressures***	**Lillia Smith** **6B** University of Portland NASA Ames Research Center Internship ***Conceptual Design of Titan's Second-Generation UAV***
2:40pm	**Sam Hauss and Eric Thomas** **7A** Portland State University OSGC Undergraduate Team Experience Award ***Integration and Testing of a Liquid Propellant Rocket Engine***	**Caitlin Hudecek** **7B** Oregon State University OSGC Faculty Research Award ***Investigation of Link Between Zebrafish Cataract Formation from Exposure to Galactic Cosmic Radiation and ^{137}Cs Gamma-Rays***
3:00pm	**Amy Caldwell, Holly Manjarrez, and Trevor Rose** **8A** Oregon State University OSGC Undergraduate Team Experience Award ***NASA University Student Launch Initiative***	**Julio Garcia** **8B** Portland State University OSGC Undergraduate Team Experience Award ***PSAS Flight Ready Electric Feed System***
3:20-3:40pm	**BREAK - Foyer**	
3:40pm	**Patrick Sandoval** **9A** Oregon State University Jet Propulsion Laboratory/California Institute of Technology Internship ***Updating Existing Report Generating through Programming***	**Nicholas Orlik and Scott Sauerwein** **9B** Oregon Institute of Technology, Klamath Falls OSGC Undergraduate Research Fellowship ***Wireless Power Transfer for Lunar Microsensors***
4:00pm	**Ethan Goldschmidt** **10A** Linn-Benton Community College NASA Goddard Space Flight Center Internship ***Spacecraft Configuration Documentation***	**Peter Bloch** **10B** Oregon State University Jet Propulsion Laboratory/California Institute of Technology Internship ***NISAR Test Procedure Automation and Documentation Generation***
4:20pm	**Daniel Quon and William Thode** **11A** Oregon Institute of Technology – Klamath Falls OSGC Undergraduate Team Experience Award ***Oregon Tech Modular Rocket System***	**Kasey Yoke** **11B** Oregon State University NASA Goddard Space Flight Center Internship ***Optical Analysis of IBF-Polished Silicon Wafers and Cryogenic Etching of Black Silicon Coating***
4:40pm	**Marie House and Nate Stickrod** **12A** Portland State University OSGC Undergraduate Team Experience Award ***PSAS Electromechanical Recovery System (ERS)***	
5-6:30pm	**RECEPTION/NETWORKING/POSTERS** - Food and refreshments provided	

Keynote Address

José-Antonio Orosco, Ph.D.
Professor of Philosophy: School of History, Philosophy, and Religion
Oregon State University

José-Antonio Orosco is Professor of Philosophy in the School of History, Philosophy, and Religion at Oregon State University. His work focuses on political philosophy, particularly theories of democracy, justice, and peace building. For several years, he has taught a course at OSU on the philosophy of *Star Trek*, and has spoken at academic conferences and comic-cons about using science fiction to help us develop our imaginative skills in order to envision more socially just futures.

Abstracts

Peter J Bloch, Oregon State University **10B**
Jet Propulsion Laboratory, California Institute of Technology

NISAR Test Procedure Automation and Documentation Generation

In order to integrate the many parts of NASA and ISRO Engineering Payload and RAB, many tests and procedures must be generated. Use of the open-source Python framework Robot Framework was implemented to chain test procedures automatically for possible third-shift use. Furthermore, through using the existing work from the Mars 2020 and SMAP projects, scripts and programs were built to facilitate easier, graphically intuitive, and simple test procedure generation and documentation. Notable advancements with this program include the graphical interface supported by multiple operating systems, and the versatility and file recognition for easier generation. Such an application has the potential to save time, prevent user-errors, and ensure uniformity with each procedure's formal generation, as it can be extracted from the code with the click of a button instead manual entry.

