OREGON NASA
Space Grant Consortium

2008 Student Symposium Proceedings
November 14, 2008
9:00 am—6:00 pm

Memorial Union
Powell Learning Center Journey Room
Oregon State University

featuring presentations from
NASA student researchers

Agenda / Presentation Schedule

TIME	STUDENT NAME	SCHOOL	PROGRAM	NASA CENTER
9:00-11:00	Open Poster Session — Snacks and Refreshments Provided			
11:00-Noon	BREAK—Meet and Greet			
Noon-1:00	LUNCH - Bag Lunches Provided			
1:00	Howard Hui	Oregon State University	SIP Internship	Goddard Space Flight Center
1:20	James Sample	Oregon Institute of Technology	Oregon Space Grant Fellow	N/A
1:40	Holly Grimes	Portland State University	JPL Internship	Jet Propulsion Lab
2:00	Jarrod Jackson	Oregon State University	LARSS ESMD Internship	Langley Research Center
2:20	Joseph Gross	Oregon State University	JPL Internship	Jet Propulsion Lab
2:40	Ethan Rhodes	George Fox University	Marshall Internship	Marshall Space Flight Center
3:00	Matthew Ferdinand	Oregon Institute of Technology	ESMD Industry Internship	Lockheed Martin
3:20- 4:00	BREAK – Refreshments and Snacks Provided			
4:00	Andrew Elliott	Oregon State University	JPL Internship	Jet Propulsion Lab
4:20	Avery Cotton	Western Oregon University	Oregon Space Grant Fellow	N/A
4:40	Alex Mieloszyk	Oregon State University	Ames Internship	Ames Research Center
5:00	David Logan	Oregon Institute of Technology	JPL ESMD Internship	Jet Propulsion Lab
5:20	Christopher Stull	Oregon State University	ESMD Industry Internship	Lockheed Martin
5:40	OSU Robotics Team	Oregon State University	University Rover Challenge	N/A

Abstracts

Howard Hui, Oregon State University
Title: Instrument Development for the POINCARE and the CMBPol Projects

NASA Goddard Space Flight Center is developing a new instrument to measure the polarization of the Cosmic Microwave Background (CMB) for the POINCARE and the CMBPol projects, intending to investigate the physic in the earliest epoch of the universe. This new instrument includes two major parts: the Variable-delay Polarization Modulator (VPM) and the detector. VPM is a novel technique in modulating the CMB signal. A prototype of a VPM is currently under construction; one of the components is a 50cm polarized grid made of 64um diameter tungsten wire and 200um pitch with overall flatness better than 30um. Strengths and weaknesses of the grid, and challenges in the process of creating it will be discussed. The new detector is made of many new technologies and components. It is created to be highly sensitive to the polarization signal. The combination of this detector and the HE11 feedhorns will enable multiple goals to be achieved, including lowest side-lodes, crosspolarization, and highly symmetric beams. A basic schematic of the detector including the planar Orthomode Transducer (OMT) and Transition Edge Sensors (TES), as well as some of the cutting edge components of the detector will be shown.

James Sample, Oregon Institute of Technology
Title: Manufacturing Assembly Robots for Applied Undergraduate Research

This presentation will showcase a graduate student thesis project currently in progress at OIT and sponsored through a Graduate Fellowship with the Oregon NASA Space Grant Consortium. This thesis project when completed will provide a tool for the education of undergraduate engineering students on topics of current importance to the aerospace manufacturing industry including Smart Assembly Systems and flexible work cells. The project will be completed using existing SCARA (Selective Compliance Articulated Robot Arm) robots donated to OIT and an existing donated work platform for the assembly cell. This dual robot manufacturing assembly cell will have the capability to simulate assembly processes similar to those used in aerospace manufacturing. In the first year the assembly, design and retrofit of the robots with new electronic controllers has been completed. Work is ongoing in the design and installation of new end effectors and the creation of virtual simulations of the work cell within Microsoft Robotics Studio. March 2009 is the scheduled completion date for this project upon completion of the integration with an external robotic parts and assembly delivery system.

