Oregon NASA
Space Grant Consortium

2014 Student Symposium
Proceedings
November 14, 2014
9:00 am - 6:00 pm

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

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

2014 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
November 14, 2014

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Agenda / Presentation Schedule

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

TIME	SESSION A - Ag Production Room	SESSION B - Ag Science Room
10:00am	**Emily Darchuck** Oregon State University Johnson Space Center Internship	**Blair Pearson** University of Portland Goddard Space Flight Center Internship
10:20am	**Joseph Truitt** George Fox University Ames Research Center Internship	**Alexsis Hundley-Kennaday, Cristina Martinez Galvez, and Sophia Zhang** Oregon State University RockOn! Team
10:40am	**Valerie Byxbe** Oregon State University Marshall Flight Center Internship	**Thomas L'Estrange** Oregon State University OSGC Graduate Fellowship
11:00am	**BREAK**	
11:20am	**Ian Averman, Matt Delaney, Fatima Dominguez, and Mike Hector** University of Portland MARS Robotics Team	**Dorcas Kaweesa** University of Portland Ames Research Center Internship
11:40am	**Tessa Von Volkenburg** Oregon State University Jet Propulsion Laboratory Internship	**Sean Brown** Oregon State University Langley Aerospace Research Student Scholars Program
12-1:20pm	**LUNCH/NETWORKING/POSTERS** - Food and refreshments provided for presenters	
1:20pm	**Alyssa Deardorff and Shellie Johnson** Oregon Institute of Technology RockOn! Team	**Teiler Kwan and Robert Scott Fisher** University of Oregon OSGC Undergraduate Research Project
1:40pm	**David Konyndyk** Oregon State University Marshall Flight Center Internship	**Dakota Peck** Linn-Benton Community College Goddard Space Flight Center Internship
2:00pm	**AmandaMarie Adams** George Fox University Jet Propulsion Laboratory Internship	**Sierra Bray** Oregon State University Ames Research Center Internship
2:20pm	**BREAK**	
2:40pm	**Hazel Betz, Ariel Stroh, and Ashley Trout** Linn-Benton Community College RockOn! Team	**David Coulter** Portland State University Jet Propulsion Laboratory Internship
3:00pm	**Nkolika Egbukichi** Portland State University OSGC Undergraduate Research Scholarship	**Kaitlin Perdue** Oregon State University Marshall Space Flight Center Internship
3:20pm	**Michael Perlin** Oregon State University Goddard Space Flight Center Internship	**Nathaniel Osterberg** Oregon State University AIAA Team
3:40pm	**Guillerma Vasquez-Garcia** Oregon State University Goddard Space Flight Center Internship	**Jennifer Woodman** Portland State University Goddard Space Flight Center Internship
4-6pm	**RECEPTION/NETWORKING/POSTERS** - Food and refreshments provided	

Abstracts

AmandaMarie Adams, George Fox University
Jet Propulsion Laboratory
Automated ISA Classifier

The Problem Reporting System (PRS) contains over 50,000 records in its database, each with a rich amount of information that can be used for risk analysis and prevention; however, the time for a human to read and understand each of these reports is impractical. Creating an automated text classifier, then, is a desirable goal. Classifying text presents multiple obstacles due to the necessity for understanding meaning behind phrases, especially in text fields where users can input free-text. By analyzing a sample of pre-classified records, we can provide the tool with a set of training data to match phrasing and words to a specific category. The current sample size is only 128 records, and thus further classifying needs to be done by hand so that the training data (the sample) can be larger and more robust. Additionally, differences in human input disrupt the effectiveness of the classifier. It is suggested that the reporting forms are simplified and made more user-friendly by reducing unnecessary fields, and that training is given to Mission Operations Assurance Managers on suggested phrasing in reports.

Ian Averman, Matthew Delaney, Fatima Dominguez, and Michael Hector, University of Portland
University of Portland MARS Robotics Team
Developing a Multi-Unit Autonomous Robotic System for the NASA Mining Robotics Competition