Devon Burson, Olivia Clark, Austin Gulstrom, Colt Harms, and Adam Ragle, Oregon State University
OSGC Undergraduate Team Experience Award **3A**

Liquid Propulsion Test Stand Design and Analysis

Current methods used in the development of liquid rocket propulsion systems face infrastructural challenges stemming from the equipment needed to test engines safely. Improving the existing propulsion laboratory facilities at Oregon State University can simplify and decrease the engine development timeline. Existing tools used to characterize liquid propulsion systems are inadequate to quantify liquid propulsion systems' performance accurately. To improve work productivity a liquid propulsion test stand was developed to automate and improve the liquid propulsion development process. The benefits of improving automation, sensor data collection and visual feedback provided by a dedicated liquid propulsion test stand result in a safer and more efficient liquid propulsion development workflow. When integrated into existing infrastructure, the improved infrastructure streamlines the process of analyzing test results and allows the development team to more quickly determine if the performance characteristics meet design requirements or if further design iterations are needed.

Amy Caldwell, Holly Manjarrez, and Trevor Rose, Oregon State University
OSGC Undergraduate Team Experience Award **8A**

NASA University Student Launch Initiative

The 2019 Oregon State University (OSU) University Student Launch Initiative (USLI) Team competed in the NASA USLI competition at Marshall Space Flight Center (MSFC) in April. The event was a NASA selected challenge which also simulated a shortened NASA project life cycle. The project serves a dual purpose: educating students about a real-world project life cycle for a complex project and rapid testing of numerous potential solutions to real challenges NASA is facing on current missions.

The 2019 challenge was a rocket that deployed a rover payload after landing. The rover had to autonomously navigate away from the rocket and collect a soil sample. This was to simulate and test potential solutions to a Mars landing.

The OSU USLI Team was able to successfully design and build functioning systems to meet all NASA requirements, however, during the competition flight at MSFC, the payload landed in a position preventing it from driving. Despite this failure, OSU still received 4th place overall out of 45 teams, 1st place for Rocket Design, 3rd place for Altitude Accuracy, and 3rd place for Project Review, based on thorough analyses, designs, and testing conducted on all systems.

The 2019 OSU USLI team had the opportunity to teach over 4,820 people, primarily students in Kindergarten through 12th grade, lessons in rocketry, aerospace engineering, and STEM. Part of the OSU USLI Team's goal is to inspire a new generation of scientists and engineers through engaging them in fun STEM lessons and activities.

Erin Campbell, Eastern Oregon University
NASA Stennis Space Center **1B**

The Development of Valve Models in a Liquid Nitrogen System

INSIGHT (Intelligent Stennis Gas House Technology) is an application of NPAS (NASA's Platform for Autonomous Systems). NPAS is a software platform that includes physics-based models that are being used to implement autonomous operational capabilities at the Stennis High Pressure Gas Facility. The development of models for valves in the liquid nitrogen system is part of this process. The models developed in this internship are used to detect discrepancies between calculated values and values received from sensors around valves in the system.

The models created calculate two things: the expected change in pressure across a valve based on temperature and flow rate through a valve. Both results can be used in NPAS to create rules that determine a valve's risk of cavitation. The calculated pressure change is also compared to sensor values to detect anomalies within the system. Constants associated with individual valves are used to calculate the maximum flow rate through the valve before risk of cavitation.

Thayne Covert, Quinn Dickenson, Chloe Gan, John Haas, and Alex Schendel, University of Portland
OSGC Undergraduate Team Experience Award **4B**

NASA 2019 Robotics Mining Competition

The University of Portland (UP) Robotics Club has designed a robotic mining system capable of operating on Mars for participation in NASA's Robotic Mining Competition (RMC) at the Kennedy Space Center. The RMC is designed to develop innovative robotic mining systems for application in human settlement on Mars. In addition to the robotic system, teams are judged on K-12 STEM Outreach programs, systems engineering papers, and oral presentations. Over the course of the 2018-19 academic year, the UP team worked to implement new designs on an existing rover, improve its K-12 STEM outreach program, and place within the top half of teams at the RMC. Although the physical competition was suspended and became a virtual competition, our goals of successfully creating a new rover and outreaching to the local community were met. As a result of the support granted from the Oregon Space Grant Consortium and the Dean of the Donald P. Shiley School of Engineering, the UP Robotics Club continues to be a successful organization. The UP Robotics Club is currently in the fabrication process of a new robot design and intends to place in the top 10 of teams at the 2020 RMC.

