OREGON NASA
Space Grant Consortium

2012/13 Student Symposium Proceedings
February 8, 2013
8:00 am - 8:00 pm

Memorial Union
Powell Learning Center Journey Room
Oregon State University

featuring presentations from
NASA student interns and researchers

2012/13 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
February 8, 2013

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

Phone: 541-737-2414
Fax: 541-737-9946
spacegrant@oregonstate.edu

Agenda / Presentation Schedule

TIME	STUDENT NAME	SCHOOL	PROGRAM	NASA CENTER
8:00-9:00	Poster Session Set-up - Breakfast snacks and refreshments provided			
9:00-11:00	Open Poster Session - Snacks and refreshments provided			
11:00-12:30	LUNCH/NETWORKING - Food and refreshments provided			
12:30	Nicole Paterson	Portland State University	Undergraduate Research Scholarship	n/a
12:45	Juliana Flores	University of Portland	NASA Internship	Ames Research Center
1:00	Mason Keck	Oregon State University	NASA Internship	Jet Propulsion Laboratory
1:15	Anndee Huff	Portland State University	Undergraduate Research Scholarship	n/a
1:30	David Meehan	Oregon State University	NASA Internship	Goddard Research Center
1:45-2:00	BREAK			
2:00	Briand Oaks	Portland State University	Undergraduate Research Scholarship	n/a
2:15	Steven Carter	University of Portland	NASA Internship	NASA Glenn Academy
2:30	Matthew Skach	Oregon State University	NASA Internship	Johns Hopkins Applied Physics Laboratory
2:45	Raven Dorr	Oregon State University	OSU Underwater ROV Team	n/a
3:00-3:30	BREAK/NETWORKING			
3:30	Trevor Waddell	Oregon State University	OSU Rocketry Team	n/a
3:45	Allen McLeod	George Fox University	NASA Internship	Johnson Space Center
4:00	Daniel Miller / Soo Hyun Yoo	Oregon State University	OSU Aerial Robotics Team	n/a
4:15	Jordan Heintz	University of Portland	NASA Internship	Marshall Flight Center
4:30	AJ Teav	Oregon State University	NASA Internship	Johnson Space Center
4:45	John Zeller	Oregon State University	OSU Mars Rover Team	n/a
5:00-6:00	RECEPTION - Food and refreshments provided			
6:00	Samuel Evers	Oregon State University	NASA Internship	Ames Research Center
6:15	Anthony Odenthal	Oregon State University	OSU Pico-Satellite Team	n/a
6:30	Kristian Liwanag	University of Portland	NASA Internship	Langley Aerospace Research Student Scholars Program
6:45	Teal Pershing	Oregon State University	Undergraduate Research Scholarship	n/a
7:00-7:15	BREAK			
7:15	Victor Dang	Oregon State University	NASA Internship	Johnson Space Center
7:30	Robert Casteel	University of Oregon	NASA Internship	Goddard Research Center
7:45	Danika Kusuma	Oregon State University	NASA Internship	Ames Research Center
8:00	SYMPOSIUM WRAP UP			

Abstracts

Steven Carter, University of Portland
NASA Glenn Academy 2012

Technology to support design for the next generation of aircraft fuel injectors is being developed by NASA's Fundamental Aeronautics Program to reduce emissions, increase efficiency, and enable fuel flexible aircraft. The design of these fuel injectors can be aided by measuring the vaporization rates of jet fuel droplets in realistic, burning sprays. Currently, in this environment, no instantaneous vaporization rate measurement techniques have been applied. After surveying techniques for potential development for this application, two techniques were identified: stimulated Raman scattering (SRS) and droplet lasing spectroscopy (DLS). Plans were developed for the modification of these techniques for this specific application. Developments of the SRS technique were tested including measurement of a water droplet diameter change rate. SRS spectra were also collected from jet fuel droplets.