Holly Grimes, Portland State University
Title: The Extension of the Data Reduction Manager (DRM) to Support the Reduction of Planetary Spectra

Dr. Glenn Orton and his colleagues in the Earth and Planetary Atmospheres Group at the Jet Propulsion Laboratory study the structure and composition of the atmospheres of Jupiter, Saturn, Uranus, and Neptune. In the course of this work, they have made mid-infrared observations of Jupiter and Saturn from the COMICS spectrometer on the Subaru Telescope. These data include some of the first ground-based spectra of planets to come from large (8-m class) telescopes with high spatial resolution and will provide information about the abundances of gasses such as methane and ethane in the atmospheres of Jupiter and Saturn. Before these important data can be analyzed, however, the spectra must be reduced. Partial support for the reduction of COMICS spectra has been added to the Data Reduction Manager (DRM), a GUI-based code that Dr. Orton and his team use for the routine reduction of astronomical data. This support includes facilities for preprocessing the data and for preparing the dark and flat images needed for the reduction of spectra. The ultimate purpose of this work is to provide full support for COMICS spectrum reduction for DRM.

Jarrod Jackson, Oregon State University
Title: Microprocessor Control of Adaptive Optical Systems

The Intellistar intelligent optical system is a project being pursued by NASA Langley Research Center. Through a combination of active pixels, tunable optical filters, and composite materials, the Intellistar system autonomously identifies individual stars and objects; enabling functions like autonomous navigation, rendezvous & docking, and collision avoidance. The Intellistar's tunable optical filter is based on liquid crystal technology; the crystals are arranged in a unique configuration that enables them to dynamically filter out specific frequencies of light while providing a wide aperture, maximizing the exposure of the active pixels. The Intellistar's active pixel array translates the filtered light into electrical signals for analysis by the microprocessors. Each active pixel in the matrix needs to be addressed and driven by a carefully tuned clock signal during light exposure. A PIC microcontroller was selected and programmed to allow the user to select a refresh rate between 7 Hz – 3 kHz to drive the active pixel matrix. Using the programmed microcontroller, the photon responsivity of the active pixels is calculated and used to correlate the combination of light frequency and intensity to known objects, such as stars or satellites. This research investigated the dynamic range of the active pixel matrix by exposing the active pixel sensor to varying intensities and frequencies of light. The code generated for this purpose is modular, adpatable, and easily integrable into the final control application. As NASA moves towards its future exploration goals, intelligent optical systems will meet the increasing demand for high-precision sensor technologies.

Joseph Gross, Oregon State University
Title: C++ Implementation of Active Optics Elements Interface

Prior research in the field of free-space Optical Communications shows that use of active optics elements such as deformable mirrors or spatial light modulators for compensation of aberrated optical systems will help test precision re-collimation. Signal distortions on a laser beam traversing the optical system can be captured as an image using a wavefront sensor, which is an input to the program interface. The goal is to correct this signal from the input and encode instructions to the output device in real time. The program should interface the devices, which requires modifying the data format from input to output. A high speed algorithm computes resolution dimensions and specifications for the image. Open Graphics Library loads the image from power of two resolution into the source formatting desired. A 24-bit bitmap is formatted for the spatial light modulator, which reads these as instructions and corrects the laser beam path. After further testing, converting the input format for the program, and setting the format for output will complete the software interface.

Ethan Rhodes, George Fox University
Title: DATA ACQUISITION AND ANALYSIS FOR OBJECT DETECTION AND AVOIDANCE USING THE SWISS RANGER 3000

Object Detection and Avoidance (ODA) is a critical area of development for the current space exploration research initiative and NASA's Constellation Program. Specific attention is given to providing ODA capability for Lunar and Mars rovers and landers. An autonomous ODA system needs to be developed that has the capability of safely directing the descent of a lander or navigating a clear path for a rover. The research described here is completed using the Swiss Ranger 3000, a Time-of-Flight (TOF) range camera. Range data from the camera's field of view is acquired and then manipulated in MATLAB for surface plotting and location analysis. Using the range data from the camera as well as the camera's actual orientation, environment data is referenced to an absolute coordinate system using Euler angles. Object detection and analysis algorithms are then created in MATLAB to detect and track hazardous objects or surfaces using various techniques. Finally, the data output from the SR 3000 will be used in conjunction with data from the SICK LMS 200 laser scanner to provide better range capability and resolution for more accurate hazard detection.

