Oregon NASA
Space Grant Consortium

2015 Student Symposium
Proceedings
November 13, 2015
9:00 am - 6:00 pm

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

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

2015 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
November 13, 2015

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Agenda / Presentation Schedule

8-9am	**POSTER SESSION SET-UP** - Breakfast provided for presenters
9-10am	**OPEN POSTER SESSION**

TIME	Presenter
10:00am	**Brianna Smith Sparks -** Linn-Benton Community College - Kennedy Space Center Title: *Spaceport Planning, Center Planning and Development Engineering Intern*
10:20am	**Greg Detweiler -** Southern Oregon University - Goddard Space Flight Center Title: *Superthermal Electron Directional Fluxes and Their Pitch-Angle Distributions in the Region of the Diffuse Aurora*
10:40am	**Alyssa Deardorff -** Oregon Institute of Technology - Ames Research Center Title: *Multidisciplinary Aeronautics Research Team Initiative: Urban SAFE50*
11:00am	**Delphine Le Brun Colon, Ariel Stroh, and Levi Willmeth** - Linn-Benton Community College - Wallops Flight Facility Title: *RockSat-C - Cosmic ray detection using an array of 6 Geiger tubes and a coincidence filter*
11:20am	**BREAK**
11:30am	**Bethany Carlson -** Oregon State University - Sea Grant Internship Title: *Seacast: Ocean Condition Forecasting Website*
11:50am	**Alyssa Adams and Victor Rielly -** Western Oregon University and Pacific University - Marshall Space Flight Center Title: *ARTEMIS Code Maintenance*
12:10pm	**John Froehlich -** Portland State University - Goddard Space Flight Center Title: *Capturing Long-duration Fluid Slosh Behavior in Micro-gravity*
12:30pm	**LUNCH/NETWORKING/POSTERS** - Food and refreshments provided for presenters
1:40pm	**Angela Piller -** Portland State University - Marshall Space Flight Center Title: *Landslide Hazard Mapping in Rwanda Using Logistic Regression*
2:00pm	**Vickie Ngo and Taylor Rawlings -** Oregon State University **-** AIAA Title: *Oregon State University's AIAA, Design/Build/Fly 2015 Competition Team*
2:20pm	**Andrew Greenberg and Katia Pahua -** Portland State University - Portland State Aerospace Society (PSAS) Title: *PSU PSAS Sounding Rocket System*
2:40pm	**E. Michelle Neely -** Oregon State University - Center for Earth and Planetary Studies (CEPS), Smithsonian National Air and Space Museum, and Oregon State University Title: *2-D Spatial Pattern Analysis of Transverse Aeolian Ridges on Mars*
3:00pm	**BREAK**
3:10pm	**Manju Bangalore -** University of Oregon - Marshall Space Flight Center Title: *Making Cents of Space Travel: The Economics of In-Space Propulsion*
3:30pm	**Dakota Peck -** Linn-Benton Community College - Goddard Space Flight Center Title: *Enterprise Monitoring Solutions*
3:50pm	**Alexsis Hundley-Kennaday, Cristina Martinez Galvez, and Sophia Zhang** - Oregon State University - Wallops Flight Facility Title: *RockSat-C - Water Bears*
4:10pm	**Caleb Turner -** Portland Community College - Marshall Space Flight Center Title: *Systems Engineering Secondary Payloads Database Development*
4:30-6pm	**RECEPTION/NETWORKING/POSTERS** - Food and refreshments provided

Abstracts

Alyssa Adams, Western Oregon University and Victor Rielly, Pacific University
NASA Marshall Space Flight Center
ARTEMIS Code Maintenance

Advanced Real-Time Environment for Modeling, Integration and Simulation (ARTEMIS) is the software currently being used for Space Launch System (SLS) core stage simulation. ARTEMIS is used to test vehicle avionics hardware and software in a hardware-in-the-loop (HWIL) environment to certify that the integrated system is ready for flight. Code is seldom perfect; therefore, it is necessary to perform quality checks to assure safety and reliability. A static code analysis tool, cppcheck, was used to identify problems known as “bugs” throughout ARTEMIS. Python programs that were written incorporate these software tools into an automated process that not only provides improved software quality today, but also provides a framework for other code maintenance tools in the future. Upon execution of the cppcheck program, dozens of errors and hundreds of warnings were detected and recorded in change requests to be reviewed by the appropriate engineers. This code verification software provides a fairly sparse analysis of code; never the less, errors and warnings were found. This suggests the verification methods employed could be very beneficial to maintain this flight simulation software.