Robert Casteel, University of Oregon
NASA Goddard Space Flight Center
Upgrading SpaceWire Testing Software

SpaceWire is a communication network optimized for space application that is being used in several NASA projects at the Goddard Space Flight Center. This includes the James Webb Space Telescope, the Lunar Reconnaissance Orbiter and the Global Precipitation Measurement mission, among others. Satellite subsystems use the SpaceWire testing software SWTS to test instrument communication with SpaceWire. However, as technology progresses, SWTS is facing more and more limitations. SWTS was originally modeled after a vendor's pci-driver program for Windows XP and is not compatible with today's multiprocessors or 64-bit machines. Hence, SWTS needed to be upgraded. It was quickly determined by my mentor, Tom Johnson, that SWTS should be ported over from Windows to Linux. This would allow for complete control over SWTS in an open source environment. In June 2012, I began this process of porting by simply loading the SWTS source files onto Ubuntu and letting the GNU Compiler Collection point out an extensive list of compiling and linking errors. Along with sorting through these errors, I spent time reading about Linux, writing Python scripts and doing anything that would help smooth this transition from Windows to Linux. I also developed a SQLite embedded database connected to a Python GUI that is ready to be added on to the program. This will help make SWTS more user-friendly. SWTS is still in the process of being ported and upgraded.

Victor Dang, Oregon State University
NASA Johnson Space Center
Mars Ascent Vehicle (MAV) Layout and Configuration

With NASA's recent development of the Space Launch System and the Orion Multi-Purpose Crew Vehicle, the United States will soon have the capability to explore as far beyond Low Earth Orbit as it wishes. The ultimate goal is of course human exploration of Mars, a challenging and technology-rich endeavor that will require extensive planning and development. Among the many difficult aspects of a trip to Mars is the return mission that would transport the astronauts from the Martian surface back into Marts orbit and towards Earth. One possible conceptual design to accomplish this task is a two-stage Mars Ascent Vehicle (MAV). In order to assess this design, a general layout and configuration for the spacecraft must be developed to determine the necessary amount of propulsion needed to escape Mars' atmosphere and a variety of other details. Therefore, the objective of my internship was to model in CREO Elements/Pro different versions of this conceptual MAV design to support NASA's latest human Mars mission architecture trade studies, technology prioritization decisions, and mass/cost/schedule estimates. Component part models developed for a previous conceptual design of a lunar lander called the Altair from NASA's Project Constellation facilitated the design of the MAV. In comparison, the MAV is much larger than the 4-crew Altair, and must be capable of a much longer mission life.

Raven Dorr, Oregon State University
Oregon State University Robotics Club Remotely Operated Underwater Vehicle Team

The OSU ROV Trogontherius, named after the giant prehistoric beaver, is a research class remotely operated underwater vehicle (ROV). The vehicle will be made available to the public research community at little to no cost in an effort to boost marine research in the region. ROV Trogontherius is designed, built, and maintained by the OSU ROV Team. Underwater robotics is a way to get students excited about science, technology, engineering, and math, and helps them see the practical applications of these subjects. The vehicle is currently designed to explore at 375 ft, and is equipped with a rolling launcher, thrusters, variable buoyancy, manipulator, cameras, and can accommodate subsystems upon request. In June of 2013, the OSU ROV Team will compete in the international Marine Advanced Technology Education ROV competition, requiring a technical report, poster, presentation, and timed underwater tasks. The vehicle's long-term effectiveness rests on the team finding researchers to utilize the vehicle.

Samuel Evers, Oregon State University
NASA Ames Research Center
Health Management of Li-ion Batteries

Lithium Ion batteries offer unique advantages that push the frontiers of energy storage. Health management algorithms will be developed and demonstrated to ensure safe use of a potentially dangerous technology. Thorough research is critical as high capacity battery packs operating under high loads are being implemented into the transportation infrastructure. Lithium-ion batteries can be dangerous due to various failure modes they often experience, some of which can result in an explosion or fire. The objective is to develop methods to understand battery failures and predict the remaining useful life of both healthy and failing batteries. These batteries fail due to aging or accidental damages after which it becomes critical to determine how long they can operate before they absolutely need replacement or lead to catastrophic failures. Experiments are being conducted to stress these batteries and collect failure data. Specific tasks in this project include running different types of experiments with Li-ion cells, analyzing data to characterize the effects of failure that will be useful in developing algorithms to detect failures, and predict useful remaining battery life. As data collection continues, further tests to analyze the affect of single cell faults within a battery pack will be examined. To do so, a re-configurable battery pack with 12 cells was designed, parts were cataloged, ordered, and the pack was constructed to facilitate those needs. As battery tests progress toward larger more powerful packs, safety precautions must be considered. An automatic non-computerized standalone fire suppression system was proposed and cataloged to plan ahead for tests that may require heightened safety monitoring.

