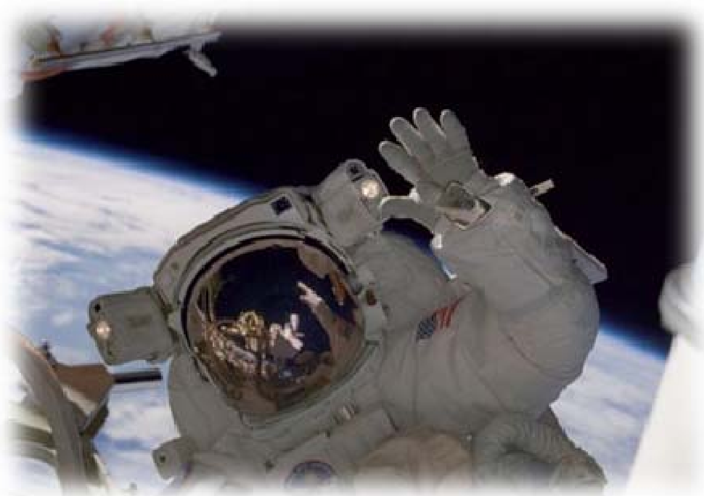
OREGON NASA
Space Grant Consortium

2007 Student Symposium
November 7, 2007
3:00 pm—8:00 pm

206 Memorial Union
Oregon State University



featuring research from NASA student interns

Agenda / Presentation Schedule

TIME	PRESENTER / EVENT	SCHOOL	NASA PROGRAM	NASA CENTER
3:00-3:45	Poster Session			
3:45	Matthew Clothier	Oregon State University	Jet Propulsion Internship	JPL
4:00	Brennan Sheehy	Oregon Institute of Technology	Exploration System Mission Directorate Internship	Glenn
4:15	Nate Edwards	Oregon State University	Goddard Robotics Internship	Goddard
4:30	Robert Peckyno	Oregon State University	Jet Propulsion Internship	JPL
4:45	Jennifer Jones	Portland State University	NASA Glenn Academy	Glenn
5:00	Greg Newbloom	Oregon State University	NASA Student Involvement Program Internship	Goddard
5:15	Ruja Kia-Duggan	Portland State University	Jet Propulsion Internship	JPL
5:30-6:00	Break (Refreshments served)			
6:00	Christopher Moore	Oregon State University	Exploration System Mission Directorate Internship	Kennedy
6:15	Dustin Lear	Oregon State University	ACCESS / ENTRYPOINT! Internship	Langley
6:30	Katy Swanson	Linfield College	Undergraduate Student Research Program	Ames
6:45	Caleb Cornelius	Oregon State University	Launch Oregon Balloon Program	N/A
7:00	Mohsen Nasroullahi	Oregon State University	Jet Propulsion Internship	JPL
7:15	Caleb Gritters	George Fox University	Jet Propulsion Internship	JPL
7:30	Melissa Jensen-Morgan	Oregon State University	Jet Propulsion Internship	JPL
7:45-8:00	Wrap Up			

Abstracts

Matthew Clothier, Oregon State University
Title: Improving Terrain Simulations with GPU Hardware Shaders and Bump Mapping Techniques

Simulating geographic terrain features typically involves using a digital elevation map (DEM) to produce a polygonal graphics object that can be visualized with a computer. This graphical object is built by sampling a DEM and then translating grid vertices to roughly correspond to a terrain's height. Many of these digital elevation maps are captured by satellite with resolution usually around 10 to 100m per pixel. This works well for most graphical applications but suffer from a loss of detail when visualizing the terrain surface at ground level. For the JPL DARTS lab, which simulates vehicles such as rovers on planetary bodies, it is important that additional details are added to the terrain for additional context, even if these details are synthetic. Unfortunately, with large DEM data sets, generating a new DEM at a higher resolutions such as 1cm is both data and graphically intensive. Thus, a better technique is to render an existing DEM terrain and add higher resolution features dynamically. With many graphics cards today equipped with Graphics Processing Units (GPUs), it has become rather easy to add graphical details on the fly. Techniques such as bump mapping, normal mapping, parallax mapping, and relief mapping all give an appearance of additional terrain features without adding geometry. By manipulating lighting and terrain texture, this can create believable surfaces such as rocks or sand. When coupled with a terrain, these techniques provide the necessary details at "ground level" while also preserving the underlying terrain with little performance cost. This research explores these various techniques as well as other shader techniques such as reflective bump mapping and shadows.