The University of Portland's Donald P. Shiley School of Engineering is currently designing a multi-device, autonomous, robotic, excavation system (MARS) for the 2015 NASA Robotic Mining Competition to more effectively enable NASA's efforts to permanently expand the human footprint into the solar system. Since 2010, the NASA sponsored Robotic Mining Competition (RMC), previously the Lunabotics Mining Competition (LMC), has encouraged university students from around the world to develop extraterrestrial mining systems capable of traversing obstacle-laden terrain, excavating and depositing the local resources to be used in *in-situ* resource utilization (ISRU). To date, developed systems have employed a single device, which completes each of the three aforementioned tasks in series. To more effectively meet the needs of an ISRU operation, the University of Portland applied a commercial mining approach to the confines of the competition to mirror effective mining operations on Earth. In the MARS, an excavator device is being designed for the purposes of removing resources from the surface and holding the material in a convenient position for material transfer to a transport device. The transport device is being designed for terrain traversal, handling of the excavator device and collected resources, and deposition of material into a collection bin. This system will perform the same functions as a single-device operation but in parallel instead of series. The MARS also features an autonomous control system as a potential solution to the infeasibility of real-time communication between Earth and Mars. This system will rely heavily on existing computer vision technologies in order to find the relative location of each device and the collection bin, and to detect nearby obstacles in an effort to avoid them.

Hazel Betz, Ariel Stroh, and Ashley Trout, Linn-Benton Community College
Linn-Benton Community College RockOn! Team

Our three-member team from Linn Benton Community College participated in the six day *RockOn!* workshop run by a collaboration between the Colorado Space Grant Consortium and the Virginia Space Grant Consortium.

The LBCC team traveled to NASA's Wallops flight facility in Virginia and joined other teams from around the country in building, integrating, and flying into space an Arduino-based payload. The payload included a variety of sensors including three different accelerometers, an x, y, and z axis gyroscope, a pressure sensor, a temperature sensor and a Geiger counter. All of the participating teams, including LBCC, flew their Arduino payloads to a height of 116 km on an Orbital Terrier-Improved Orion Sounding Rocket.

During the workshop we built our sensor payload, integrated our payload into the rocket, witnessed the rocket's flight, and successfully retrieved the data gathered by our sensors. Our team gained technical skills in anti-ESD tools, blink codes, and surface soldering, and experience in teamwork, testing, and troubleshooting.

Our team is taking the skills and experience learned at the *RockOn* workshop back to Linn Benton Community College. We have started a club dedicated to researching, designing, and building our own Arduino based payload that we plan to fly into space in the summer of 2015. Our project is part of the RockSat-C program, the next step after RockOn, and also facilitated by the Colorado and Virginia Space Grant Consortiums.

Sierra Bray, Oregon State University
NASA Ames Research Center
X-Plane Simulation Development

Learning a new skill can run a high risk to equipment and be very costly for the equipment to be used. Simulations can be used to teach basic task functions and test novel prototype ideas while eliminating high-risk situations and usually being far less costly than actual training and development of prototypes. The Vertical Motion Simulator (VMS) is currently being used for these simulations. An alternative is being developed at NASA Ames Research Center that is more cost and time effective than the VMS using an advanced flight simulation, X-Plane that is approved by the Federal Aviation Administration (FAA). The X-Plane simulation, with modified flight dynamics is currently being developed at NASA Ames to enable handling quality assessments of various vertical lift aircraft during conceptual design. The development will use X-Plane graphic simulation, but with flight dynamic models developed by NASA engineers running through MATLAB and Simulink. This project will be used to research the incorporation of input controls for remote control (RC) unmanned aerial systems (UAS). New models will be incorporated and validated, graphic models will be incorporated and validated, and advanced hardware design.

Sean Brown, Oregon State University
Langley Aerospace Research Student Scholars (LARSS) Program
Slat-Cove Filler: Material Feasibility and Parametric Study

A slat-cove filler (SCF) is an experimental component that partially fills the gap created between an aircraft slat and wing, causing a substantial decrease in wing noise during takeoff and landing. The purpose of this project is to prove the feasibility of a SCF and to analyze and improve performance based on materials selection and component arrangement. Previous work, based only on bench top models, suggested that a SCF comprising multiple segments of varying stiffness might lead to desirable performance. Using finite element analysis (FEA) software Abaqus CAE, a model of a slat, main wing and SCF for a transport-class aircraft was created. Several simulations were run each day, enabling a parametric study of the size and placement of a stiff middle segment (mid-link). An optimal size and placement is one that still allows for full, automatic SCF deployment and generates the lowest maximum strain in our SCF model. Results of the simulations were conclusive. As suspected, there is no deployment of the SCF without the inclusion of the mid-link. This result was shown to be true for a variety of materials over a wide range of elasticity. We have created clear bounds on the size and location of the mid-link where the SCF is fully operational. Analysis trends show that within these bounds, the maximum strain decreases with decreasing mid-link size and increasing chord-wise placement. FEA has proven to be a valuable tool in determining the feasibility and improving the performance of a three-segment SCF.