Manju Bangalore, University of Oregon
NASA Marshall Space Flight Center
Making Cents of Space Travel: The Economics of In-Space Propulsion

From the Apollo missions to the Space Shuttle to the International Space Station, no spaceflight is possible without a reliable propulsion system. The largest factor in the aerospace market, above all, is the cost of the space travel. Chemical propulsion is always used to lift off from the Earth. However, once in space, aerospace engineers have a wider selection of technologies to choose from.
While chemical propulsion offers high acceleration, it only allows for a certain payload mass. On the other hand, electric propulsion provides high fuel efficiency, but usually comes at the cost of delaying the mission for hours or, sometimes, for years. At these scales, the selection of propulsion technology becomes dependent on money.
Optimizers are typically used to establish the trip times for missions. However, performing case-by-case analysis for individual projects is tedious and time-consuming.
A project conducted at NASA’s Marshall Space Flight Center eliminated the need for an optimizer by establishing a tool that can be used to complete cost optimization studies for any given mission. The analysis was performed on both chemical and a variety of electric propulsion systems, while variables such as efficiency, launch costs, and power levels were altered. The tool generated will be used to guide subsequent space transportation architecture assessments.

Bethany Carlson, Oregon State University
Sea Grant Internship
Seacast: Ocean Condition Forecasting Website

The purpose of the Seacast summer internship was to maintain the Seacast.org ocean condition forecasting website and to add new features to the software. Seacast was started in 2013 and has been a Capstone Senior Design project for two teams of Oregon State University computer science students. It displays ocean condition forecasts, which are generated by OSU scientists and is targeted to Oregon coastal fishermen. The goals of the project are to improve safety and profitability for Oregon fishermen, to give feedback on the accuracy of the scientists' models, and to allow collaboration between fishermen, scientists and software developers. The summer internship retained one of the students from the Capstone team.

This software development project included Python programming, Linux server management, and interactions with both the scientists and the fishermen who are the end users of the website. A new ocean condition model was added to display wave direction. Improvements were made to the visualization of the wave height model, and a display for wave period was developed. The website was migrated to a new server to improve performance and processing power. Functionality was added to automatically send user comments made on the website to one of the OSU researchers. Past days' forecasts were displayed to allow users to compare predicted values with actual observed conditions.

The Seacast project was improved to provide fishermen with more functionality, to bridge the summer gap between Capstone teams, and to develop requirements for the 2015-2016 software development cycle.

Alyssa Deardorff, Oregon Institute of Technology
NASA Ames Research Center
Multidisciplinary Aeronautics Research Team Initiative: Urban SAFE50

This summer at NASA Ames Research Center in the Multidisciplinary Aeronautics Research Team Initiative (MARTI) Alyssa Deardorff worked with eight students from across the country. MARTI dedicated seventy percent of their time to studying safe autonomous flight environments below 50 feet (SAFE50) for autonomous unmanned aerial systems (UAS). UAS need to safely operate in the National Airspace and with ground operations especially when in dense and low-altitude environments. The MARTI team focused on computational fluid dynamics of a quadcopter in hover and steady flight, motor failure control systems, and reliable energy systems. The other thirty percent of their time was committed to the exchange of ideas, decision making, prioritizing, and planning space missions to expose the inner workings of NASA, academia, and industry through team sessions, meetings, and tours. MARTI shared their work at the first Unmanned Aerial Vehicle Traffic Management Convention at NASA Ames Research Center on July 28-29, 2015. Further, they presented to the NASA Ames Research Center director, Dr. Tu, hosted a Code A (Aeronautics) Technical Seminar, and presented to Dr. Jaiwon, NASA Headquarters Aeronautics Research Mission Directorate. Alyssa Deardorff concentrated on battery prognostics for accurately predicting end of discharge and end of usable life events. In order to model a UAS vehicle battery operational behavior, she developed a C++ module with an equivalent circuit model for a NASA distributed embedded systems flight simulation program. Battery prognostics enable better system interface during failure events and therefore more efficient and safer UAS.