Brennan Sheehy, Oregon Institute of Technology
Title: Abrasion Testing as a Predictor of Dust Penetration in Spacesuit Materials

Future spacesuits must protect astronauts against hazards of the lunar environment, including lunar dust, for long periods of time. Lunar dust is electrostatically charged by the solar wind, causing it to stick to many surfaces including the fabric of the spacesuit. The dust abrades the spacesuit, posing a safety hazard for the astronauts. Three spacesuit fabrics were selected for abrasion resistance testing. An abrasion apparatus was adapted from an ASTM standard, designed, fabricated, and installed into a lunar environment simulator. The fabrics were abraded with lunar dust simulant and analyzed. Results were derived from a comparison of the abraded samples to the clean, new samples, as well as a sample from an Apollo 12 suit. The method of abrasion present in the apparatus was determined to be different than that on the Moon; however, the device was a good predictor of dust penetration. Further testing is needed before conclusions about the fabric can be drawn.

Nate Edwards, Oregon State University
Title: Applications of Lessons Learned from Mars Rovers for Lunar Exploration

Building off of the success of the popular Mars Rovers Spirit and Opportunity and fulfilling the President's goal of returning man to the moon by 2020 resulted in the basis of the 2007 NASA Robotics Academy project at Goddard Space Flight Center. Tasked by the Lunar Architecture Group to design Modular Rovers we started out by researching every space robot ever built. Specifically the Mars Rovers, Lunar and Mars Landers, Lunokhod 1 and 2 and the Lunar Roving Vehicles. We compiled research on electrical, mechanical and thermal systems as well as the Lunar Environment. All of this data was compiled into a website for a rover lessons learned database. After completing this research we used the knowledge to create modular concepts, servicing concepts, connector concepts and further researched areas of current rover design concepts. We met with Rover experts and created several 3d models of the concepts we came up with. Those concepts will be presented with videos of potential servicing mechanisms to other NASA centers and be included in Goddard final report for possible machining in the future years. The concepts are believed to have potential to be part of the missions to create a moon base and should promote robots doing most of the work to explore and build the first celestial body base. Further group project work was a big focus of the summer as trips to congress to promote robotics education and help create future legislation.

Robert Peckyno, Oregon State University
Title: Shaping Titan: A Spatial and Temporal Analysis of Landform Distribution and Process on Saturn’s Largest Moon using GIS

Since its arrival at Saturn, the Cassini spacecraft has used high resolution Synthetic Aperture Radar (SAR) to image just over 20% of Titan’s surface. Analysis of these images has revealed a complex world with a young surface extensively modified by cryovolcanism, fluid flow, impact events, tectonic activity, aeolian processes, and atmospheric deposition. To better understand the interplay between the various processes that have shaped this world, a geospatial analysis of the distribution of these landforms across Titan’s surface was undertaken using the tools in the ArcGIS software package. The extents of discernable features were outlined, both manually and through contours of equal return, and these shapefiles were subsequently layered on several projections of processed SAR swaths. Statistical analysis of the resultant maps shows that at high latitudes, fluvial processes are the primary means of landform modification, while at lower latitudes, aeolian processes are dominant. Further, this analysis also enabled a derivation of temporal relationships between these and other geomorphic processes at local scales.

Jennifer Jones, Portland State University
Title: Liquid Propellant Gauging in Low Gravity: the Pressure-Volume-Temperature (PVT) Method

Fluids in low gravity are controlled by surface tension. Since cryogenic propellants in spacecraft are not held at the bottom of fuel tanks by the Earth's gravity, a reliable and accurate gauging method is essential to mission success. Desirable gauging methods are accurate without requiring settling of the fuel tanks. This reduces fuel margins, reducing both the mass and cost of the mission. The Pressure-Volume-Temperature (PVT) method does not use fuel in the gauging process, works with various tank geometries and liquid placement within the tank, and minimizes the amount of additional hardware required. The PVT method uses a noncondensible gas to pressurize a propellant tank. The mass that is transferred from the pressurant gas supply bottle to the propellant tank is determined to find the percentage of liquid volume that is left within the tank. Analytical and experimental work has been performed using helium as the pressurant gas and liquid oxygen (LO2) as the propellant. Tests were performed at propellant tank pressures of 50 psia, 150 psia, and 250 psia to verify the accuracy of the PVT gauging method. The data show accuracies within ±3% of full scale or better, thereby demonstrating PVT as a viable gauging method for cryogenic propellants in low-g.