Madison Davis and Tyrone Stagner, Southwestern Oregon Community College
OSGC Undergraduate Team Experience Award **4A**

Upper Empire Lake Nutrient Map

Nutrients are essential for any ecosystem to thrive but an overabundance of nutrients, called eutrophication, can have a negative and lasting impact on the environment. Eutrophication refers to an excess of nutrients in a body of water, which causes algae and other plants to grow too much. When those organisms die and decay, they use all of the dissolved oxygen in the water, suffocating aquatic life. Measuring the concentrations of dissolved species and creating a nutrient map of a body of water can help to determine if the area is eutrophic. This project describes the creation of a nutrient map around the perimeter of Upper Empire Lake. This map gave a better understanding of the chemical composition of the lake. A variety of digital probes were used to measure the concentration of analytes in the field. Along with the use of digital probes, water samples from the lake were collected and tested for lead and chromium with the use of the Atomic Absorption Spectrometer (AAS). Testing an ecosystem for these heavy metals is important because of the effects they will have. Large traces of lead in water will damage organisms living in that ecosystem but chromium is an essential micronutrient found in aqueous environments. Results indicated from the water samples suggest that there were no detectable traces of lead or chromium in Upper Empire Lake. The analysis of the field measurements determined the lake is generally homogeneous in terms of pH, temperature, dissolved oxygen, etc.

Tanner Fromcke, Oregon State University
NASA Ames Research Center **2B**

Creating Standardized Models in OpenVSP

During the summer of 2019, the OpenVSP team created standardized models of conceptual aircrafts. OpenVSP (Vehicle Sketch Pad) is a 3D modelling program developed by NASA to quickly and easily express the shapes of aircrafts using common aircraft parts. Models created in OpenVSP are typically imported to other programs for further analysis; however, models may not import properly unless they are in standard form. In standard form, only a specific subset of parts is used along with a naming convention. Models created in OpenVSP may be imported to Rhino to be smoothed in preparation for 3D printing and computational fluid dynamics analysis like in ANSYS and RotCFD. In addition, NDARC (NASA Design and Analysis of Rotorcraft) is used to analyze the performance of imported models. There are plans to create a conversion tool between OpenVSP and NDARC. The models created during the internship will be used to analyze the effectiveness of this conversion tool during its development.

Julio Garcia, Portland State University
OSGC Undergraduate Team Experience Award **8B**

Portland State Aerospace Society (PSAS) Flight Ready Electric Feed System

Portland State Aerospace Society (PSAS) requires a Flight-Ready Electric Feed System (EFS) for their upcoming Launch Vehicle 4. An EFS is an electronically controlled pump system used to provide necessary pressure gain to deliver high pressure liquid propellant to fuel a rocket engine. The EFS must be compatible to withstand the environment that the liquid oxygen (LOX) and isopropyl alcohol (IPA) propellants create. In order to create such a system, the design team used compatible material along with in-house CNC manufacturing and commercial off the shelf parts to create a specialized EFS for PSAS.

While this project did not provide a flight ready system, significant headway was made on developing a cryogenic compatible EFS. The developed twin pump system proved to have flaws and require necessary design changes in order to become reliable equipment. Vast improvements were made upon the original EFS prototype design from 2016 and recommendations on how to proceed are being drafted for future EFS design teams.

Ethan Goldschmidt, Linn-Benton Community College
NASA Goddard Space Flight Center **10A**

Spacecraft Configuration Documentation

It is critical to understand the performance of the physical components used to build spacecraft; the reliability, operational functionality alone and together with other components. Documenting all components and parts that have flown on prior missions in the Mission Configuration (MC) database opens the door for more efficient assessment of risk and reliability. Utilizing this perpetual catalog increases likelihood of success in future missions. The goal of this project was to create several mission configuration trees down to the Standard Component level so that MC can be populated quickly. Files containing spacecraft configuration details e.g. review presentations were examined for Landsat 9, Plankton, Aerosol, Cloud, ocean Ecosystem (PACE), and the Gamma-ray Large Area Space Telescope (GLAST)/Fermi. The investigation offered insight into the respective spacecraft architectures and enabled the creation of drawing trees. Block diagrams, drawings, materials and parts lists, and photographs were extracted and saved as separate pdf files. Files containing detailed information of the Standard Components were saved and referenced on the drawing tree for future expansion of the drawing tree. These will be integrated with the Mission Configuration database where they will be accessible for safety and reliability assessment, thus informing decisions on future missions.