Greg Detweiler, Southern Oregon University
NASA Goddard Space Flight Center
Superthermal Electron Directional Fluxes and Their Pitch-Angle Distributions in the Region of the Diffuse Aurora

Based on the model developed by Khazanov et al. (2014), we present the solution of the Boltzmann-Landau kinetic equation that uniformly describes the entire electron distribution function in the diffuse aurora, including the affiliated production of secondary electrons and its energy interplay in the magnetosphere and two conjugated ionospheres. In this investigation superthermal electron activity along the magnetic field lines that lie at a distance of 4.6 and 6.8 Earth radii from the Earth's equator was considered. The major focus of this presentation is to study how both electrostatic electron cyclotron harmonic waves (ECH) and upper bounded chorus (UBC) and lower bounded chorus (LBC) whistler mode waves influence the superthermal electron directional fluxes and their pitch-angle distributions in the ionosphere and magnetosphere. This is achieved by numerically solving the Boltzmann-Landau kinetic equation with ECH, LBC, and UBC wave activity taken into account and comparing the results to the solution of the Boltzmann-Landau kinetic equation when only the influence of coulomb collision is considered. We also disscuss how the wave-particle interaction processes contribute to the energy balance of thermal and superthermal plasmas in the ionosphere-magnetosphere system.

John Froehlich, Portland State University
NASA Goddard Space Flight Center
Capturing Long-duration Fluid Slosh Behavior in Micro-gravity

A better understanding of fluid sloshing behavior in microgravity environments has the capacity to make propellant-fueled spacecraft more effective and predictable. Energy lost from the movement of the propellant in fuel tanks affects the gyroscopic stability of spacecraft, this instability can lead to catastrophic control issues caused by nutation (rocking, swaying, or nodding motion). This fluid behavior is a phenomenon not yet entirely understood by the scientific community. Determining slosh effects on spacecraft's requires the need to construct and test scale models, which can be costly and time consuming. Therefore, the ability to model slosh dynamics and determine its effects on oscillatory motion is imperative. The low-gravity, long-duration propellant sloshing experiment will collect experimental benchmarking data that may be used to validate and verify computational fluid dynamic models for liquid and gas behavior in microgravity environments. The goal of this project is to begin the initial designs of an experiment that will map the force distribution along the inside wall and propellant management device (PMD) of a scale propellant tank, while collecting low-gravity, long-duration sloshing data for the purpose of validating common CFD slosh motion models. These models will be used by industry partners during design and mission planning. As part of a small team, we conducted the initial literary research, made sensor and hardware selections, delivered a cost analysis and developed the experimental framework and communication architecture for a liquid sloshing unit to collect dynamic data during a mission aboard the International Space Station. NASA Goddard propulsion engineers are currently verifying NASA SSE data to be used as validation for this anticipated future slosh experiment.

Andrew Greenberg and Katia Pahua, Portland State University
Portland State Aerospace Society (PSAS)
PSU PSAS Sounding Rocket System

The Portland State Aerospace Society (PSAS) is an interdisciplinary student group at Portland State University that designs, builds, and tests small amateur sounding rockets with sophisticated avionics systems. Started in 1998, the project has launched 3 high-power amateur rocket airframes over the course of 13 launches from the central Oregon desert. Recent launches demonstrated a one degree of control system over roll using canards.Current projects include a fully modular carbon fiber / Nomex honeycomb airframe, an electromechanical module separation system, a cold-gas based reaction control system, a WiFi-based long distance telemetry system, a software-defined GPS receiver, and a prototype liquid fueled engine.

Alexsis Hundley-Kennaday, Cristina Martinez Galvez, and Sophia Zhang, Oregon State University
NASA Wallops Flight Facility
RockSat-C - Water Bears

The OSU RockSat-C experiment observed tardigrades in three simulated environments.
Tardigrades are unique extremophiles with the ability to control their physiology in response to environmental changes. Linked to this ability allows the Tardigrades to enter a "tun state," or a form of protective hibernation where they slow their metabolism, in reaction to stressors. These reactions were to be monitored in correlation with their respective environments. Our control environment was water to represent a basic earth environment where tardigrades are normally found, another was a mixture of water and dry ice that was sealed within the slide to create an environment of mainly carbon dioxide in order to replicate the atmospheric conditions of Mars. The third environment was a mix of iron oxide, aluminum oxide, and silicon dioxide in order to recreate the basic conditions of the surface of Mars. Each of these environments was monitored by separate USB powered microscope cameras in order to document the tardigrades' activities during the high-G load launch conditions and microgravity of low-earth orbit.