Valerie Byxbe, Oregon State University
NASA Marshall Flight Center
Landslide Hunting in East Africa

Landslides are responsible for major life losses and socioeconomic damage each year across the globe. Due to their frequency and considerable impact, landslide-forecasting models and risk assessment tools have been put into use in many regions of the world in order to mitigate their effects. However, some landslide-prone areas lack statistical data on which to formulate their own regionally specific models and decision-making algorithms. This kind of knowledge gap exists in the East African countries of Uganda and Rwanda. This study seeks to provide a more precise catalog of landslide events that have occurred in these two countries since 2003. Our catalog contains data from existing global landslide inventories, local media sources, and new observations gathered from earth observing satellites (including LANDSAT 7, EO-1, Early Bird 1, Quick Bird, World View 1, and World View 2) in order to create a more complete inventory. It contains data on 122 landslide event candidates that took place between 2003 and 2014. Each candidate is represented visually using a digital elevation model compiled from data collected by NASA's Shuttle Radar Topography Mission (SRTM) in ArcGIS along with statistical data related to each event. This data will be made available to decision-making bodies responsible for disaster management policy in Uganda and Rwanda as well as researchers involved in the development crowd-source-based technology.

David Coulter, Portland State University
Jet Propulsion Laboratory
Composition and Analysis of Thermal Emission Data from Saturn

Many observations of Saturn's atmosphere have been made over the last 20 years with a variety of platforms and instruments, and at various epochs. Of particular interest are observations of Saturn in the thermal infrared, as heat transport within Saturn is the main factor that determines Saturn's atmospheric dynamics. To build a deeper understanding of these dynamics, existing techniques are explored and new techniques are developed for merging disparate hemispherical radiance maps together into planet-wide composite. Optimal map-making techniques are then used to build a compendium of composites ranging in wavelength from 7.70μm to 24.80μm, taken from observations made from 2003 through 2013 by the MIRSI, COMICS, and VISIR instruments on the IRTF, Subaru, and VLT telescopes respectively. An analysis of these maps reveals the presence of thermal waves derived using power-spectral analysis of the composite-map residuals, with future work to characterize these waves as a function of planetographic position and time of year.

Emily Darchuck, Oregon State University
NASA Johnson Space Center, JSC SF4 - Space Food Systems Laboratory
Space Food Development

The Space Food System Lab supports the International Space Station by supplying food for crew members and advancing food technology research for future extended duration missions. This internship had two components, a literature review supporting food technology research and secondly supporting the ISS through trouble shooting current menu items.

The literature review highlighted recommendations on how processing, food matrix and ingredient conditions impacts the bioavailability of 13 micronutrients with the goal of improving the nutritional efficiency of meals for future extended duration missions.

This presentation will focus on the second part of the internship which was the development and application of a freeze dried dairy base which was needed to solve rehydration issues in existing menu items following reformulation for sodium reduction. Experimental design methodology and learnings gathered from astronaut crew sessions were used to quickly and efficiently screen 25 variables to create a rehydratable dairy base that meets the nutritional and functional requirements for microgravity consumption. The base created was used in 3 meal formulations, which were taken from conception to production scale in under 8 weeks. All three entrees were well received and a stroganoff and a soup formula were approved for scale up and sensory testing. These entrees were scheduled for sensory panel evaluation at the end of my tour and if passed will be approved for flight to replace the current ISS menu formulations of these products.

Alyssa Deardorff, Krista Galloway, and Shellie Johnson, Oregon Institute of Technology
Oregon Institute of Technology RockOn! Team