Sam Hauss and Eric Thomas, Portland State University
OSGC Undergraduate Team Experience Award **7A**

Portland State Aerospace Society (PSAS) Integration and Testing of a Liquid Propellant Rocket Engine

The Portland State Aerospace Society (PSAS) is seeking to launch a liquid bi-propellant rocket to a height of 100km. PSAS developed an undersized 2.2kN, regeneratively cooled rocket motor and pintle style injector for testing prior to developing a full scale 100km capable engine.

The purpose of this year’s project was to test the engine and test-stand for future scalability for the 100km rocket.

Several testing methods were planned for validation of the engine and injector designs. In both cases, the provided hardware failed their preliminary validation testing. The first test for the 3D printed engine was to undergo CT scanning. Analysis of the results found internal manufacturing defects inside of the regenerative cooling channels which prevented hot fire testing. A full analysis of the 3D printing process and design for manufacturing recommendations was provided to PSAS as one of the deliverables for this project.

The pintle injector was then tested with water to determine if it met the flow rate and pressure requirements for the engine. The provided injector did not meet the requirements and required a complete redesign which was not within the original scope of the project. A new injector design which meets the flow rate requirements has been built and tested. Complete design documentation, instructions, and CAD drawings have been created as an additional deliverable to PSAS.

The design of the 2.2kN engine configured test stand was completed. Construction of the stand is ongoing.

Marie House and Nate Stickrod, Portland State University
OSGC Undergraduate Team Experience Award **12A**

Portland State Aerospace Society (PSAS) Electromechanical Recovery System

Our team studied, designed, and tested a two-stage, electromechanical parachute recovery system for the Portland State Aerospace Society (PSAS). The final design will fly on their high-altitude amateur rocket that is competing in the Base 11 Space Challenge. Previously, PSAS used 'purely' pyrotechnics or a combination of pyrotechnics and electromechanical devices for actuation of their recovery system - pyrotechnic actuation inherently includes properties that change with extreme altitude changes. To help prepare PSAS for their 100 km flight challenge, our team developed a flight-ready system that can handle the various environmental and physical challenges that arise at extreme apogees and that can be tested at a scaled size in their current rocket. The final design is comprised of two systems: the nose cone separation and the drogue parachute release. The nose cone release utilizes a DC motor, lost motion, and an open body design to meet each of the design specifications. The drogue parachute release uses a system most commonly employed by skydivers, a mechanical design that can withstand the shock of parachute deployment while requiring very little force to actuate.

Caitlin Hudecek, Oregon State University
OSGC Faculty Research Award **7B**

Investigation of Link Between Zebrafish Cataract Formation from Exposure to Galactic Cosmic Radiation and ^{137}Cs Gamma-Rays

As interest grows in the possibility of manned Lunar and Martian missions, understanding the impact of non-terrestrial radiation exposure on biological systems becomes more acute. Forty-eight cases of lens opacification have been observed amongst a population of 295 astronauts having flown space missions. For astronauts and cosmonauts on lunar missions or high inclination orbits, Cucinotta, et. al. reported post mission cataracts in 35 of 39 cases.

Refinement in the statistical confidence of the relationship between cataract formation in astronauts during long duration, deep space missions and radiation dose from Galactic Cosmic Rays, GCR, is being investigated using AB-wild type Zebrafish exposed to a target dose of 0.75 Gy using an accelerator beamline at NASA Space Radiation Laboratory, NSRL. The dose-response curve for cataract development in zebrafish exposed to terrestrial radiation fields is also investigated using the NSRL ^{137}Cs gamma-rays irradiation facility ($E\gamma$ - 661.6 keV) to doses of 2, 4, 6, 8, 10, 20 and 0 Gy. The effect of mixed field, GCR and gamma-ray, irradiations were also conducted.

Six months post irradiation, approximately 10% of the fish in the 20 Gy gamma-ray exposure group have exhibited early focal cataracts, and 9 months post irradiation 5% of the fish in the lower dose groups have early focal cataracts. Since laboratory zebrafish have a very low incidence of spontaneous cataracts, these findings are sufficiently interesting to warrant early reporting. The zebrafish irradiated in the GCR beam are ~ 45 days post irradiation and are under study for cataract formation.