Juliana Flores, University of Portland
NASA Ames Research Center
Engineering Support of Hub-Mounted Video Camera and Tiltrotor Test Rig

Single camera photogrammetry is the extremely accurate process of measuring the relative position of an object using high-speed cameras. The accuracy and speed of this technology makes it ideal for measuring the positions of helicopter rotors at high velocities. Using this measurement technique, a high-speed camera will be installed on the UH-60 RASCAL hub looking down at a single rotor blade. White elliptical targets will be placed along the upper surface of the rotor blade from root to tip. The camera will record the position of white elliptical targets to measure the lead-lag, pitch, flap and length of the blade during flight testing. Measured data will be compared to predicted data (CFD) in order to improve analytical prediction codes. The current assignment is to study the camera design, understand the flight requirements and capabilities of the HMVC and provide technical drawings to the machine shop to manufacture this flight-approved hardware. The Tiltrotor Test Rig (TTR) will provide the DoD and NASA with large-scale proprotor testing capabilities. Bell Helicopters and Triumph Aerospace have submitted a design for review by the NASA TTR team. The design review includes approving of the changes made to the forward frame of the TTR due to incorrect analysis and review of the results of the new analysis. The task assigned was to review and edit several TTR drawings and attend the design decision review sessions of the TTR team.

Jordan Heintz, University of Portland
NASA Marshall Flight Center
Heat Absorption Rating Device of Friction Stir Welding Fixtures

Friction Stir Welding utilizes a rotating pin tool in order to mechanically stir material together in a solid state metal joining process by means of plastic deformation of the material. The heat generated through the plastic flow of the metal as well as by means of friction greatly reduces the flow stress such that the material may more easily be plastically deformed and successfully welded. Three parameters greatly affect the success of a weld: rotational speed, travel speed, and plunge or pinch force. These parameters are developed for each welding process on the process developing system. Once parameters yielding a successful weld have been developed, they must be adjusted to yield successful welds on a different production fixture, such as the vertical weld tool in building 4755. This adjustment of the parameters is necessary because each fixture dissipates the heat mechanically generated by the tool differently and the mechanical input must be adjusted in order to account for the heat loss to each fixture. By measuring the variations in heat loss to each fixture and modeling the mechanical input of the pin-tool, estimates can be made of the necessary adjustments of the parameters in order to maintain a successful weld.

Anndee Huff, Portland State University
Impact of Climate on International Development Programs

Nearly a billion people in the world lack access to safe drinking water and two billion have inadequate sanitation facilities. Amplifying these problems are the international effects of climate change, expected to significantly impact developing countries. While efforts exist to improve these situations, many international development programs struggle to accurately and reliably impact communities in need. Continuous, remote monitoring with in-situ sensors can address this issue by better informing development programs of their impacts and thereby improve the application of international development aid. Sensors that can inexpensively report near real-time data can be used to analyze performance, which can lead to a better understanding of programmatic, social, economic and seasonal changes that may influence quality.

An adaptable monitoring technology has been developed at Portland State University's Sustainable Water, Energy and Environmental Technologies Laboratory (SWEETLab™). The SWEETSense™ is a low-power, low-profile, remotely accessible instrumented monitor designed for remote communities around the world. The device has a comparator circuit board that samples commercially available front-end sensors at a reasonably high rate. The sensors are selected for specific applications including water treatment, cookstove, sanitation, infrastructure or other applications.

Specifically, SWEETSense™ Fire measures usage and emissions of high efficiency cookstoves that have been installed in Rwandan households. The sanitation monitor, SWEETSense™ Passive Latrine Use Monitor (PLUM), measures latrine usage in communities of Orissa, India and Jakarta, Indonesia. The usage data from these development programs have been correlated to seasonal precipitation and temperature data to determine that weather patterns have an impact on utilization.

