OREGON NASA
Space Grant Consortium

2011 Student Symposium
Proceedings
November 4, 2011
9:00 am—7:00 pm

Memorial Union
Powell Learning Center Journey Room
Oregon State University

featuring presentations from
NASA student interns and researchers

2011 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
November 4, 2011

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Agenda / Presentation Schedule

TIME	STUDENT NAME	SCHOOL	PROGRAM	NASA CENTER
8:00-9:00	Poster Session Set-Up — Snacks and refreshments provided			
9:00-11:30	Open Poster Session — Snacks and refreshments provided			
11:30-Noon	BREAK / NETWORKING			
Noon-1:00	LUNCH - Food and refreshments provided			
1:00	Cody Hyman	Oregon State University	NASA Internship	Jet Propulsion Laboratory
1:15	Ellynne Kutschera	Portland State University	Graduate Fellowship	n/a
1:30	Jesse Grimes	Oregon State University	ESMD Senior Design Project	n/a
1:45	Vasha Dutell	University of Oregon	NASA Internship	Ames Robotics Academy
2:00	Mason Keck	Oregon State University	NASA Internship	Goddard Research Center
2:15– 2:45	BREAK / NETWORKING			
2:45	Dar Dahlen	University of Oregon	NASA Internship	Ames Robotics Academy
3:00	Brian Larson	Portland State University	Graduate Fellowship	n/a
3:15	Anthony Odenthal	Oregon State University	Pico-Satellite Project	n/a
3:30	Brandon Snook	Western Oregon University	Undergraduate Research Scholarship	n/a
3:45	Courtney Solem	Oregon State University	NASA Internship	Ames Research Center
4:00—5:00	RECEPTION—Snacks and refreshments provided			
5:00	Cullen Andrews	University of Oregon	Graduate Fellowship	n/a
5:15	Courtney Klosterman	University of Oregon	NASA Internship	Ames Research Center
5:30	Thomas Bauska	Oregon State University	Graduate Fellowship	n/a
5:45	Daniel Sidlauskas Miller	Oregon State University	OSU Aerial Robotics Team	n/a
6:00-6:15	BREAK / NETWORKING			
6:15	Damani Proctor	Portland Community College	NASA Internship	Goddard Research Center
6:30	Alex Krewson	Oregon State University	NASA Internship	Johnson Space Center
6:45-7:30	NETWORKING AND SYMPOSIUM WRAP UP			

Abstracts

Cullen Andrews, University of Oregon
Investigating XUV Disk Galaxies at Pine Mountain Observatory

Extended-ultraviolet (XUV) disk galaxies are classified so because space-based UV observations reveal star formation in their faint outer reaches, beyond the limits imposed by previous interpretation of near infrared data. At Pine Mountain Observatory near Bend, Oregon, ultraviolet images were obtained for six galaxies, which previously were rigorously analyzed and classified as XUV (3 of the 6) or non-XUV (the other 3) using data from the GALEX ultraviolet space telescope. In addressing the simple question of what XUV disks look like in ground-based observations, several possible indicators in the Pine Mountain data were tested for association with XUV status. These hypothetical indicators focused mainly on observations of the outskirts of the target galaxies. A set of IRAF and Source Extractor scripts for subtracting foreground stars was developed in order to more accurately scrutinize these faint regions. Of the indicators tested, two qualities in the Pine Mountain images emerged as possibly being associated with XUV disks—(1) excess proportion of UV flux detected beyond the cataloged half-light circular aperture, and (2) comparatively large spiral structures at or beyond the limiting isophote determined by the Source Extractor script employed. All three of the confirmed XUV disks exhibited one or both of these qualities, and none of the three confirmed non-XUV disks did. This is contradicted, somewhat, by measurements of 11 additional disks with unknown XUV status, seven of which exhibit these possible indicators, far in excess of the ~20% of disks found in rigorous, space-based studies.