Kevin Lee, University of Oregon
Jet Propulsion Laboratory, California Institute of Technology **2A**

Improving MSL's Operational Efficiency by Re-examining Margining Policies

The MSL IPE has closely been monitoring future configurations of the Curiosity rover currently on Mars to improve its sustainability as it passes its 7th birthday. How rover uses its time becomes increasingly important because the RTG (energy source) slowly degrades with time and it is unable to produce as much power. My objective is to analyze the Event Reports (EVR) that are generated from the rover and visualize how the estimated time use vs. the actual time of each activity (arm back bone, drive backbone, etc) use is different. The end goal is to reduce idle time of the rover as much as possible so more activities can be conducted within the given time frame. By visualizing the marginal use of different activities of the past soles, we're able to closely observe which activities have a higher marginal use than others so that it can be adjusted accordingly. Building a tool that autonomously retrieves data from the server, parses it, and then visualizes it on a web dashboard required multiple sets of skills. Somethings to consider building the tool were sustainability, accuracy, ease of use, and stability.

Holly Manjarrez, Oregon State University
NASA Ames Research Center **6A**

Characterizing the Flow in a Subsonic, Closed Loop Wind Tunnel at Low Reynolds Numbers and Martian Pressures

This summer I contributed to the Mars 2020 project at NASA Ames Research Center (ARC) by analyzing the flow in a new wind tunnel that is in the works for the Mars Helicopter testing. While there is extensive data on lift, drag, and thrust coefficients of airfoils with changing air densities, none range as low as Mars' atmospheric pressures. The atmospheric pressure on Mars is only 2% of Earth, and the helicopters rotor performance is unknown at such conditions. Recent NASA studies suggest the coefficient of thrust changed in a manner unfamiliar to thrust coefficients at normal Earth atmospheric pressures. A wind tunnel is designed and built around the specifications of the test section, where the object under analysis is located. In order to accommodate for the test section parameters, a flow analysis must be conducted around the whole tunnel to account for energy losses, flow condition, the fan flow rate output required, and the power input required. I gathered equations, wind tunnel dimensions, and other input values required to characterize a flow and built a MATLAB script that is valid for the analysis of any subsonic, closed loop wind tunnel. This script can also be used to test changes that are being considered to see the effects on flow conditions and losses, before implemented.

Nicholas Orlik and Scott Sauerwein, Oregon Institute of Technology, Klamath Falls
NASA Goddard Space Flight Center **9B**

Wireless Power Transfer for Lunar Microsensors

In recent years, there has been a focal shift in space exploration toward micro satellites and the unique capabilities they provide. These advanced systems bring their own engineering obstacles; power supply limitations being one key issue. Limitations of battery technology have led to renewed interest in alternative power methods; one such promising field is wireless power transfer. This project will investigate the latest advances in this field and apply the information gathered to build a prototype wireless power transfer system with an intended lunar application.

The primary purpose of this prototype will be focused toward expanding the lifespan of small sensors, such as those which might be used for surface-based lunar observation. The prototype will be a solar energy collection and storage module that wirelessly provides 1.2V/60mA power to multiple sensors of the type that might be used for surface-based lunar observation. These sensors will be positioned within near-field wireless power transfer boundaries of 100m, allowing them to forgo the complication of individual energy collection or storage methods. Additionally, it will provide the only source of external power available during the 15-day dark side transition of the moon's rotation.

Additional research will be done on the feasibility of expanding the design into far-field transfer. The goal of this project is to demonstrate a functional alternative power method for surface-based lunar applications and provide a foundation for further innovation in space exploration concepts.

Daniel Quon and William Thode, Oregon Institute of Technology, Klamath Falls
OSGC Undergraduate Team Experience Award **11A**

Oregon Tech Modular Rocket System

This project served as the senior capstone project for nine members of Oregon Tech Rocketry and Aerospace (OTRA). The goals for this project were to have OTRA's first Level 3 launch using a solid fuel motor, to have a modular design that could be completely disassembled and serve as a testing platform for future launches, and to be able to integrate OTRA's 2018 liquid fuel engine design into our rocket body. The rocket was built according to the specifications of the Spaceport America Cup Design Rules, but entry in the tournament was not an immediate goal for this year. The rocket was designed to reach 10,000ft on a Level 3 motor. The members of our project used store bought components and components manufactured in house at Oregon Tech to assemble the rocket. A combination of CNC work, manual machining with mills, lathes, and other tools, welding, and composite hand layups were used to achieve the final product. The final rocket uses a fiberglass nose cone, carbon fiber tubes, and aluminum bulkheads and centering rings with aluminum fasteners allowing for disassembly, with an ejection system using pressurized CO2. An additional Newman Rack-style launcher was created for the rocket out of angle iron. The project was successfully launched on Jun 23rd at OROC's public launch in Brothers OR. It was test launched using an L-805P and flew to 3438 feet, successfully certifying a OTRA team member for Level 2 flights.