The seventh annual RockOn! 2014 Workshop was conducted in partnership with the Colorado and Virginia Space Grant Consortia and supported by NASA through their Sounding Rocket Program, Office of Education and the National Space Grant College and Fellowship Program. Through the support of the Oregon Space Grant Consortium, our team of three Oregon Tech students participated in this program from June 21-26, 2014, one of 21 teams of community college and university students and instructors at the Wallops Island Flight Facility that built and integrated scientific payloads to collect data in space. First, our team built a Geiger counter to evaluate audio and visual cues to count alpha, beta, and gamma radiation. Then, the Arduino's shield was assembled with a 2 MB Flash Memory and 8 GB SD Card Memory, pressure sensor, temperature sensor, 3 axis gyroscope, 3 axis acceleration in low and medium range, humidity sensor, and 1 axis acceleration in high range. Next, the Arduino MEGA 2560 was integrated with the shield. These PCB boards were mechanically mounted on to the payload plate with the batteries and G-switch and the flight code was reviewed and uploaded to the Arduino. The system was tested at each stage with a series of blink codes before being stacked into canisters. These canisters were then integrated into a Terrier-Improved Orion suborbital sounding rocket. At 7:21 am EDT on June 26, 2014 from MRL Launcher, Pad 2 at Wallops Range, the rocket was launched and reached an altitude of 73.3 miles. 12.16 minutes later, the vehicle landed via parachute 43.9 miles from Wallops Island in the Atlantic Ocean. The rocket was recovered by NASA and Oregon Tech's data was successfully collected for 3-axis acceleration, spin rate, radiation counts, humidity, pressure, and temperature for the duration of the vehicle's flight.

Clara Dunklee, Robert Scott Fisher, and Teiler Kwan, University of Oregon
OSGC Undergraduate Research Project
A Proposed Mid-Infrared Study of Exoplanet 55 Cancri E

The 55 Cancri (Rho^1 Cnc) binary star system has five confirmed exoplanets orbiting the sun-like G8V star, 55 Cnc A. The rocky innermost planet, 55 Cnc e, orbits its parent star at 0.01 AU, and is known as a "Super Earth" since it has a mass of approximately eight Earth masses. As a result of its proximity to its parent star, it is proposed that 55 Cnc e is being vaporized by a strong stellar wind and extreme temperature gradients across the face of the planet. A possible consequence of this slow vaporization is a toroid of planetary material being formed in situ as the planet orbits the star.

We conducted a feasibility study to determine the rate of planetary vaporization needed to detect a presumed "debris tail" from 55 Cnc e with CANARICAM, the mid-infrared camera mounted on the earth's largest optical/infrared telescope, the Gran Telescopio Canarias (GTC). In our study, we analyzed the potential mid-IR excess of 55 Cnc A by compiling and analyzing previous ground- and space-based flux measurements (e.g. 2Mass, OSCIR, IRAS, Wise, Akari, and Spitzer). This archival data was compared to Ian J. M. Crossfield's absolutely calibrated model of 55 Cnc A (Crossfield, 2012). If a mid-IR excess is confirmed at an amount capable of detection via CanariCam and the GTC, we will propose the use of long-slit spectroscopy to determine the spectral features and properties of the planetary composition of 55 Cnc e.

Nkolika Egbukichi, Portland State University
OSGC Undergraduate Research Scholar
Characterization of the RNA-DNA Hybrid Virus Capsid Protein, Stedman Lab – Center for Life in Extreme Environments

Currently there are three major classes of known viruses: exclusively RNA viruses, DNA viruses, and so-called retroviruses. A single stranded DNA (ssDNA) virus genome, recently found using metagenomics in Boiling Springs Lake in Lassen Volcanic National Park, USA (BSL) contains elements homologous to both ssRNA and ssDNA viruses. This virus has a genome, which contains an open reading frame (ORF) for a replication initiation protein (Rep) homologous to that of the Porcine Circovirus (PCV) and other ssDNA replicons. The other ORF of interest encodes a putative capsid protein (CP) that is not at all similar to the PCV CP in sequence. The CP ORF however, is homologous to the CP of viruses from the ssRNA virus family Tombusviridae (TBV). The ssDNA genome of BSL RNA-DNA hybrid virus (BSL-RDHV) is about 4.1kb and also contains two additional ORFs with unknown functions. Phylogenetic analysis of the CP and Rep ORFs strongly suggest a chimeric origin from both ssRNA and ssDNA viruses for this novel genome. This study proposes characterization of the BSL-RDHV capsid protein. The long-term goal of this research is to determine the structure of the BSL-RDHV CP and compare it to the known structures of the PCV CP and the TBV CP. To gain further insight into the structure of the BSL-RDHV CP, the gene will be assembled in an expression vector using the Gibson Assembly Cloning Method™ and transformed into competent *E. Coli* cells. The CP will be purified from cell lysate using column chromatography, and pure protein will be obtained in milligram quantities.