Thomas Bauska, Brook, E.J., Oregon State University
Paleoatmospheric records from Blue Ice Regions

The ice sheets of Greenland and Antarctica are unique archives of the earth's climate history. Most notably, ice cores have provided a detailed record of the atmospheric history of greenhouse gas concentrations over the last 800,000 years. Traditionally, these records are extracted by drilling thousands of meters of ice from surface to bedrock of the thickest portions of the ice sheet where the ice accumulates. These deep ice cores provide long records of climate histories with little chronological uncertainty. A major drawback from this method is that the core provides a relatively small amount of sample per time interval. Another method for recovering records of past atmospheric history is to sample from the ablation zones of the ice sheets (often referred to as a blue ice zone). In a blue ice zone, the flow of the glacier has done the work of the drill and brought the ice of interest to the surface. We document that Taylor Glacier in the Dry Valleys of Antarctica is a blue ice region that contains at least a 10,000-year record of the last glacial termination. A record of the concentration and isotopic composition of carbon dioxide and the concentration of methane will be presented from this site. This is the first record of carbon dioxide variability ever extracted from a blue ice region.

Dar Dahlen, University of Oregon
NASA Ames Research Center Robotics Academy
Feasibility of Using an IMU for Inertial Navigation on the Lunar Surface

A small Inertial Measurement Unit (IMU) was considered as a dead reckoning navigation tool for a Lunar Micro Rover (LMR). The LMR is a small (less then 10kg) robot designed to carry various scientific payloads on the lunar surface, traveling up to several hundred meters. It is designed to operate in conjunction with a lander that provides radio contact with Earth. In the event that the LMR loses contact with the lander, it must be able to navigate autonomously back to the location at which it last had signal. In order to navigate, an IMU was considered as a dead reckoning inertial navigation device. The moon lacks a consistent magnetic field, and therefore an IMU cannot use this field as a compass as it can on Earth. The absence of this field severely increases the error in the measured position. Several sensors were investigated to compensate, however all were determined to be too heavy or required a large of a percentage of the LMR's power. Various IMU units were investigated, and Monte Carlo simulations were created to estimate the drift that would be experienced in the estimated position of the rover. It was found that an IMU was insufficient by itself to provide useful position estimates over any length of time in excess of several minutes.

Vasha Dutell, Zwach, M., University of Oregon
NASA Ames Research Center Robotics Academy
Simulating Ionizing Radiation in a Lunar Micro Rover

The Lunar Micro Rover (LMR) is a small modular robot that is designed to carry and execute a scientific or exploration payload on the lunar surface using a small budget compared to legacy NASA missions. In order to keep costs low, LMR has been designed with many electronic components that are not radiation-hardened to withstand the ionizing-radiation environment in the Van Allen belts and on the lunar surface, both of which will be encountered during the mission. Radiation shielding materials must therefore be implemented both inside the rover chassis, and in the lunar transport module, which will encase LMR en route to the moon. Because of the time and monetary expenses of testing prospective shielding materials by irradiating them, characterizing their shielding ability using simulations is a sensible alternative. Radiation simulation tools were investigated for being inexpensive, having well-established accuracy, and accessible such to be quickly learned, used to create simulations, and produce meaningful data on a 10-week time scale. Using SPENVIS, simulations were conducted to determine the effectiveness of prospective radiation mitigation techniques in multiple environments, including low earth orbit, a translunar injection orbit, and the lunar surface, both during normal conditions, and during a worst-case solar flare event. Additionally, simulations were created to anticipate the results of a planned radiation test at Indiana Cyclotron Facility. Based on data from these simulations, the chosen radiation-mitigation techniques were determined to be somewhat effective against normal radiation levels for travel to and a short mission on the lunar surface, but ineffective against a worst-case solar flare event.