Mason Keck, Oregon State University
NASA Jet Propulsion Laboratory
Improved Maneuver Reconstructions for the GRAIL Orbiters

Maneuver reconstructions for the Gravity Recovery and Interior Laboratory (GRAIL) A and B lunar orbiters were improved through updates to the orbit determination filter and dynamic models. Consistent reconstructions of the 27 GRAIL A and B maneuvers from the Trans-Lunar Cruise phase in fall 2011 through the Transition to Science Formation phase in February 2012 were performed. Standard methods of orbit determination were applied incorporating the latest dynamic models and filter strategies developed by the GRAIL Navigation and Science Teams, including a high resolution lunar gravity field model. For Trans-Lunar Cruise for GRAIL-A (TLC-A), maneuvers executed with maximum ΔV error of 5.32 ± 0.37 mm/s, spacecraft Y angle error (Y error) of 0.2472 ± 0.0011 degrees, and s/c Z angle error (Z error) of 0.0963 ± 0.0974 degrees. Each GRAIL-A lunar orbit maneuver had ΔV error below 29.18 ± 0.70 mm/s, Y error below 0.3274 ± 0.0006 degrees, and Z errors below 0.4911 ± 0.0241 degrees. For TLC-B, each maneuver executed with ΔV error below 8.60 ± 1.41 mm/s, Y error below 0.2181 ± 0.0014 degrees, and Z error below 0.3002 ± 0.0011 degrees. GRAIL-B maneuvers in lunar orbit executed with maximum ΔV error of 24.43 ± 0.74 mm/s, Y error of 0.2199 ± 0.0064 degrees, and Z error of 0.4212 ± 0.0026 degrees. These maneuver reconstructions helped the GRAIL Navigation Team characterize the main engine performance of each spacecraft, which helped the Navigation Team navigate low (≥ 4 km) altitude orbits during the extended-mission phase in fall 2012.

Danika Kusuma, Oregon State University
NASA Ames Research Center
The Effects of Hypergravity on Oxidative Stress Responses in Drosophila melanogaster

Biological organisms are subjected to relatively brief instances of hypergravity during space flight particularly during takeoff and landing. The hypergravity experienced during this time may be associated with increased levels of oxidative stress in organisms. When oxidative stress occurs, the biological body produces reactive oxygen species (ROS) that may cause macromolecular damage within an organism if not balanced by the organism’s natural antioxidant defenses. Genes implicated in the oxidative stress pathway were chosen based on preliminary behavioral assays of Drosophila melanogaster. RNAi gene knockout mutations for these genes, that were specific to the brain, were tested for altered behavior, ROS levels, and gene expression by qRTPCR after being subjected to hypergravity (approximately 3g) in a centrifuge. The experimental group was compared to a control group kept at 1g. The thioredoxin system plays a large role in cell defense to ROS damage by producing antioxidants. The genes participating in the thioredoxin system include TrxR1, TrxR2, Trx1, and TrxT. D. melanogaster mutants for these genes will be tested for altered behavior, ROS levels, and gene expression specifically in the mushroom body of the brain which regulates fly behavior between activity and rest. While this particular study is still in progress, the results from the assay will be included in a larger collection of gene data that will ultimately map the complete oxidative stress pathway.

Kristian Liwanag, University of Portland
NASA Langley Research Center

The purpose of the project was to resolve a compatibility issue between the main control system provided by Sciaky Inc. and the Indradrive servo drive controllers provided by Rexroth Corp on the 2nd generation portable EBF3 system. The issue resulted from limited communication between the two vendors in which the main control system was configured to work with a previous model of the Indradrives but a new model was provided instead. Successful resolution of the issue would help to progress the development of the Electron Beam Free-Form Fabrication (EBF3) process at the NASA Langley Research Center.

The strategy utilized to resolve the issue was to understand the functionality of each unit, both individually and cooperatively in the overall system, through review of documentation for each unit provided by the vendor and previous interns. It was possible to integrate the two units by determining the appropriate connections between them such that the necessary signals were communicated. The documentations had different nomenclatures for each signal and it was necessary to determine how the nomenclatures were associated to the appropriate inputs and their purpose.

The overall system could be divided into three components: the vacuum chamber containing the servos and electron beam, the EBF3 welder containing the Indradrives and the main control unit. To confirm that the signals were correctly associated to its appropriate input, the entire system needed to be wired and checked for functionality through performance and continuity tests. A junction box was required containing the appropriate connections between the servos in the vacuum chamber and the EBF3 welder.