Delphine Le Brun Colon, Ariel Stroh, and Levi Willmeth, Linn-Benton Community College
NASA Wallops Flight Facility
RockSat-C - Cosmic ray detection using an array of 6 Geiger tubes and a coincidence filter

Linn-Benton Community College's RockSat-C scientific payload measures cosmic rays using a circular array of Geiger–Müller tubes. Cosmic rays were measured and differentiated from lower energy sources using a latching circuit and microcontroller to record the results. The G-M tubes were arranged in a small circle around the center of the canister, to optimize the chances of a particle passing through two tubes. It was assumed that a change in voltage across two or more tubes would indicate we had detected a cosmic ray.
Our design focused on the importance of timing, redundancy and testing. Using a hardware circuit allowed us to use cheaper components while distinguishing between events within 600 ns of each other. This high degree of precision gave us the confidence to assert that a simultaneous event was a high energy particle, and was unlikely to be caused by two separate lower energy particles. The modular design allowed us to replace damaged parts quickly if needed, and thorough testing revealed consistent baseline results on the ground.

The results after the flight showed a dramatic 1486% increase in measurements taken in space when compared against the average number of results from a ground test of the same duration. We saw increased detection rates around 30 km, although the amount of increase was not as pronounced as previous research led us to expect.

E. Michelle Neely, Oregon State University
Center for Earth and Planetary Studies (CEPS), Smithsonian National Air and Space Museum and OSU
2-D Spatial Pattern Analysis of Transverse Aeolian Ridges on Mars

Approximately 30% of the Earth's surface is arid or semi-arid environment, where sediment transport and deposition of aeolian-eroded material occurs at local and global scales. Understanding aeolian processes is important to understanding arid environments. Particle erosion, transport, and deposition by aeolian processes results in various depositional features such as dunes and ripple bedforms, depending on particle size and wind strength. Aeolian processes are observed on Mars today as well as a range of depositional bedforms, including large dunes to smaller, ripple-like Transverse Aeolian Ridges (TARs). Understanding the spatial patterns of populations of TAR fields can inform understanding of formational wind processes. The goal of this project was to use imagery from the High Resolution Imaging Science Experiment (HiRISE) camera (aboard the Mars Reconnaissance Orbiter (MRO) to obtain 2-D TAR spatial measurements (wavelengths, crest lengths, and sinuosity angles) for various TAR field types (crater-, chasm-, valley-, and channel-confined TARs). TAR crestlines were digitally traced in line segments, wavelengths between crestlines determined, and angles between crest lengths were measured to determine TAR sinuosity. These data were plotted to identify overall trends for each TAR field type. This work supports a larger project to infer formational wind processes by comparing 2-D terrestrial analog aeolian bedform and local wind analysis to 2-D TAR spatial patterns.

Vickie Ngo and Taylor Rawlings, Oregon State University
Oregon State University American Institute of Aeronautics and Astronautics (AIAA) Team
OSU AIAA Design/Build/Fly 2015 Competition

Established in 2013, the Oregon State University student chapter of the American Institute of Aeronautics and Astronautics (AIAA) has become a defining constituent of the College of Engineering identity. Led by Professors Nancy Squires and Roberto Albertani, the AIAA club helps promote industry networking with students in the form of industry tours and guest speakers, and participates in annual aerospace competitions as a part of the senior design capstone curriculum. This past year, OSU's AIAA made their third appearance at Design/Build/Fly, an international competition held for remote control planes. This presentation discusses the design and building processes implemented for the completion of the plane with integrated canard wing design, as well as the challenges faced when competition time arrived. After recovering from a devastating crash, extensive repairs and design renovations were made that allowed the plane to successfully fly two of three missions. OSU placed 11th overall out of 84 teams, a record high for the school, and was the highest scoring team to not have an aerospace program at their school.