Greg Newbloom, Oregon State University
Title: Cross-linked Oriented Nanocomposite Extrusion (CLONE): Nanocomposite Processing and Optimization

Cross-linked Oriented Nanocomposite Extrusion (C.L.O.N.E.) is primarily concerned with the optimization of mechanical properties such as Young's Modulus and Ultimate Strength through processing techniques such as solvent synthesis and twin screw extrusion. Since a polymer nanocomposite combines properties from its constituents, this allows potential for this material to be very strong yet light weight. Based on those facts, NASA has put forth funding towards the amazing potential of these materials to revolutionize various space applications. Although solvent processing was used as a reference technique, the primary polymer nanocomposite processing is done in the twin screw extruder (TSE). The TSE uses heat to melt the polymer and then screws to mix it with the nanofiller. The extruder processing parameters can be optimized to produce the best mechanical properties. These mechanical properties are obtained through tensile testing with microstructural analysis done for verification. Through tensile testing we were able to see that processing parameters of (2 lbs/hr PS, 0.2 lbs/hr CNF LD, 200 RPM) with single feed port and vacuum pump yielded the highest tensile modulus and ultimate strength. Our research team saw a 58% increase in modulus and a 48% increase in tensile strength over pure PS. These results were verified by our microstructural analysis which showed a decrease in porosity for those processing parameters. Even with the increases in mechanical properties, C.L.O.N.E. still has a long way to go. NASA has set high expectations for this project, but with high expectations comes immeasurable potential.

Ruja Kia-Duggan, Portland State University
Title: Market Research: An Analysis of JPL's Competitive Position Through Surveying Relative Marketplace On Student Compensation and Degree Funding Programs.

Abstract: Employees aging and retirement of baby boomer generation is a question of major importance within organizations today. Organizations need to continually recruit and retain new, and in particular newly degreed, hires to replace and replenish the company know-how. To better understand the dynamics of these movements, this research was undertaken to analyze differences between compensation programs offered to recruit and retain students and current employees in degree funding programs. A survey was designed and conducted to capture information on student and degree funding compensation programs from peer organizations. Fifty Federally Funded Research & Development Centers (FFRDC), high-tech, and aerospace organizations were identified as peer organizations and contacted to participate in the survey. Twenty-two organizations completed the survey providing information on their compensation practices, which were analyzed to define market practices. The results were then compared to JPL practices to determine its competitive position for student and degree funding programs. The overall rate of participation by the organizations in this survey suggests an interest among organizations on compensation issues concerning student programs. Analysis revealed varying trends in terms of salaries offered to the students across different fields of study. This analysis resulted in showcasing the unique features of a program at JPL that concentrates on students and focuses on creating incentives to recruit them.

Christopher Moore, Oregon State University
Title: Simulation and Analysis of Launch Teams (SALT)

I spent my days working on the Simulation and Analysis of Launch Teams (SALT) project. While working for my mentor I first spent time researching different avenues NASA could pursue in outreach through digital media, especially with virtual reality technology. I spent time working on integrating applications with 3D technology such as Second Life and the Torque game engine. I developed a modified Second Life client capable of communicating with a previously developed application, the Prototype Training Application (PTA). I developed parallel in-game scripts and web services that would have eventually facilitated integration with the PTA and the Second Life virtual environment, however for accessibility of distribution reasons we decided not to pursue this further. Through this research we learned a great deal about the development platforms of Second Life and Torque, including code extensibility, scripting, and remote connection capabilities. After researching that field I began programming on the Prototype Training Application (PTA). I spent some time looking into domain-specific scripting languages. Once settling on a language I then merged all previous languages which the script was running off of into the new consolidated language. I also abstracted the scripting engine from the language interpretation so that multiple language wrappers/syntaxes could possibly be implemented in the future. Making use of this I added support for the language to be described in XML. I also abstracted the method of reading in the script and added support for the PTA to read scripts from either files or remote sources over the internet.

Dustin Lear, Oregon State University
Title: Preserving NASA's Past

My internship with the National Aeronautics and Space Administration (NASA) was different than most – it was intended to help NASA preserve its past. The Langley Research Center (LaRC), located in Hampton, Virginia, was NASA's first facility. Many of the buildings at LaRC are 50 or more years old. Several are, or will become, historical sites. A number of buildings have gone through renovations – some have different capabilities and are used for different purposes than when they were first built. Some buildings are no longer in operation, and others have been demolished with little record of how they were used. Both NASA and the State of Virginia are requiring that the buildings be properly documented. The Geographic Information System (GIS) team at NASA LaRC is working on a project to document various parts of the history of the buildings at LaRC. The GIS team is preparing two websites – one public, and one private – to record historical information, in the form of various media, documenting the tests and happenings in the various buildings at LaRC. The media will include: technical papers, movie clips from videos stored at the NASA LaRC Library, photographs, virtual tours, interviews, and more. My project involved researching the various media, attempting to determine which buildings were involved, and helping to build a database for the public and private websites.