Alexsis Hundley-Kennaday, Cristina Martinez Galvez, and Sophia Zhang, Oregon State University
Oregon State University RockOn! Team

RockOn! 2014 was a one-week workshop we participated in during Summer 2014. The workshop's purpose was to build a payload in groups of three while applying electrical and mechanical skill-sets. The main components of the payload required soldering and using electrical components including an Arduino board, Arduino shield, Geiger Counter, resistors, capacitors, LEDs, accelerometers, gyroscope, SD card, G-Switch, and two 9V-batteries. After completing each stage of the payload, tests were conducted to ensure that all stages were meeting the required specks. Flight code was programmed into the SD card, to activate data collecting and also control functioning of electrical components through the Arduino board. Assembling all of the electrical components onto the main plate and wiring all of the parts together consisted of the mechanical aspects. After all of the payloads were completed, they were loaded into canisters. Next came testing. Each payload was tested to make sure power was running though all of the components by activating the G-Switch. Later, the canisters were loaded into the sounding rocket for rocket spin tests. After receiving positive results, everyone prepared for launch day. The sounding rocket's launch was an awe-inspiring moment that signified the result of the group's hard work. The rocket's landing was a sign that it was time for retrieval. Once we got back the payload, we retrieved and extracted the collected data from the SD card to create graphical representations of them. This helped us learn how temperature, sensitivity, acceleration, and ionizing radiation amounts fluctuated throughout the launch.

Dorcas Kaweesa, University of Portland
NASA Ames Research Center
Overhauling and Testing 1/50th Scale NFAC Model Motors

The National Full- Scale Aerodynamics Complex (NFAC) is a wind tunnel consisting of two test sections powered by six motors in its fan drive system. The NFAC facility is used to test and measure the aerodynamic performance of full-scale aircraft models. A 1/50th scale model of the NFAC was designed and fabricated to closely simulate the performance of the full-scale NFAC facility. It is powered by six 10-HP motors in its fan drive system. The model is used by engineers to investigate possible flow quality improvements of the full-scale NFAC facility. The 1/50th scale NFAC model has not been repaired for several years.

This project entailed the disassembly of the motors from their respective nacelle units and the refurbishing of the motors. While one of the motors was sent for refurbishment, an adjacent un-refurbished nacelle unit was set up and run at the motor's maximum speed to test vibrations, bearing temperatures, voltage, and current. The measurements of the un-refurbished nacelle were accurate. Nonetheless, the motor will be refurbished. Ultimately, all motors will be refurbished and re-installed in their nacelle units. The fan-drive system will be operated to maximum speed. This will ensure accurate measurements for future test operations and flow improvement studies.

David Konyndyk, Oregon State University
NASA Marshall Flight Center
Space-Capable Nuclear-Thermal Propulsion: Reactor Control Design and Tools for Neutronic Analysis

Four decades have passed since the cancellation of the highly successful NERVA program and the subsequent waning of space-capable nuclear-thermal propulsion (NTP). Today, renewed support for a manned Mars expedition coupled with the advantageous prospects of low-enriched uranium (LEU) fuel has reignited interest in the development of NTP technology. By expanding cryogenic H2 propellant through reactor cooling channels, nuclear-thermal rocket engines can generate ISPs in excess of 900 seconds. A proven increase in efficiency and thrust-to-weight ratios when compared to chemical rockets puts NTP in a prime position for the first human missions to Mars. Equipped with the latest tools and materials, the NASA Space-Capable Cryogenic Thermal Engine (SCCTE, or "Scotty") team has assembled to develop a nuclear rocket engine "point design" for speculative purposes. Assisting the team in its mission, I aided in a redesign of radial reflectors and control drums based on reactor specifics and known physical constraints. I then introduced a mechanical design for a hydraulic reaction control assembly, which was built and tested with positive results. Taking a multi-disciplined approach, I also developed a mathematical method of reactor control drum analysis and theorized an optical material, which could be made to simulate neutron diffusion in solids. The optical analog is the basis of an undergraduate thesis, which will evolve through the coming year.

Thomas L'Estrange, Oregon State University
OSGC Graduate Fellow
Enabling Self-propelled Condensate Flow During Phase-change Heat Rejection Using Surface Asymmetry

The central hypothesis of the proposed work is that asymmetry in surface microstructures can cause self-generated directional motion of the condensate. If such directional motion of the condensate can be achieved, a condenser with such microstructures can be combined with a similarly designed evaporator to create a pumpless thermal management loop. The hypothesis will be tested on three specific asymmetric surface morphologies and compared against symmetric surface microstructures. The first two surface morphologies will consist of hydrophilic and hydrophobic micro-structured asymmetric ratchets respectively. The third morphology will consist of a combination of hydrophilic and hydrophobic faces on each ratchet. In accordance with the hypothesis, the overall objective is to characterize the effects of surface microstructures on droplet dynamics and/or film dynamics, and on heat transfer rate, by variation of the microstructure size or surface conditions. Design of gravitationally independent phase-change components has been identified by NASA as a critical area of research in order to further its mission. The proposed concept and work plan are strongly aligned with NASA Technology Area 14 in the area of heat rejection through condensation heat transfer in partial and microgravity environments towards design of thermal control systems and further human exploration of space.