Jesse Grimes, Oregon State University
Mars Rover Robotic Arm

The Robotic Arm is built for and integrates with the 2011 OSU Mars Rover and is the most versatile robotic arm ever used in the University Rover Challenge. It is a jointed, three to six degree of freedom robotic arm capable of carrying over 40 lbs and performing complex tasks such as plugging in power plugs. It is comparable to and is a much less expensive than the robotic arm design installed on Spirit and Opportunity, currently in use on Mars. Functionally, this arm is designed for use on a Rover that assists astronauts living on and exploring Mars. These astronauts can use this device to investigate potentially interesting sites from the safety of their Mars Habitat and collect soil and rock samples for analysis in the aid for the search for Martian life forms. With the simple exchange of an end effector on the Robotic Arm, it can then be used for servicing field equipment. The Rover can also be used to carry and deploy supplies astronauts working outside the habitat such as extra oxygen or tools. This device serves as a proof of concept that adequate technology and devices can be developed with College students, a relatively small budget, and six months. This robotic arm was developed and implemented by Mechanical and Electrical Engineering students in cooperation with the OSU Robotics Club and funded by Oregon NASA Space Grant Consortium.

Cody Hyman, Tung, Yu-Wen; Oregon State University, Jet Propulsion Laboratory
NASA Jet Propulsion Laboratory
A Hyperbolic Ontology Visualization Tool for Model Application Programming Interface Documentation

Spacecraft modeling, a critically important portion in validating planned spacecraft activities, is currently carried out using a time consuming method of mission-to-mission model implementations and integration. A current project in early development, Integrated Spacecraft Analysis (ISCA), aims to remedy this hindrance by providing reusable architectures and reducing time spent integrating models with planning and sequencing tools. The principle objective of this internship was to develop a user interface for an experimental ontology-based structure visualization of navigation and attitude control system modeling software. To satisfy this, a number of tree and graph visualization tools were researched and a Java based hyperbolic graph viewer was selected for experimental adaptation. Early results show promise in the ability to organize and display large amounts of spacecraft model documentation efficiently and effectively through a web browser. This viewer serves as a conceptual implementation for future development but trials with both ISCA developers and end users should be performed to truly evaluate the effectiveness of continued development of such visualizations.

Mason Keck, Ptak, A., Oregon State University, NASA Goddard Space Flight Center
NASA Goddard Space Flight Center
Scoping the Science Parameter Space of Future X-Ray Calorimeter Missions

High spectral resolution X-Ray spectroscopy will be carried out by future X-ray calorimeter astrophysics missions. The high spectral resolution, below 5.0 eV, of the calorimeters developed for the Astro-H mission and the AXSIO and ATHENA mission concepts will allow for future X-ray calorimeter missions to characterize key physical processes, including the effects of strong gravity at black hole accretion disks, black hole spin, and metal outflows from starburst galaxies into the inter-galactic medium. To help in the development of these future X-ray calorimeter missions, I developed a routine to automate the generation and error fitting of simulated spectra of astronomical objects using the X-ray spectral-fitting package XSPEC. The routine reports the expected errors for a large range of input spectra parameters, instrument responses, and background spectra. This routine will help in the definition of the science focus of future X-ray calorimeter missions.

Courtney Klosterman, University of Oregon
NASA Ames Research Center
Project OMEGA: Mixing Algae

NASA's Project OMEGA (Offshore Membrane Enclosures for Growing Algae) will harvest biofuel from growing freshwater algae in floating photobioreactors in the ocean. The algae use nutrients from wastewater, energy from the sun, and carbon dioxide to grow and mature. The photobioreactors will be made from clear, flexible, polymer bags that become circular when filled with algae. The algae will travel long distances (30 feet) through photobioreactors before it reaches a gas exchange column where oxygen gas is released (from photosynthesis) and carbon dioxide is absorbed (for photosynthesis). However, during travel between the gas exchange columns, the algae need sunlight to effectively perform photosynthesis. With large bag diameters, the bottom of the flow will never see light and the center of the flow will travel faster than the rest. Currently, swirl vanes with a half integer turn are being studied to ensure proper mixing and flow rates throughout the photobioreactors. Also, wave motion is being tested for mixing versus the use of swirl vanes, with/without air bubbles in the system. Overall, experiments will help parameterize flow rate, efficient mixing with swirl vanes and waves, bubble flow in photobioreactors and gas exchange column, and the durability and strength of the polymer bags.