Matthew Ferdinand, Oregon Institute of Technology
Title: Real-World Applications for the NASA Orion Program

The new NASA Orion program is the next manned spaceflight module scheduled to start flights in March 2015. I worked with many different engineers on the new NASA Orion program. I specifically worked for Lockheed Martin in Houston, Texas. I was part of a mechanisms team that was named the docking team. The docking team was in charge of all Lockheed Martin components of the docking mechanisms, these included the Docking Tunnel, the Abort System to Docking System (ASDS), and the Docking Mechanism Jettison System (DMJS). I took a step inside the world of systems engineering for the summer and was made in charge of the ASDS component specification sheet which gave me an opportunity to extensively utilize Microsoft Excel. I was also given a chance to design a latch for the blast shield for a tensile testing machine. I attended many meetings during the summer which gave me a great understanding of the work place in larger prestigious companies like Lockheed Martin. My experience was less of a research project and more of a sneak peek into the real world application of many of the concepts I was taught in the classroom.

Andrew Elliott, Oregon State University
Title: Moulin Explorer

Recent data shows that the Greenland ice sheet has been melting at an accelerating rate over the past decade. This melt water flows from the surface of the glacier to the bedrock below by draining into tubular crevasses known as moulins. Scientists believe these pathways eventually converge to the ocean. The Moulin Explorer Probe has been developed to traverse autonomously through these moulins. It uses in-situ pressure, temperature, and three-axis accelerometer sensors to log data. At the end of its journey, the probe will surface in the ocean and send GPS coordinates using the Iridium satellite network so it may be retrieved via helicopter or boat. The information gathered can be used to map the pathways and water flow rate through the moulins and help quantify the rise in sea levels.

Avery Cotton, Western Oregon University
Title: The Development of Global Climate Change STEM Materials

The first draft of the Oregon Department of Education's update to the Oregon Science Content Standards stipulates that seventh grade students will be able to "Identify and describe factors that affect global climate change." Furthermore, high school students will "Identify and analyze the energy sources and transfer processes, and physical forces that affect essential Earth processes such as … climate change on Earth."

My project's two main points:

- Establish lessons and activities for the K-5 classroom that develop skills necessary for understanding Global Climate Change (GCC) while minimizing misconceptions.
- Review and critique currently available age-appropriate literature on GCC.

Two workshops were hosted over the summer where K-5 teachers received training, information, materials, and activity ideas for classroom use. Pre/post test analysis revealed that although some GCC concepts were well-understood, misconceptions certainly existed. The workshops treated these misconceptions and developed conceptual understanding backed by scientific experiment. Attendees overwhelmingly found the workshops to be an informative and valuable experience. GCC books accessible to K-5 students are quite numerous, but many authors lack credibility. Furthermore, language and artwork within some books induces misconceptions. Through a collaborative critiquing process, students, teachers, professors, and scientists, have dug into the literature to identify misconceptions, giving educators a chance to address them in the classroom. GCC now is part of a potential State of Oregon Science Content Standard. Data indicates a need for development of K-5 educators' scientific understanding of GCC and continued scrutiny of literature on Global Climate Change to prevent misconceptions from spreading.

Alex Mieloszyk, Oregon State University
Title: Testing of Small Radioisotope Thermoelectric Generator Designs

Radioisotope Thermoelectric Generators (RTG's) are an important source of power in regions where sunlight, and consequently solar power, is limited. This makes RTG's highly applicable for surface missions to higher and lower latitudes of Mars. The purpose of this study is to test the thermal performance of a new RTG design. The Multi-Mission RTG (MMRTG) was designed by NASA's JPL. The MMRTG is powered by a single General Purpose Heat Source (GPHS) with an output of about 250W_t and is intended to provide 20-25W_e. The MMRTG model tested in these experiments was originally built and tested at Oregon State University (OSU). However, the current tests utilized a GPHS model provided by Marshall Space Flight Center and some design modifications were mandated by the use of this heat source. The MMRTG used in these tests also made use of Multi-Layer Insulation (MLI) with the hope of obtaining better thermal performance. This paper details the testing of the MMRTG, as well as the thermal modeling of the MMRTG to help predict performance in physical tests.

David Logan, Oregon Institute of Technology
Title: Phase Stability in the Ground Equipment for the Uplink Array

The uplink array uses three 34 meter antennas at the Goldstone site on Fort Erwin to communicate with spacecraft. So far, efforts have focused on combining the signal from the three antennas to increase the power of the transmitted signal. Some of these methods include using a phase modulator to apply a phase shift to the signal of one or more antennas so that a coherent signal arrives at the spacecraft. My research focuses on the stability of the ground equipment. This involves quantifying how the phase of a signal transmitted from the exciters to the antennas varies with temperature. This requires collecting data over a few to many hours during important changes of the day. For example a change from day time, when it is hot, to night time, when it cools down. Once this is known, the variations can be compensated for to further increase the transmitting power of the uplink array. To collect the data, a computer program recorded the phase of a signal transmitted from the exciters to one or more antennas. The result of the data collected was that there are phase variations of the signal over time. These variations could be caused by the cycling of temperature due to the air conditioning system in the building were the exciters are housed or bay temperature changing with night to day transitions.