E. Michelle Neely, Portland State University
Jet Propulsion Laboratory
Mapping Dust Sources over North Africa Using MISR Winds and Aerosol Products

Transported dust affects multiple Earth systems, including the energy budget, carbon cycle, ocean productivity, and CO_2 exchange. To better understand the global dust cycle and its effect on Earth systems, it is important to identify the major dust source regions. The most practical way to study deserts is through satellite remote sensing. However, identifying dust source regions remotely remains a challenging task. The primary objective of this work was to develop a new automatic dust source identification technique using Multi-angle Imaging SpectroRadiometer (MISR) cloud-motion winds and aerosol products. To demonstrate our approach we investigated Sahara desert dust activity at 10:30 am local time – the time of MISR overpass. Potential Saharan dust source areas were identified by delineating images of MISR wind count observations with near-surface (below 2km) wind speed above 25 m/s. The identified areas were then further investigated in term of MISR mean aerosol optical depth (AOD) and mean non-spherical (dust) fraction. The areas of high near-surface winds, and high AOD/dust fraction were studied in terms of topography, and geomorphology. Based on MISR observations and surface geomorphological features, major dust source regions across the Sahara were identified and a database was assembled with detailed comparisons that can be used for future analysis.

Nathaniel Osterberg, Oregon State University
Oregon State University American Institute of Aeronautics and Astronautics (AIAA) Team
OSU AIAA Design Build Fly Competition

Two and a half years ago, students and faculty in the college of MIME (Mechanical, Industrial, and Manufacturing Engineering) created the OSU chapter of AIAA (American Institute of Aeronautics and Astronautics) to help connect students with the aerospace industry and engage interested students in aeronautics and astronautics.

One focus of OSU AIAA is the participation in student design competitions. This presentation will focus on OSU AIAA's involvement in the DBF (Design-Build-Fly) competition sponsored by AIAA.

Through this competition students design and build a remote controlled aircraft to perform a specific set of missions. The intent of the competition is to replicate the design process of full-scale aircraft. Students determine engineering requirements from mission specifications, create a product that is optimized to meet those requirements, and fly their design at competition.

Over the last two years OSU AIAA has been able to send students to this competition to compete with top aerospace universities from around the world. The first year OSU AIAA placed 14th of 100 competing teams and was recognized as the best rookie team; the second year the OSU DBF team had a 38th place finish.

Through the successes of OSU AIAA, both in student competitions and in industry involvement, the organization's footprint on campus is expanding rapidly and will hopefully help the college of MIME and the university administration appreciate the growing demand for curriculum in aeronautics and astronautics at OSU.

Blair Pearson, University of Portland
NASA Goddard Space Flight Center
Utilizing a Cryogenic Loop Heat Pipe for Large Area Cryocooling

Some spacecraft require cooling at extremely low temperatures, typically using an open refrigerant system that suffers lifetime issues. This may be resolved by a loop heat pipe (a closed system) operating at cryogenic temperatures. Such a device must be able to cool a large area into a small heat sink, opposite from current loop heat pipe applications. As no cryogenic loop heat pipe has been used in space flight in this manner, behavioral characterization is essential. Operation of the existing demonstration unit is tested in a thermal vacuum chamber with two-phase helium, and thermal performance is assessed. Demonstration unit startup is achieved at the low thermal extreme with only 10 mW pumping power. During operation, the device is shown to have twice as much cooling power as its pump is supplied, up to 120 mW and 60 mW (respectively). The maximum pumping power is also shown to be around 70 mW. The device displays a high tolerance for sudden changes in heat load. The total heat removal capability is also of interest, but as of this writing has not been tested. Test results thus far verify that it is feasible to utilize a cryogenic loop heat pipe for large area cryocooling.