Alex Krewson, Oregon State University
NASA Johnson Space Center
Simulated Atmospheric Pressure Testing of the Orion Capsule

The stresses and strains on an irregularly shaped window pane of a crew module exposed to an atmospheric pressure difference are difficult, if not impossible, to predict theoretically. For this reason, it is necessary to conduct a test under simulated pressurized conditions to examine the response of the window assembly to insure an adequate pressure seal. The project in which I was involved at the NASA Johnson Space Center involved the testing and analysis of the front pressure pane of the Orion Capsule, which is the crew module section of the Multi-Purpose Crew Vehicle. The acrylic pressure pane that was being tested was to be deflected using a series of closely spaced jackscrews to simulate the deflection of the crew module under pressure. While deflected, a positive air pressure was to be applied to the "interior" side of the pressure pane. Rate of leakage through the O-ring seal of the pressure pane was to be measured, although this step of the procedure was never reached due to technical difficulties during the deflection process. These technical difficulties were the result of excessive loading on the jackscrews, which caused galling and seizure throughout the test fixture. Despite the best efforts of the test personnel, no results were gathered by the time of my departure.

Ellynne Kutschera, Khalil, A., Shearer, M., Rice, A., Rosenstiel, T., Portland State University
Transport of Methane in Trees

Although overall methane (CH_4) emissions for croplands, wetlands, and forests have been measured, the exact dynamics of CH_4 transport through trees is not well understood. What roles transport mechanisms play in emission rates is fairly unknown for trees. Better-defined plant transport mechanisms yield a more accurate determination of greenhouse gas flux and its variations, contributing to a comprehensive theory quantifying greenhouse gas emissions globally. CH_4 emissions from the common wetland tree species black cottonwood (Populus trichocarpa) native to the Pacific Northwest have been measured under hydroponic conditions in order to separate plant transport processes from the influence of soil processes. Canopy emissions of CH_4 have been measured via canopy enclosure. Measurements of CH_4 flux from each of 16 trees have indicated that emissions are normally constant over the half-hour sampling period. Samples for stable carbon isotope composition have been taken during these experiments and measured on a mass spectrometer. Compared to the isotopic composition of root water CH_4, canopy CH_4 is depleted in ^{13}C; this indicates that CH_4 moving through the tree is not following a bulk flow pathway (where no depletion would occur), but instead moves either diffusively or through other cell or tissue barriers. Correlations were found to exist between parameters such as temperature, water transport, and leaf area and CH_4 flux. This is vital to upscaling tree-level emissions to the global level since parameters such as leaf area index (LAI) for various regions may be obtained from satellite data products and used to upscale flux.

Brian Larson, Lehman, N., Portland State University
Interpretation by the DSNL-0 Ribozyme and its Implications to Origins of Life

As a requirement of life, a minimal entity must have the ability to interact with the environment and have the potential to manipulate function dependent on the environment. The interplay between entity and environment mandated by the emergence of life is outlined by Robinson and Southgate's (2010) definition of interpretation. To investigate the ability of RNA to be an interpretive entity we have, using a modified version of the DSL ribozyme (2006), selected catalytically favorable variants active in the presence of specific metal ions and simultaneously selected at specific pH. The variants have been sequenced after eight selective generations and specific advantageous mutations have been observed. We are currently characterizing the variants and assaying for inactivation by base hydrolysis dependent on the metal ion and pH used in selection in an effort to investigate the interaction between evolution and the environment in an Origins of life context. To more directly show interpretation is an evolvable trait, a previously described (1993) five error mutant of the self spicing Tetrahymena ribozyme is being challenged to react in varying metal ion mixtures. The assays are designed to allow the molecule make a chemical choice based on the environment and satisfy the criteria of interpretation. These in vitro evolution studies investigate the potential role of interpretation as a selection pressure in early evolutionary steps in the emergence of life and foundation of such properties in an RNA world.