The junction box was constructed and connected to the overall system. Connections were verified between the servos and Indradrives by continuity tests. Connections between the Indradrives and the main control unit remain to be connected. A spreadsheet was created to document the connections for the overall 2nd portable EBF3 system to assist in continuing the systems integration.

Allen McLeod, George Fox University
NASA Johnson Space Center

Orbital Debris Gap Filler Balloon Satellite

Orbital debris are all man-made objects in orbit about the Earth which no longer serve a useful purpose. Debris can travel at relative speeds up to 15 km/s and can cause significant damage upon impact. In order to design and prepare for such impacts the use of research, modeling, and experimentation is paramount. A great amount of work has been done to predict and analyze the behavior of orbital debris; however the models are constantly evolving and there are gaps in available data. In an effort to gather more information on debris 1mm – 3mm in diameter I lead experimental testing and analysis for the Orbital Debris Gap Filler Balloon Satellite project. Experiments were conducted in order to investigate the suitability of various mylar and Kapton sheets as large-area sensors. The use of existing Habitat Particle Impact Monitoring System (HIMS) sensors allowed the impacts to be categorized based on impact location and would allow for quantities such as velocity, size, and trajectory to be derived. Through various small scale testing the system provided positive results detecting and locating impacts. However, upon hypervelocity testing the results became inconclusive and the system failed to register impact information. It was found that at hypervelocity the projectiles would melt through the material and the piezoelectric transducers could no longer detect the impacts. Based on this finding the system was proved unsuitable for collecting orbital debris data. Other techniques must be investigated to accomplish the desired goal.

David Meehan, Oregon State University
NASA Goddard Space Flight Center
Developing Applications to Simplify FPGA Design Flow

From June to August, 2012, I interned at NASA's Goddard Spaceflight Center. Working under Omar Haddad, I was able to complete my initial project and a secondary project. The first project involved writing a Perl script, which automatically created a working Makefile when supplied with a directory of VHSIC hardware description language (VHDL) files. The ultimate goal for the project was to save engineering time on FPGA development for satellites by automating a generally manual and time-consuming process. Perl and VHDL were both completely new to me, so I researched each to get sufficient background knowledge. As I researched I began to plan the underlying structure of the script. Perl would search the VHDL files for keywords, which gave information about the hierarchy of the VHDL project, which would be used to create a working Makefile. I started by writing some 'proof-of-concept' scripts to show that my planned solution was realistic. As I worked on the project I gained not only proficiency in new programming languages, but I was also able to put into practice and solidify the project planning, testing and collaboration skills I have been taught at Oregon State. The second project involved writing a C++ program, which interacted with an existing error report. The program wrote HTML to make the error report more human readable, adding color for errors, font changes for different kinds of errors and an interactive hierarchical list. I was able to build upon my customer collaboration and technical skills.

Briand Oaks, Portland State University
Passive Two-Phase Separation in Microgravity Conditions

In the absence of gravity, capillary forces can dominate fluid interfacial behavior. Capillary action has the potential to be exploited for the control of fluid systems operating aboard spacecraft as well as in micro-scale systems on earth. Currently, mechanically-driven fluid systems employed in space utilize resources that could be conserved by more natural means that exploit unique container geometries that induce phase separation passively with no moving parts (Weislogel et al. 2011). In this research, by exploiting channel geometry and wetting characteristics, the migration of gas bubbles driven by interfacial forces is observed and analyzed. Channel geometry and fluid properties are identified to quantify capillarity-driven phase separation in a wedge-shaped conduit. Experiments are conducted using Portland State University's Dryden Drop Tower, where a 2.14 second free-fall time provides a brief but repeatable, high quality microgravity environment. The capillarity-driven separations of gas bubbles from predominately liquid flows along a wedge-shaped conduit in a microgravity environment are recorded, reviewed, and analyzed. By purely empirical methods the location of an open section along the conduit provides a free surface through which the gas bubbles may exit the flow. The analysis of interactions between interfacial capillary forces and gas bubbles in a wedge-shaped conduit provide new knowledge of passive phase separation in microgravity and new capability to separate such flows with similar expectations on earth, where the force of surface tension and wetting replace those of gravity.