Dakota Peck, Linn-Benton Community College
NASA Goddard Space Flight Center
Enterprise Monitoring Solutions

Consolidated enterprise monitoring allows one-stop insight to Network infrastructure, Network traffic, application availability, database utilization, and other service performance. This allows for greater knowledge of the inner workings by way of metrics gathering, identification of performance bottlenecks, routine reporting for Management, and in-time alerts to service providers when services are interrupted. This also allows the data center to be proactive to stakeholder needs and allow greater Quality of Service. Additionally, monitoring assists in identifying necessary avenues of improvement as well as planning for future growth.

Angela Piller, Portland State University
NASA Marshall Flight Center
Landslide Hazard Mapping in Rwanda Using Logistic Regression

Landslides in the United States cause more than $1 billion in damages and 50 deaths per year (USGS 2014). Globally, figures are much more grave, yet monitoring, mapping and forecasting of these hazards are less than adequate. Seventy-five percent of the population of Rwanda earns a living from farming, mostly subsistence. Loss of farmland, housing, or life, to landslides is a very real hazard. Landslides in Rwanda have an impact at the economic, social, and environmental level. In a developing nation that faces challenges in tracking, cataloging, and predicting the numerous landslides that occur each year, satellite imagery and spatial analysis allow for remote study. This study focuses on the development of a landslide inventory and a statistical methodology for assessing landslide hazards. Using logistic regression on 24 test variables (i.e. slope, soil type, land cover, etc.) and a sample of over 200 landslides, it is determined which variables are statistically most relevant to landslide occurrence in Rwanda. The pair of variables selected were Slope (30 meter resolution) and Population Density (2002), with a McFadden's Rho-squared of 0.388. The logistic regression equation for these two variables was **Y = -4.639061 + (10.030704 * Slope30) + (0.003977 * PopDen)**. Overall accuracy was 79.6%. A preliminary predictive hazard map for Rwanda was produced.

Brianna Smith Sparks, Linn-Benton Community College
NASA Kennedy Space Center
Spaceport Planning, Center Planning and Development Engineering Intern

I worked at Swampworks in the Electrostatics and Surface Physics Laboratory primarily on the Electrodynamic Dust Shield (EDS) Flight Development Project. I supported EDS research by documenting potential EDS designs utilizing microscopes to image and analyze copper/Kapton EDS configurations. The EDS configurations will be attached to spacecraft thermal radiators and used on the International Space Station (ISS) experiment: Materials for International Space Station Experiment 10 (MISSE-10). I attended COMSOL Multiphysics workshop: A workshop that teaches use of the COMSOL multiphysics software platform for simulating physics based problems and model multiphysics phenomena.
I worked at Kennedy Space Center Headquarters within the Center for Planning and Development.(CPD) I participated in a formal proposal evaluation processes regarding the Vehicle Assembly Building (VAB) and Launch Pads 48 and 49. I was a member on an assessment panel for a Notice of Availability, (NOA) where I

assessed requests for land use by identifying feasibility of proposed Concept of Operations, Financial Capability, and Experience.

I created multiple templates for Announcement for Proposals (AFP) which enabled a consistent process to evaluate proposal content. These templates are being utilized for evaluations by Proposal Evaluation Panels (PEP) and support reliable evaluation documentation and ensure PEP maintain consistent evaluation work flow. I was able to edit and optimize the Master Plan website, an internet based document. My contributions included developing content trees, reorganizing content, writing new content, content design elements, and enhancing user experience by the design of an interface, which offers easy access to discover information.

Caleb Turner, Portland Community College
NASA Marshall Space Flight Center

Systems Engineering Secondary Payloads Database Development

Functional electronic databases are one of the innovative tools used for many applications in engineering, specifically revolutionizing the way that we store, manipulate, and produce necessary data used in a variety of projects. This allows us to make the transition from hard copy information storage to electronic information storage, saving on the valued resources of time and money. The goal was to implement multiple control steps as well as a multifaceted graphical user interface to streamline the information process. Utilizing Filemaker Pro software, a database with custom user controls, and report generators was designed in order to maximize the efficiency of the Secondary Payloads System verifications and interface requirements as well as the requirements governing the use of individual payloads aboard the Space Launch System and how it fits into the systems engineering engine. This project will allow engineers to better store and manipulate data pertaining to the requirement verifications of the Secondary Payloads System and specific payload interface control documents. This project is currently still in work.