Logan Mitchell, Brook E., Sowers, T., Oregon State University, Penn State University
Multidecadal Variability of Atmospheric Methane and the Inter Polar Methane Gradient in the Late Holocene

Atmospheric methane is a potent greenhouse gas that is responsible for ~20% of the total increase in radiative forcing since the industrial revolution. Despite methane's importance, the spatial and temporal variability of sources and sinks is poorly understood. New measurements of methane from Greenlandic and Antarctic ice cores have decadal scale resolution, analytical precision of <3 ppb, and are highly correlated with the only previous high resolution ice core methane record from Law Dome, Antarctica. These records can be used to reconstruct the methane Inter-Polar Gradient (IPG) which is controlled by the latitudinal distribution of sources and sinks. The IPG provides a constraint on the global methane budget which can be used to constrain past emission scenarios. Preliminary analysis reveals that over the last 2.7 ka, the IPG was ~43 ppb with a standard deviation of 7 ppb and has not changed significantly despite an overall increase of ~80 ppb, half of which occurs over a ~50 year time span at ~1000 B.P. This indicates that the latitudinal distribution of methane sources has also not experienced significant changes on centennial timescales. The EBAMM (Eight Box Atmospheric Methane Model) atmospheric chemical transport model is ideally suited to investigate the long term evolution of the latitudinal distribution of methane sources as well as the isotopologues of methane. We will discuss the preliminary results from EBAM in looking at the IPG over the late Holocene.

Anthony Odenthal, Oregon State University
OSU Pico-Satellite Program and the New Satellite Ground Station

The Pico-Satellite Program has constructed and is operating a satellite ground station on the OSU Campus. The station is able to track and communicate with satellites in Low Earth Orbit, and can operate a wide variety of modes, and modulations. Future plans are to expand from the current 2m & 70cm to include 1.2GHz and 2.GHz, and to handle all digital radio via Software Defined Radio. The balloon program is building a payload platform which includes power, communications, position tracking, and basic sensors along with an integrated cut-down device to increase the reliability and reduce the complexity for balloon launches. This platform is currently undergoing thermal/shake testing.

Damani Proctor, Portland Community College
NASA Goddard Space Flight Center
A Discussion of NASA Summer Programs

This presentation gives a 10 minute discussion on my participation in NASA's summer programs. This covers summers 2009 - 2011 and includes work, trips and projects, what it was like to work at NASA, and what these projects entailed.

Daniel Sidlauskas Miller, Oregon State University
OSU Robotics Club Autonomous Aerial Vehicle Project

The Oregon State Robotics Club Autonomous Aerial Vehicle Team is a primarily undergraduate team committed to developing a flight platform which can autonomously navigate indoors. This year the team is intending to compete in a number of autonomous aerial robotics competitions including the Sparkfun Autonomous Vehicle Competition and the International Aerial Robotics Competition. The latter is the primary competition which consists of finding a one meter square window on a building, entering and navigating the building to find a flash drive, picking up the flash drive and exiting the building. Currently, a prototype dual rotor flight platform is in testing and there are plans to purchase a quad rotor kit in order to ensure the team can have a stable flight platform early on. The team is also experimenting with rotating distance sensors to recognize features such as tables, windows, doors, and corners. There are also several team members looking into using the OpenCV libraries to implement computer vision in order to recognize the flash drive as well as other signs included in competitions. Sponsors currently include Oregon Space Grant, Rellim, and the Oregon State University College of Engineering.

Daniela Sifuentes Makowski, George Fox University
Edge of Space Balloon Launch

The purpose of this project was to establish a Balloon Launch program at George Fox University that will be used to inspire k-12 kids to pursue a career in STEM (Science, technology, engineering, and mathematics). This project took off as part of the Servant Engineering curriculum and it was fully funded by NASA's Oregon Space Grant Consortium. The first successful launch was on October 22, 2011. Based on research of previous successful balloon/payload infrastructure designs, we decided to incorporate in our design a GPS tracking system that used ham radio, thermocouples to gauge internal and external temperatures, a camera for visual feedback, and heating elements to ensure battery life. A twin J-pole antenna was used to send the GPS packets back to the station. The goal of the first benchmarking launch was to ensure that the electronic components chosen worked at the extremely low temperatures and high altitude. The launch was successful; the weather balloon burst at an altitude over 110,000 ft; the lowest temperature was -70F, and the maximum latitudinal velocity was 122mph. We hope to implement a microncontroller board that controls a variety of sensors (altimeter, temperature, pressure, accelerometer, humidity). The next launch will include high-altitude experiments that k-12 kids will be able to design with the help of GFU engineering students.