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

The satellite ground station at Oregon State University is being augmented with additional equipment to provide extended functionality. This includes the lightning protection, signal processing equipment and an amplifier. These additions are supporting not only greater communication capacities but also the development of software and procedures to allow the station to be used to preform radio astronomy tasks. With these modifications the station can serve as a framework to build other similar stations across the state and to develop the necessary software to build out these stations to function as a network providing greatly expanded coverage. Current plans are to develop and install a similar station at the Evergreen Aviation and Space Museum for use by the Engineering and Aerospace Sciences Academy.

Nicole Paterson, Portland State University
Protein Expression of Novel Extremophilic Enzyme

Studies of extremophilic biomes investigate the limits of biological life, in terms of the upper and lower limits of heat tolerance, pH tolerance, and carbon availability. This kind of study is often involved in the "bottom up" approach to studies of the origin and evolution of life wherein austerity of components is imperative. Such studies, often involving attempts to recreate essential enzymes, amino/nucleic acids, proteins etc. can give scientists and scholars insight into potential extraterrestrial life as well as answering existential inquiry as to the nature of life itself. This work expressed a putative DNA polymerase sequence (an enzyme that is responsible for copying DNA during replication, a process necessary to replicating organisms and essential to life) using genetic recombinant techniques to yield a novel protein from a sequence never before described in the literature. This sequence was acquired from a high throughput analysis of viral genomic elements from Boiling Springs Lake within Mt. Lassen State Park, California. This is a highly acidic "hyperthermophilic" environment inhabited mainly by archaea, bacteria and viruses with special adaptations to the harsh environment (pH 2, 80C). The DNA polymerase expressed is from a climate and acidity that may give it desirable features in research and bio-industrial applications. While the results obtained from DNA cloning with this enzyme were inconclusive, these endeavors do explore the role that enzymes play in the evolution of genomes throughout history/present day and can tell us much regarding the general structure of life as a concept.

Teal Pershing, Oregon State University
Fourier Optics Using a DMD with Applications to Solar Granulation Analysis

We detail a method to investigate physical correlations between granules, mesogranules, and supergranules produced by convection cells in the sun's photosphere using optical Fourier analysis. An experimental approach to Fourier analysis using a Digital Micromirror Device (DMD) as a spatial filter is developed through the analysis of a Ronchi ruling optical pattern. Maximum intensities measured in the Fourier transform plane with a CCD camera are compared to the theoretical intensities predicted by Fourier optics theory.

Computational Fourier analysis of a Ronchi ruling is also performed using the Meade LX200 reflector telescope, a CCD camera, and Python's "fft" library. Resolution of mesogranulation and supergranulation object distance to object wavelength ratios is recognized and a maximum object distance to object wavelength ratio of 72,172 is resolved.

Additional optical applications for the DMD are also considered. The DMD is used as a flexible mask in a telescope's focal plane with applications in weaker binary star and circumstellar disk viewing. Successful viewing of a simulated weaker star companion 5,000 times less intense than its brighter companion with an angular resolution of 3.4 arcsec is achieved. A Fourier optics lab was also created for the Oregon State University undergraduate optics course.

Matthew Skach, Oregon State University
John Hopkins University Applied Physics Lab
Morehead Ground Station Upgrade and Experimental Ground Station Design

The Morehead Ground Station in Morehead, Kentucky is home to a twenty-one meter radio telescope operated by Morehead State University. First operational in 2006, the Morehead Ground Station was tasked along with the Johns Hopkins University Applied Physics Lab (JHUAPL) ground station and the Arecibo Radio Telescope to work with the Mini-RF radar instrument onboard the Lunar Reconnaissance Orbiter (LRO). When the Mini-RF transmitter failed shortly after arriving in lunar orbit, funding was reallocated to upgrade the Morehead Ground Station's ground-side equipment to an experimental ground station that provides the flexibility needed to support future near-earth and lunar missions. Towards this goal, new front end equipment to record and process S-band analog and digital signals was installed at the Morehead Ground Station and mission-independent software applications were developed to configure, test and use the new hardware.

