Online Proceedings

Poster Session 1

MGH 241, Easel 160

12:00 PM to 1:30 PM

Designing a Probe to Study Sub-Glacial Lakes

Ross Edward (Ross) Olason, Senior, Mechanical Engineering
Mentor: Dale Winebrenner, Earth & Space Sciences
Mentor: Tim Elam

Life is abundant on planet Earth but we have relatively few locations in which we can study environments similar to those on other celestial bodies. One possible terrestrial feature that is similar to those on some of the moons of Saturn and Jupiter is Lake Vostok, located under 4000 meters of ice in Antarctica. If we can prove that life can survive in this desolate environment that has been covered by ice for the last 35 million years, there is a heightened chance that extraterrestrial life exists within our own solar system. To study this area, we are designing a probe that will melt through the ice and take measurements from the lake to determine if bacteria or other life forms can survive in such a harsh environment. The main goals of my project were to create a mechanism that will allow the probe to move vertically in the lake via user control, determine the optimal cable and wire storage method for such a large endeavor, and eventually design a housing for the probe that can withstand immense pressure without leaking. I did this by using 3D computer aided design software and pressure and stress analysis tools. From these designs, I manufactured actual prototypes to test my concepts. Eventually, this work will lead to a functioning probe that will survey Lake Vostok and other sub-glacial lakes in an attempt to find evidence of life.

Poster Session 1

MGH 241, Easel 144

12:00 PM to 1:30 PM

Mechanical Effect of Blood Flow on the Carotid Artery Bifurcation

Laura De Barros Van Kolck, Senior, Mechanical Engineering
Mentor: Alberto Aliseda, Mechanical Engineering

The carotid artery bifurcation is one of the main sites of atherosclerosis, a disease that causes plaque buildup on artery walls, which can lead to Stroke. Through examination of the flow in the carotid artery bifurcation, we expect to better understand the influence of hemodynamics on plaque formation and growth, as well as on potential treatments. In order to investigate this, we have designed a model of the carotid artery using medical imaging and computer aided design software (SolidWorks). We are investigating rapid prototyping techniques to create a physical model of the carotid artery. Utilizing the physical model of the carotid artery lumen, we cast a mold made of water soluble material. This allows us to remove the mold leaving behind a reconstruction of the carotid artery with the necessary physical properties. Currently this project is focused on finding an ideal casting process that preserves the optical clarity. The next phase of this research will be to examine flow through the mold using particle image velocimetry (PIV). The setup of the PIV involves adding tracer particles to the flow that are illuminated with a laser. Using the light scattered by the particles to record the displacement collected with a photographic camera synchronized with the laser illumination. These images will be processed using an algorithm that compares the displacement from two consecutive images. The velocity of the flow will be calculated from the displacement of the tracer particles and its profile is used to determine the shear stress acting on the walls of the artery. This measurement of the stress acting on the arterial wall, together with the transport of chemical species to and from the arterial wall, is crucial in understanding the influence of hemodynamics on the physiology of the arterial wall and the development of atherosclerosis.

Poster Session 1

MGH 241, Easel 135

12:00 PM to 1:30 PM

The Helmet Drop Tower Project

Tyler Dennis (Tyler) Wickstrom, Senior, Mechanical Engineering
NASA Space Grant Scholar
Mentor: Irving Scher, Guidance Engineering
Mentor: Randy Ching, Mechanical Engineering, Applied Biomechanics Lab

Helmets have been trusted to provide protection against head impacts for millennia and have become a universally promoted piece of safety equipment. Current helmet standards provided by NOCSAE, SNELL, and ASTM for football, ski, motorcycle, and other activities specify the requirements for critical impacts under varying conditions such as; temperature, impact location, and impact energy. However, most standards only minimally account for the effects of subcritical collisions and the natural fatiguing processes experienced by a helmet during its use. Intuition suggests that these seasonal cycles and minor impacts attenuate the utility of protective headgear; however, a scientific inquiry into such effects could illuminate or invalidate this assumption. The working hypothesis of the research team under Professor Randal Ching and Irv Scher was that sub-critical impacts and seasonal cycling would diminish a helmet's protective abilities (as measured by metrics such as peak linear acceleration and severity indices), and the goal was to illustrate that current standards and refurbishing methods need to account for these various effects of age and use. Accordingly, my research group designed a helmet drop tower to test a variety of different helmets (football, motorcycle, and ski) according to SNELL and NOCSAE standards, and used helmets were compared to their new counterparts. Direct comparisons between used and new helmets were used to evaluate the effects of age and minor impacts on helmets, the effectiveness of current standards at predicting the utility of helmets, and the expected lifetime of helmets under given conditions. As the first independent study of helmet performance in the state of Washington, this study could give vital feedback to helmet manufacturers, helmet standard foundations, and helmet users alike.

POSTER SESSION 2

MGH 241, Easel 156

2:00 PM to 3:30 PM

Centrifugal Method for Particle Size Segregation

Cameron Kelly (Cameron) Turner, Senior, Mechanical Engineering
Christopher Thomas (Chris) Pauly, Senior, Mechanical Engineering, Electrical Engineering, Mathematics
Nicklaus Charles Smith, Senior, Aeronautics & Astronautics
Julianna Carroll, Senior, Aeronautics & Astronautics, English (Creative Writing)
Keith Charles Woehrlin, Senior, Mechanical Engineering: Mechatronics
Joshua Rosenberg Hooks, Senior, Mechanical Engineering: Mechatronics
Ansley Barnard, Senior, Aeronautics & Astronautics
Harbin Hee Kim, Senior, Aeronautics & Astronautics
Declan Pray Mallamo, Senior, Aeronautics & Astronautics
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: James Riley, Mechanical Engineering