Brandon Snook, Taylor, S., Western Oregon University
Comparative Hydrogeomorphic Analysis of Western Oregon Watersheds Using Airborne Laser Swath Altimetry (LiDAR)

Mountainous watersheds are fundamental landscape elements that form an important setting for local ecological interactions, human occupation, and water resource development. The western Oregon landscape is associated with active mountain building and extreme precipitation patterns that result in a dynamic geomorphic system characterized by seasonal flooding, slope failure, and debris flow activity (Benda, 1990). Taylor (2002) conducted GIS-based analyses of Coast Range watersheds to elucidate associations between bedrock composition and slope gradients. The study revealed that certain bedrock types are associated with significantly steeper slopes, wider valley bottoms, and higher occurrence of slope failure compared to others. This project involved a comparative analysis of three watersheds in western Oregon: (1) the Upper Nehalem (Coast Range); (2) the Lower Luckiamute (mid-Willamette Valley); and (3) Lookout Creek, Blue River Basin (Western Cascades) using high-resolution terrain modeling techniques afforded by emerging Light Detection and Ranging (LiDAR) technologies. The working hypothesis for this study was that stream gradients, channel network and valley morphologies would statistically vary as a function of bedrock composition and climatically driven erosion patterns. Using the spatial analyst tool set in ArcGIS, the LiDAR data was used to create terrain models that aided in confirming the hypothesis that hydrogeomorphic factors, such as hill slope failure and valley morphology, are seen in similar bedrock compositions over the three locations. The models and data showed that sedimentary bedrock has a higher rate of hill slope failure than volcanically originated bedrock in the three western Oregon watersheds.

Courtney Solem, Oregon State University
NASA Ames Research Center
Using Fly-By-Wire Technology in Future Models of the UH-60 and other Rotary Wing Aircraft

Several fixed-winged airplanes have successfully used fly-by-wire (FBW) technology for the last 40 years. This technology is now beginning to be incorporated into rotary wing aircraft. By using FBW technology, manufacturers are expecting to improve upon the weight, maintenance time and costs, handling and reliability of the aircraft. Before mass production of this new system begins in new models such as the UH-60MU, testing must be conducted to insure the safety of this technology as well as to reassure others it will be worth the time and money to make such a dramatic change to a perfectly functional machine. The RASCAL JUH-60A has been modified for these purposes. This Black Hawk helicopter has already been equipped with the FBW technology and can be configured as a near perfect representation of the UH-60MU. Because both machines have very similar qualities, the data collected from the RASCAL can be used to make future decisions about the UH-60MU. The U.S. Army AFDD Flight Project Office oversees all the design modifications for every hardware system used in the RASCAL aircraft. This project deals with specific designs and analyses of unique RASCAL aircraft subsystems and their modifications to conduct flight mechanics research.

Eric Walters, Pete, A., Oregon State University, Ames Research Center
NASA Ames Research Center
Aerodynamic and Flight Handling Characteristics of the Rotormast V-22 Osprey

Tiltrotor airplanes offer an unprecedented level of versatility: they take off vertically like a helicopter, fly like an airplane, and land vertically like a helicopter again. As demand for tiltrotor aircraft increases, so too will the demand for new efficient and practical tiltrotor designs. If we can closely simulate the aerodynamic and handling characteristics of the V-22 using a much smaller, less expensive model, we can adapt the model to test new designs for a fraction of the cost of full-scale prototyping and wind tunnel testing. My project was designed to evaluate the Rotormast V-22 Osprey to determine whether or not it represented a suitable platform for further tiltrotor design testing. My work consisted of building the Rotormast model and preparing it for scale flight and eventual wind tunnel testing. I finished constructing the model, but unfortunately my internship ended before I could conduct any flight tests. The off-the-shelf model will provide some interesting data when it finally flies. Another project I was involved in was a control stiffness test of the NASA Large Rotor Test Apparatus. The objective of this test was to numerically determine the stiffness of the LRTA control servos at different azimuth locations. The data was used to correct the extensive measurements collected from the UH-60 Blackhawk Airloads Program.