Patrick Sandoval, Oregon State University
Jet Propulsion Laboratory, California Institute of Technology **9A**

Updating Existing Report Generating through Programming

Currently there are several reports that the Mars Science Laboratory planning section is updating manually and would like to have automated. This project encapsulates 2 main sections, 1 being an auto generated report and the second being a web server for data retrieval/storing. For the first section, the final product will be a script that runs and auto generates a planning report containing current sol date information. The second section is a nodeJS web server that is used as a data retrieval web application. The initial process was to gather information on specifics from the planning team. Get information on which tools integrate with software at JPL. I then began programming each section. The automated generated report showed request sol information in a form. This form is visibly similar to past manually generated reports. It shows all relevant info and is updated with each change in planning. The web server attaches to a database and functions as a web application for users to store sol data.

Keenan Siminski, University of Oregon
NASA Marshall Space Flight Center **5A**

Pump-Fed Reaction Control Systems for Future Lunar Landers

RCS systems will be used in the 2024 Lunar Lander to fine tune the trajectory and orientation of the lander during the landing sequence. We have been creating a test system to validate a new pump-fed configuration of the RCS system that will decrease weight. The end goal for Summer 2019 is to finish constructing a liquid nitrogen test article and begin running tests and validating the results of this pump-fed configuration. The liquid nitrogen system is being constructed to analyze the heat transfer and find the optimal amount of passive circulation to limit incoming heat while maintaining pressure levels to fire thrusters without a large delay. A water test system has also been constructed by past interns that is used to validate the RCS system being used prior to the design of the more advanced liquid nitrogen system. We have used this system to demonstrate some limitations of the new pump-fed RCS configuration, and to test a method of increasing pump frequency as thrusters fire to minimize pressure slump.

Lillia Smith, University of Portland
NASA Ames Research Center **6B**

Conceptual Design of Titan's Second-Generation UAV

In 2034, NASA's newest member of the New Frontiers program, Dragonfly, will explore the equatorial region of Titan, Saturn's largest moon. With a dense atmosphere, a methanogenic cycle, and a world rich in complex organic materials, Titan offers the unique prospect of life. The purpose of the project was to design this UAV and evaluate the utility of developing a second-generation vertical lift vehicle to aid in the exploration of Titan, specifically examining the northern pole. The summer consisted of going through many design iterations and finalizing a conceptual design of this UAV. The proposed vehicle is capable of aerial flight and subsea locomotion allowing for the exploration of Titan's lakes and seas, which consist of liquid methane. The UAV repeatedly takes off, hovers, lands on the surfaces of these lakes and seas, and submerges itself into the bodies of methane. Capabilities of the UAV include gathering and analyzing liquid samples, performing subsea imaging, and collecting data regarding changes in chemical composition and flow rate with variation in depth. Simultaneously, the UAV searches for potential microbial life forms while relaying all data directly to Earth. Conceptual design and analysis of this hybrid exploration system was performed to develop a comprehensive mission for its use.

Parker Southwick, Portland State University
OSGC Undergraduate Team Experience Award **3B**

Thermal Analysis of a 2U CubeSat

OreSat, Oregon's first satellite, is a 2U CubeSat; a type of small satellite developed in 1999 at California Polytechnic State University. The primary purpose of this satellite is to observe and collect information on cirrus clouds in Earth's upper atmosphere while remaining in low Earth orbit during its voyage. One major obstacle to operation is appropriately handling the temperature of the satellite's critical subsystems and its batteries. In order to mitigate the risks of various kinds of thermal failure, actionable data of its steady state conditions were collected in order to provide insight to the minimum and maximum temperature boundaries. Heat transfer analyses using STAR-CCM+ and ANSYS were conducted to cross check results against each other. We examined two cases where the satellite was in full view factor of the sun and Earth, and full view factor of just the Earth when in the shadow of the planet, while not being in view of the sun. These are defined as our hot and cold scenarios. Results detailed a worrisome case of the satellite freezing to death if left in the shadow of the earth until steady state, while remaining alive in the face of the sun and earth. This data provided an informed decision for anodization of the satellite, and future needs for transient analyses.