Extraterrestrial regolith can be utilized for a variety of in-situ resource utilization applications including the production of oxygen and slurry materials. These capabilities are crucial for the success of long-term missions to both the Moon and Mars. However, the value of the regolith often depends on extracting a specific particle size. Therefore, our objective is to develop a regolith sifting system for integration into extraterrestrial surface systems. Furthermore, this system will be designed to operate independent of gravitational forces in order to offer flexibility by maintaining the same degree of reliability and efficiency in terrestrial, lunar, martian, asteroidal, and orbital environments. To accomplish this task, a centrifuge design was adopted. A container fitted with two sets of sifting screens is rapidly spun so that the centripetal forces cause the particles to pass through the screens. At high speeds the effects of gravity and particle cohesion become negligible. The design was carried through several stages of development where parameters such as geometry, induced agitation, sample size, rotation speed, and test duration were optimized to give accurate sorting results with minimal energy input. Data collected from ground testing will be compared to data collected on NASA's low-gravity aircraft in June. The low-gravity testing introduces more challenges to the design, such as automated gates that keep the particles from self-sorting in between low-gravity flight parabolas, and integration into a air-tight glove-box for safety. For future research, techniques for autonomous and continuous operation will be crucial for adoption into extraterrestrial surface systems.

SESSION 2L

MCNAIR SESSION - ACCESS AND TECHNOLOGY

Session Moderator: Eve Riskin, Electrical Engineering

Mary Gates Hall 287

3:30 PM to 5:00 PM

* Note: Titles in order of presentation.

The Relationship of Young's Modulus to Porosity in 3DP Stoneware Ceramic: A Complete Analysis

Alexandra Patricia Kanoelehua (Alex) Gramling, Senior, Mechanical Engineering
McNair Scholar
Mentor: Mark Ganter, Mechanical Engineering
Mentor: Grant Marchelli, Mechanical Engineering

Three dimensional printing (3DP), a subfield of additive manufacturing, has experienced many novel advancements by way of innovative material development over the past few years. With the recent expansion in capability, information regarding the mechanical integrity of these new material systems is generally lacking. In an effort to fill this informational void, the present study examined the relationship between Young's modulus and porosity in 3DP stoneware ceramic test specimens. During this experiment, the ceramic specimens or "pucks" were printed using a three dimensional powder printer and measurements of height and diameter were taken to map the variation in subsequent kiln firing operations. The pucks were kiln sintered according to a predetermined schedule, which involved strategically placed ramp rates and isothermal soaks for varying time periods. After sintering, Archimedes Method was used to determine the porosity and bulk density of the specimens. The pucks were then crushed using an Instron Universal Tester resulting in a measure of the 3DP stoneware's stiffness versus porosity. It is expected that as the porosity of the pucks increases Young's modulus will decrease. The aim of this research is to provide the first experimental relationships of porosity and stiffness resulting from sintering parameter modification as well as to investigate the possibility of producing 3DP ceramics that are comparable to those that are conventionally manufactured.

POSTER SESSION 3

Commons East, Easel 74

4:00 PM to 5:30 PM

Comparison and Implementation of Multi-Legged Gait Patterns

Kurt Joseph (Kurt) Stalsberg, Junior, Mechanical Engineering
Mentor: Scott Wilcox, Mechanical Engineering
Mentor: Santosh Devasia, Mechanical Engineering

Multi-Legged terrestrial biological systems demonstrate complex forms of locomotion by utilizing different gait patterns. These complex forms of locomotion provide a path for promising advancements in the development of biomimetic systems. In previous research, we analyzed various multi-legged terrestrial systems and several variables that effect the selection of the gait pattern became apparent. It was found that the number of legs, stability of the system, and velocity of the system all had a significant effect on the gait patterns selected and the gait patterns that are available for use in the system. This research focuses on constructing biomimetic walking systems, using LEGO Mindstorms NXT robotic kit, which implement the carious characteristics of animal locomotion to determine the effect of these variables on the gait patterns. The current systems under analysis consist of six legs controlled by interactive servo motors and an NXT micro-computer which allow the system to move with several distinct gait patterns. From the biomimetic system, it is shown that some gait patterns are inefficient under certain conditions and this may lead to determination of when a gait pattern change is necessary in both the biological and biomimetic systems. Application of this research include pattern selection in mechanical systems and design influence on biomimetic systmes.

POSTER SESSION 3

Commons East, Easel 66

4:00 PM to 5:30 PM

Design, Construction, and Testing of the URSA Wind Tunnel

Luke Daanomah, Sophomore, Aerospace Engineering, Electrical Engineering, Mechanical Engineering, Edmonds Community College
NASA Space Grant Scholar
Phillip Garas

Hamzah Musleh

Josia Ravelonanahary

James Stoddard

D'Artagnon Womack

Mentor: Tom Fleming, Department of Physics, Edmonds Community College

Wind tunnels are devices used to simulate real-world aerodynamic conditions and characteristics using small-scale models that will be experienced by larger-scale engineering structures such as aircraft, buildings, bridges, windmills, and even cities. They are useful for studying and addressing problems of the stability, efficiency, and feasibility of engineering designs on a small-scale before scaling-up to larger and more-expensive engineering projects. We present here an overview of the design, construction, and testing of the EdCC Undergraduate Research Students Association (URSA) research-grade wind tunnel which was conceived to support further student studies in aerodynamics across the Physics, Engineering, and Materials Sciences departments at EdCC, including detailed contributions from the four student teams involved with the project: Aerodynamic Theory Team, Engineering and Construction Team, Software, Sensors and Acquisition Team, and the Computational Physics Team.