AJ Teav, Oregon State University
NASA Johnson Space Center
Streamlining Process to Visualize COMPASS Simulation Data

The remaining trajectory software that supported STS before its official retirement will be updated to meet operation requirements for future space programs. One of two simulation programs currently being developed to meet this is called COMPASS, which is an n-DOF trajectory simulator that analyzes the translational and rotational dynamics of spacecraft trajectory. The software uses a computerized mathematical technique to generate quantitative results for various space mission scenarios.
The primary use of COMPASS is to simulate a wide variety of space missions and scenarios and provide the user numerical results. Two prime examples of creating and assessing scenarios in COMPASS are a rendezvous between the ISS and the Orion capsule and the launching stages of the SLS and Ares I-X launch vehicles. For each scenario simulated by COMPASS, the program overwrites and updates the corresponding data file for that scenario, which contains hundreds of thousands of data values for each aspect of the scenario. After the data file has been produced, it is then injected into a graphics program to visually prove and validate the simulation results. To make this process more efficient for COMPASS users, the scenarios, which are represented by python scripts, were recoded to adjust the output configuration rules for the data file to meet the input requirements for the graphics program.
Reducing the post-process user changes on the data file validates and displays the potential of COMPASS and its supporting role in future MOD strategy plans.

Trevor Waddell, Oregon State University
OSU Oregon State Space Society Rocket-Boosted Unmanned Aerial Vehicle Project

The Oregon State Space Society is in the preliminary stages of designing a rocket-boosted unmanned aerial vehicle (UAV) equipped with an environmental radiation-sensing payload to be entered into the NASA University Student Launch Initiative and the SEDS-USA Rocketry Challenge. The project consists of a 25-foot single stage, dual-deploy reusable rocket system, which will boost and eject a rotating-wing UAV located in the aft section of the booster. Upon reaching a specified altitude the solid rocket motor will burn out and the booster will separate into three sections. The UAV will then be ejected and will commence semi-autonomous flight with guidance from a ground control station. The UAV radiation-sensing payload will be equipped with a compact CsI photodiode detector that will collect data on ground-based radiation emitters. The data collected from this project will test the real-world viability of rocket-deployed UAV's in tactical contexts such as disaster mitigation and nuclear non-proliferation. The preliminary design review of the project has concluded and prototyping has begun on the UAV and rocket booster. Several teams are managing electronics, flight controls, airframe construction, UAV development and ground support equipment. Systems integration and ground testing are projected for May 2013, with a final launch test scheduled in June 2013.

Soo-Hyun Yoo, Oregon State University
Oregon State University Autonomous Aerial Robotics Team

The OSU Autonomous Aerial Robotics Team builds aerial robots capable of autonomous indoor navigation and flash drive pickup towards competing in the International Aerial Robotics Competition. The competition unites mechanical and electrical engineers and computer scientists to build an autonomous aerial robot from scratch. The complexity of the competition pushes the team to learn technical skills applicable in fields beyond aerial robotics and to stretch the boundaries of what is possible in autonomous systems. This year the focus will be to optimize the robot chassis and power system to the bare minimum necessary for a "clean" completion of the competition in under seven minutes and to maximize the robot's sensory functions. By June 2013, we expect to have built two quadrotors equipped with stereoscopic vision that are capable of 3D simultaneous localization and mapping.

John Zeller, Oregon State University
Oregon State University Mars Rover Team

The 2013 OSU Mars Rover Team is an external student organized project within the Oregon State University Robotics Club, which designs, builds, and tests a remotely operated terrestrial rover. This rover competes in the University Rover Challenge (URC), hosted by the Mars Society, which is an international competition to design a mobile robotic platform that can specifically perform 4 tasks presented in the competition. The competition fosters the next generation of scientists and engineers who may go on to design rovers that will one-day work alongside humans in the field on Mars. The 2013 Rover is a continuation of the previous years project, which saw many successes but ultimately was left with more work to be done. Mechanically, the rover is nearly complete and this proposal outlines the plans to improve upon some of the design decisions made in the 2012 model. The 2012 model includes: a 6-wheel drive system with individual steering control for each wheel; an Analog video transmission/receiving system capable of 4-channel transmission/receiving, delivering feeds from several cameras placed across the rover; and a Robotic arm with 3-degrees of freedom giving us the ability to service equipment, clear solar panels, and check voltage, all remotely. Improvements for the 2013 Rover include redesigns of the wheel arches, tripod system, and several attachments on the robotic arm all to reduce weight and increase functionality. Previous team members have pointed to the OSU Mars Rover Team as the key experience that defined their undergraduate work and gave them an edge when applying for jobs and graduate school admission.