Gabriel Sutherland, Oregon State University
OSGC Undergraduate Research Fellowship **5B**

Spacecraft for Autonomous Space Debris Remediation Utilizing Multi-Modal AI and Experimental Propulsion

This project studied whether an autonomous microsatellite can utilize an intelligent AI-augmented propulsion system management software to safely neutralize and deorbit space debris in near-earth orbit. The proposed satellite would employ a mesh composed of interwoven electroactive polymers (EAPs) and Carbon nanotubes (CNTs) to form a net for debris capture, allowing for a relatively low mass while retaining a high degree of kinetic resilience. The satellite would be able to alter its orbit through an experimental form of electric propulsion system. The net portion of the satellite, which would be composed of an EAP and carbon-nanofiber composite, was designed to withstand impacts from small space debris less than 10g in mass at orbital speeds, up to 17,500mph relative speed. Using computer simulations derived from the World Magnetic Model, Autodesk Inventor, Celestia, ASTOS, Matlab and Simulink, the satellite's capabilities were simulated. Specifically, the ability to modify its orbit, both in altitude as well as eccentricity and inclination, as well as the resiliency of the net portion were studied. A satellite with a 1km^2 net could theoretically both neutralize space debris in a specific orbital lane, as well as deorbit itself and break apart upon re-entry. Results indicate this system could be viable as a space-debris capture and neutralization mechanism, with further testing and refinement of system. Future studies will investigate the effectiveness of a fully autonomous AI-enabled flight management system for determining and effecting orbit transfers for space-debris intercepts.

Rosemary Williams, Oregon State University
NASA Marshall Space Flight Center **1A**

Designing a Uranium Injection System for a Nuclear Propulsion Rocket Concept

The PuFF (Pulsed Fission Fusion) project aims to revolutionize space travel through nuclear propulsion. PuFF will produce both high specific impulse and high thrust, enabling one-month transit times to Mars, and five-month transit times to the outer solar system.

PuFF creates thrust by imploding a fission-fusion target using a Z-pinch. The process involves using the Lorentz force to create extremely high pressures by injecting current-carrying liquid lithium into the nozzle. When the lithium streams connect, a circuit including a network of capacitors is completed, and a high current pulse flows down the lithium. The z-pinch slams the lithium onto a fission-fusion uranium target, which reaches super-criticality and explodes. The expanding plasma is directed out of the back by a magnetic nozzle and used as thrust.

Kasey Yoke, Oregon State University
NASA Goddard Space Flight Center **11B**

Optical Analysis of IBF-Polished Silicon Wafers and Cryogenic Etching of Black Silicon Coating

NASA's direct imaging of exoplanets missions and projects such as WFIRST and LUVOIR require fabricated coronagraph masks to control scattering and diffraction of light. In this study, we intend to enhance the pathfinder masks for High-contrast Imager for Complex Aperture Telescope (HiCAT) at Space Telescope Institute (STScI) while assessing their optical performance independently. The fabrication of pupil mask involves silicon wafers to be sliced and polished at $\lambda/20$ using recently procured ion beam figuring (IBF) system where the absorbent region will be black-silicon etched using Oxford Instrument Etching system currently under commission at the GSFC Detector Characterization Lab. Prior to the cryogenic etching of BSI,

a comparison of the B7 and B34 interferometers on the GSFC campus will be conducted to both validate the optical analyses of the silicon wafers and to ensure the interferometers are performing to a high degree of accuracy. In this comparison, we will be mainly looking at RMS and PV, pre- and post-IBF polishing, using a Matlab script to analyze the surface figure errors of each wafer. This study shows IBF polished wafers could improve the surface figure on the wafers to only a few nanometers RMS and black silicon Bidirectional Reflectance Distribution Function (BRDF) measurement shows very low specular reflectance.
The cryogenic etching of BSI on IBF polished wafers to be completed by the end of summer.