Katy Swanson, Linfield College
Title: Sailboat Anemometer Position Error

The current placement of sailboat anemometers produces inaccurate measurements, because the anemometers are located on top of the main mast and experience disrupted airflow from the sails. Therefore research was conducted in order to discover the magnitude of the error and display how greatly the sails affect the velocity readings, while providing valuable information about anemometer placement on sailboats. This information will allow for better implementation of anemometers that are currently used in major sailboat races, like the America's Cup race. It will also provide sailors with the ability to steer their boats more effectively and make directional corrections based on the actual speed and direction of the wind. In order to determine the magnitude of error and the most accurate anemometer position, tests are being conducted on a main-sail model, an RC sailboat, and a full-scale sailboat. Several different types of sails were used for the main-sail model, along with two different diameters of masts. Roached sails and triangular sails were constructed out of cardboard, thin aluminum and cloth. The results from every roached sail test found that there was indeed a positive correlation between wind direction and the angle of the main sail. However, the results for the triangular sails show error fluxes that display no direct correlation with the main sail rotation. Although the triangular sail data doesn't provide conclusive evidence, the roached sail data is consistent enough to warrant further testing and investigation.

Caleb Cornelius, Oregon State University
Title: Launch Oregon Balloon Program - Aether Guided Lander Unit

The Aether Guided Lander Unit (GLU) will provide a way for balloon satellite teams to designate where payloads should land. By utilizing GPS technology and a servo-to-parachute course correction system, the unit will be able to automatically adjust its direction based on its current position and heading at any given time. Guided landings will increase recovery rates allowing for more intricate and expensive experiments and designs. The steering algorithm initiates action by asking the GPS for current coordinates. The GPS unit obtains coordinates from satellites, tracked by the antenna, and sends the coordinates to the microchip. With these coordinates and the target coordinates, which are programmed into the microchip, the desired heading is computed every five seconds. If the angle between the desired and actual headings is outside the acceptable range, the chip will vary the frequency of the signal sent to the servo, turning it. When turned, the back left string is shortened and the back right string lengthened. This imbalance in string lengths creates more drag on the left or right side of the parachute and the CanSat's heading shifts accordingly. When the servo goes back to a center position, the line lengths are returned to balance and the CanSat continues on a straight path until the next GPS coordinate is determined.

Mohsen Nasroullahi, Oregon State University
Title: Automation to Reduce Cassini Instrument Operation Risk and Cost

The Navigation Team notifies the Instrument Ops Team periodically with the latest update information, as Cassini-Huygens transmits data to earth through Deep Space Network. The accuracy of the updates is critical for Science and Navigation Team for post processing of public data. This process is currently performed manually and is subjected to the human errors. The main goal in this task was to automate the update process; and it has been accomplished using an object oriented approach. This design currently uses only for Planetary Constant Kernel files for update. The secondary goal is to reflect the update on the Space Planetary Instruction Camera-Matrix Events (SPICE) website. The website is under redevelopment to meet the current World Wide Web Consortium Hypertext Markup Language standards using Hypertext Preprocessor and Structured Query Language. In addition a design is underway for the maintenance of Science Operations Personal Computer (SOPC) accounts. SOPC Account Request are originated, circulated and stored in hardcopy form. Distributed Operations Teams around the world FAX or hand delivered the paper requests. Creating an online system is expected to reduce the time and resources used to generate and approve account requests as well as eliminate storage of multiple paper copies.

Caleb Gritters, George Fox University
Title: Long Range Sampling From a Rover Using a Harpoon: Feasibility and Further Research

Sample acquisition is a growing area of research as the exploration of Mars turns from visual observation to a desire to gain usable science. Future missions on Mars will focus on sample acquisition around the 2015-2020. MER class Rovers are an established technology and the next natural step is to use them as test beds for applications such as drilling and marsupial Rover designs. The idea of using a harpoon to penetrate rock from a distance of 10 meters with a projectile is explored in this project. Proof of concept is verified if a sample of measurable, usable size is retrieved from a Rover at a distance no less than 10 meters. Project results: After a trade study was performed it was found that a crossbow delivered the most efficient and reliable package. Tool steel bolts were machined and hardened so the tips of the projectile could easily penetrate the rock. An automatic fishing reel was used to reel in the bolts after firing from the Rover. High Speed photography was used to capture the hyper velocity conical jet of escape particles, and the speed of the projectiles. The device functioned such that proof of concept was indeed verified, and four samples of differing rock types up to 120MPa were gathered. Further studies could include projectile design, tip design/geometry, and material selection.

Melissa Jensen-Morgan
Title: Development of Sample Caching Subsystem

Sample caching is a concept NASA is pursuing for Mars missions in the near future. The subsystem must be small, lightweight, self contained, and use the minimum amount of motors. It also must be able to interface with various coring tools. Our design uses a large amount of passive compliance so that only three motors are needed for the entire system. With the completion of our prototype demonstrable unit, NASA management will be able to see the concepts involved in the system and its overall simplicity.