Dakota Peck, Linn-Benton Community College
NASA Goddard Space Flight Center
Enterprise Virtualization with Failover Clustering

In recent years the practicality of virtual machines (VM) has seen a large growth with both small and large businesses. Virtual machines are software-based computers that use their allocated physical components more efficiently. Where physical servers previously had to be turned off for physical maintenance, with VM's we can now perform such tasks extemporaneously. The ability to perform such actions is due to failover clustering. A failover cluster is a grouping of servers with a shared storage space where VM's are stored. However the host of the VM's can be any of the computers in the cluster. The way a failover cluster works is that in the case of one physical server's failure the VM's will migrate to another host in the cluster. Due to this, hosted applications and services upon the servers will continue to operate. A failover cluster was implemented at the code 700 datacenter. The cluster was successfully implemented using Microsoft Hyper V. It was a five-node cluster with storage space upon a Netapp Filer. The result of this was a stable production system used to host critical VM for the NASA network.

Jordan Pemmerenck, Katie Watkins-Brandt, Radu Popa, and Martin Fisk, Oregon State University
***In-situ* Imaging of Fluorescing Minerals Present on Mars**

The Mars Hand Lens Imager (MAHLI) camera mounted on the end of the Mars Science Laboratory Rover's robotic arm is capable of capturing close-up images of minerals, textures, and structures of the Martian environment. Illumination is achieved using four white LEDs allowing photography even during nighttime conditions. Two UV LEDs at 365nm are also present on the camera that can be used to examine minerals. When certain minerals are excited by photons with sufficient energy such as the energy emitted from the two UV LEDs, those objects will fluoresce. This fluorescence results in an image with higher red pixel values than an image taken without lighting from the two UV LEDs. A commercial camera records all raw information in RGB pixels. This raw data from the camera sensor provides the necessary information to determine the fluorescence intensity of various minerals. In the laboratory, we have demonstrated fluorescence from a variety of minerals known to be or suspected of being present on Mars using a Canon EOS Rebel T2i camera and a lighting setup identical to that on the MAHLI camera. Using the unique RGB signatures of known minerals as a baseline we plan to analyze MAHLI images of *in situ* outcrops and determine if specific minerals present on Mars and further investigate the geologic history of the landing site.

Kaitlin Perdue, Oregon State University
NASA Marshall Space Flight Center
Calibration Setup for Electric Propulsion Thruster Test Stand

The purpose of this project was to develop a calibration setup for a small thrust stand to quantify the performance of a low-thrust propulsion system. The stand presently in development has a linkage system that amplifies the displacement produced during operation such that the motion can be more readily quantified. This provides an improvement in the resolution and measurement accuracy because often the deflection of the primary linkage (i.e. the one to which the thruster is attached) is quite small owing to the low thrust levels. The measurement of thrust is accomplished by calibrating the thrust stand response through the application of known forces to the primary linkage and measuring the resulting deflection.
There are two types of calibration provided by the setup. The first method is a steady state calibration that is achieved by using a stepper motor to raise and lower fixed masses, with their weights being applied through a thin string to the primary linkage as the motor raises and lowers them. The second method is a pulsed calibration where current is pulsed through a solenoid to produce a magnetic field that acts on the thrust stand arm through a force transducer, providing a direct measure of the pulsed force applied. The thrust stand apparatus, including the calibration hardware, is operated using an Arduino microcontroller and Labview software. The calibration setup was successfully developed and is ready to be incorporated into the thrust stand.

Michael Perlin, Oregon State University
NASA Goddard Space Flight Center
Micro-newton Thruster Modulation and Analysis for the LISA Pathfinder

The micro-propulsion system control loop on the LISA Pathfinder relies on knowledge about thruster positioning and specifications. Consequently, a system identification protocol was developed to determine thruster calibrations, orientations, and response time delays. Thrusters are commanded to generate a sinusoidal thrust at distinct frequencies, which allows for their concurrent characterization via a frequency-domain analysis of space craft response signals. Differential position data between the space craft and inertial test masses together with propulsion control loop signals are combined to measure the force exerted on the space craft at each thruster frequency. A principal component analysis of these forces yields their magnitude and direction, which translate to corresponding thruster calibrations and orientations. The phase of the transfer function from commanded to measured thrusts at the respective thruster frequencies yields the time delay of each thruster. In simulations with space craft models under current development, calibrations are thus measured at ~1.02 of their injected value, and orientations to ~10 microradian (0°0'2'') accuracy; response time delays are measured to be ~130 ms. Discrepancies between injected and measured thruster parameters are used to test the space craft models. Models have yet to be interpreted to determine expected response time delays, but these anticipated to be on the same order as the measured values.