Christopher Stull, Oregon State University
Title: Software Development for the Correlation of Crew Exploration Vehicle (CEV) Solid Models

Initial efforts were made to develop a Java based software tool that could correlate Crew Exploration Vehicle (CEV) solid models created in Pro Engineer with items found in a MS Excel based CEV master equipment list (MEL). In addition, the tool was expected to facilitate rapid updating, and modification of solid model parameters such as drawing units systems and material properties. By providing engineers with these capabilities it would be possible to ensure accurate part representation when using solid models to assess crew radiation exposure during solar particle events. Due to significant fidelity differences between the current CEV drawing package and MEL, the software's effectiveness as a method for correlating items was limited despite utilization of multiple matching algorithms. The software's performance was further hindered by lack of a standardized model naming scheme. As a means of updating and modifying model parameters the software was also unsuccessful, however; an alternative solution was developed using a Pro Engineering tool called Smart Assembly. Regardless of initial deficiencies, ground work was laid for a tool that can easily integrate with Pro Engineering as a Java Applet and provide engineers with valuable part management tools. A trade study was also conducted to investigate novel thermal interface materials in an effort to enhance cooling for small footprint, high heat avionics components. The study resulted in identifying a number of graphite based materials that offered significantly lower thermal resistances than those previously used. Unfortunately, graphite materials also impose a potential for galvanic corrosion when compressed between aluminum surfaces. Currently, feasibility studies are underway to determine if corrosion can be mitigated without adversely effecting the potential cooling enhancement offered by these materials.

OSU Robotics Team, Oregon State University
Title: University Rover Challenge 2008

In March 2008, the OSU Robotics club was sponsored by OSGC to compete in the University Rover Challenge (URC), held by the Mars Society. The purpose of this sponsorship was to develop students and generate future interest in robotics at OSU. The object of URC was to build a mars rover prototype that can accomplish typical mars rover tasks at the Mars Society's Mars Desert Research Station near Hanksville, Utah. The four typical tasks were to analyze soil, study geology, perform simple mechanical repairs, and locate and deliver supplies to a stranded astronaut. The OSU Robotics Club won the URC 2008. The students have since traveled to the annual Mars Society Convention, assisted the Campaign for OSU in the drive for future scholarships, and published a magazine article in Robot magazine. The students that participated in URC 2008 had a great experience in developing and competing with a mars rover. The URC 2009 competition was announced in late October. A larger OSU Robotics Club team is already forming for this next year.

Ryan Stillwell, Oregon State University
Title: Microstrip Wiring Analysis and Heatsinking for X-Ray Microcalorimeter Arrays

As detectors in arrays increase in number, unwanted electrical and thermal crosstalk occurs because of increased wire density and inefficient removal of heat. Microstrip wiring is a way to help reduce electrical crosstalk by reducing the amount of wire on the array. From testing the microstrip wiring, which is composed of a bottom layer of niobium, a middle layer of silicon dioxide, and a top layer of niobium, it was found that the wiring goes superconducting at 9K and that through thermal cycling the wiring occasionally delaminates form the substrate. To help reduce thermal crosstalk, front side heatsinking is used. To fabricate front side heatsinking, thicknesses of up to a few microns of metal need to be removed while not damaging the substrate. This was done by a combination of lapping and polishing processes. A mild lapping process using 3um alumina particles followed by a shorter polishing process of 0.25um diamond particles cleared away the metal efficiently while leaving only small scratches on the substrate.

Benjamin Silver, University of Oregon
Title: Thermal Epoxies for High Temperature Applications

The Lunar Microrover Project (LMR) examined phase change material (PCM) in two different binders as potential lightweight thermal management solutions intended for a lunar mission. The PCM was designed to absorb excess heat in the microrover system while on the lunar surface in order to extend the life of on-board computer systems. Stycast 2850 FT epoxy and Fuchs Chemplex 1381 mixed with PCM were heated in air while the internal and external mixture temperature was monitored. A performance per gram "c" value was determined for each compound, and though the epoxy had a higher "c" value, the paste's ease of application made it a better choice for the intended application.