Joseph Truitt, George Fox University
NASA Ames Research Center
Determination of Rotormast V-22 Blade Structural Properties

There is currently a large push in the aviation world (by companies such as Amazon) for the ability to use autonomous aircraft such as drones and quadcopters as an asset in commercial applications. Before such enterprises can become realistic investments, methods must be developed to analyze such devices. The purpose of this project was to develop testing methods that can be explored using a Rotormast V-22 radio-controlled model tiltrotor aircraft. This project focused primarily on the physical properties of the blades. The beam structural analysis program UM/VABS was used to calculate area-based properties. Physical tests were performed to determine stiffness and mass properties. The validity of these processes for determining physical and structural properties was evaluated for every experimental setup.

Guillerma Vasquez-Garcia, Oregon State University
NASA Goddard Space Flight Center
Magnetic Bearings for Space Flight Applications

The goal of this project is to reconstruct and operate an existing magnetic bearing system that was developed by the Electromechanical Systems Branch (Code 544). During the mid 90's, HIRDLS EOS-CHEM (Earth Observing System-Chemistry) required an optical chopper that needed to be operated at 5,000 rpm throughout the mission life. Due to concerns that mechanical bearings might not be able to meet the life requirement, a magnetic bearing based optical chopper was developed as a parallel effort, but was never flown. Magnetic bearing can reduce vibrations, allow higher precision, eliminate friction and lubrication, and have a longer life compared mechanical bearing.
Reconstruction of the magnetic bearing system required understanding all the details of the magnetic bearing mechanism, electronics, and controller hardware and software. This required discussions with the engineers who were originally on the project, digging into documentation that was available, and consulting with dSPACE technical support. Since there is a multiplicity of sensors, windings, driver circuits, sensor processing circuits, etc., these all needed to be identified with the magnetic bearing coordinate system. A harness was designed to connect between the electronics and a dSPACE controller. Matlab/Simulink is where the controller algorithm resides. Sensor signal voltage range and scale factor was determined, as well as magnetic bearing parameters, and all circuit gains, in order to develop the closed loop control system. This effort will lead future magnetic bearing space flight application.

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The Emergence of Life: An Abiotic Synthesis of Amino Acids

In the primordial ocean life is considered to have emerged at submarine alkaline hydrothermal precipitate mounds as a result of pH and redox gradients. The inorganic minerals formed were coopted into acting as proto-enzymes coupling exergonic reactions with necessarily lesser endergonic ones. Such reactions were driven by gradients operating across the precipitate membranes hypothesized to eventually result in early cellular activity. One such proto-enzyme is needed to reduce nitrate to ammonium. The mineral green rust, a double-layered hydroxide, was examined after being shown to demonstrate this capability. An expectation is that the ammonium formed in this way would aminate carboxylic acids to amino acids. We synthesized abiotically a chloride form of green rust to react with nitrate and produce ammonium. An attempt was made to use the resulting ammonium to aminate pyruvate to alanine in the conditions hypothesized at the submarine Hadean mound. Alanine is considered to have been one of the earliest amino acids; one that is essential to peptide and protein formation and structure. Producing such a molecule strictly by chemical processes would provide a pathway to understanding how primitive life may have emerged, and under what conditions life on other terraqueous planets may be discovered.

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Slow Down, I'm Not a Scientist: A Field Guide to Science Writing

How do you tell your story? You're at the cutting edge of research, but communicating what you do to people outside of your discipline can be daunting. Good writers can be your conduit to the public – to support, to funding, and to scientific understanding in the communities you serve. Effectively translating complex scientific information and presenting it to the public requires patience, curiosity, and a willingness to dive into foreign territory, often without a net. WWW.EARTHZINE.ORG is an online publication created to help build bridges between what is happening in the Earth observing community and the public-at-large. An Earthzine internship offered me the opportunity to hone my writing skills in a truly extraordinary environment; this will serve me well as I begin the transition from academia to a career as a science writer. At the end of a summer at Goddard spent interviewing scientists and NASA administrators about groundbreaking technology and research, I am armed with a portfolio of published articles that demonstrate my potential to future editors and employers. Since my internship did not necessitate doing scientific research, I used the poster presentation as an opportunity to outline the writing process. I believe that this helps demonstrate the work that I did at Goddard as a writing intern in a cohesive manner. Additionally, the presentation helps illustrate the similarities between science writing and scientific research, which may be of benefit to fellow interns as they move towards a career in the sciences where they will need to be able to effectively communicate with the public in a written format.