Abstract Book

FURI Research Symposium

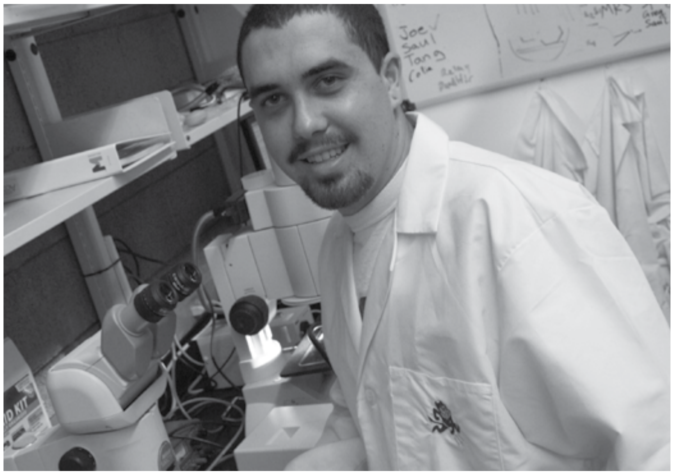
This event is a poster session for engineering students to display and summarize findings from their research areas.

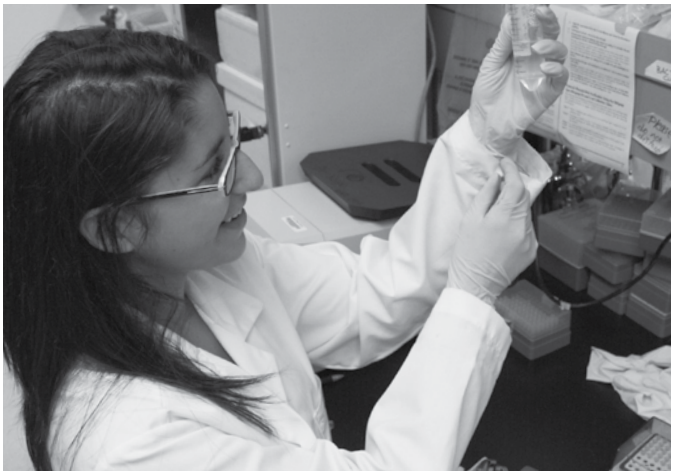
FURI Fulton Undergraduate Research Initiative

Fall 2009

ASU Ira A. Fulton Schools *of* Engineering

ARIZONA STATE UNIVERSITY





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November 20, 2009

Welcome to the fall 2009 Ira A. Fulton Schools of Engineering Undergraduate Student Research Symposium!

Since receiving the very generous $50 million naming gift from Dr. Ira A. Fulton, the schools of engineering have experienced a dynamic transformation. With the growth of the research agenda and the increased interest of our best students in the investigative activities of our laboratories and research clusters, the Fulton Investment is being used to design programs to expand the undergraduate research experience. These programs are managed under the Fulton Undergraduate Research Initiatives (FURI). The Symposium–one of the FURI programs–is the culminating event of our students' semester-long research projects.

Participants in this Symposium have been mentored by some of our best faculty, research associates and doctoral students. Most of the students participating in this Symposium are being funded under the FURI Research Program and the Honors Thesis Program. Each of these students took the initiative to identify a research topic, seek out a mentor, submit an application and withstand a competitive selection process. Having managed their time, budgets and research, 69 students successfully participated in this tenth offering. The Symposium also highlights other undergraduate students who are being funded by the FURI Travel Grant Program, the FURI Honors Summer Institute and the Computer Science and Engineering Research Scholarship. In total, 85 students and their research are featured in this abstract book.

We invite you to read and enjoy the accomplishments of our very robust community of scholars. Also, please take the time to learn about the unique characteristics of our programs and to acknowledge all the contributors who have made this event possible. Finally, we congratulate all our participating undergraduate students and mentors for being part of this great program!

Deirdre R. Meldrum

Deirdre Meldrum
Dean, Ira A. Fulton Schools of Engineering

Christine M. MacLeod

Christine MacLeod
Associate Director, Undergraduate Initiatives

Acknowledgements

Dr. Ira A. Fulton

The generous and visionary support of Dr. Ira A. Fulton in providing the financial means to make all the FURI programs possible is acknowledged and deeply appreciated.

Barrett, The Honors College also deserves special recognition for contributing financially to the FURI Honors Thesis Program. By combining our resources, we have expanded and enriched our students' experiences.

The success of the FURI programs depends upon the willing participation and support of numerous individuals within the Ira A. Fulton Schools of Engineering. We express our sincere appreciation to Drs. Jerry Coursen, Valana Wells, Paul Westerhoff, Stephen Krause and Mutsumi Nakamura for their help in selecting the FURI participants.

Special thanks are extended to Christine MacLeod, Associate Director of Undergraduate Initiatives, who graciously and conscientiously worked to make the Symposium a showcase experience for all participating students, faculty and staff. Also, we would like to thank Dr. Hubele, Emeritus Faculty, for her vision of and dedication to the FURI programs, Aimee Garza for her help in all aspects of the FURI program, and Carol Vance and Barbara Minich for their assistance in business matters.

On behalf of the undergraduate students participating in the FURI programs, we extend our appreciation to the mentors for their guidance: It is your teaching that enables our students. Thank you!

Dr. Soyoung Ahn
Dr. Morteza Abbaszadegan
Dr. Metin Akay
Dr. Terry Alford
Dr. David Allee
Mr. Nathan Baldwin
Dr. Chitta Baral
Dr. Winslow Burleson
Dr. Michael Caplan
Dr. Yinong Chen
Dr. Lenore Dai
Dr. Harshil Dhruv
Dr. David Frakes
Dr. Michael Goryll
Dr. Stephen Helms Tillery
Dr. Richard Herman
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Dr. Martin Reisslein
Dr. Bruce Rittmann
Dr. Ronald Roedel
Dr. Veronica Santos
Mr. John Schloendorn
Dr. Praveen Shankar
Dr. Henry Sodano
Dr. Kyle Squires
Dr. Kenneth Sullivan
Dr. Bruce Towe
Dr. Marion Vance
Mr. Michael Verdicchio
Dr. Brent Vernon
Mr. James Villarreal
Dr. Bryan Vogt
Dr. Hongbin Yu
Dr. Weiwen Zhang

To all the unnamed individuals, staff, friends and family members, who provided intellectual, emotional and logistical support, we extend our gratitude in helping to enrich our students' experiences and for making this offering of FURI programs a success!

Participants Listed Alphabetically

Undergraduate Research

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Craig Bailey
Milad Behbahaninia
Emma Blass
Peter Bremer
Maria Arreola Croda
Taylor Ehrick
Kyle Fortin
Mark Garrison
Bradley Goodman
Susannah Harding
Calvin Jin
Galen Johnson-Bates
Andrew Larson
Angel Lastra Miranda
Jacob Mickle
Andrew Payne
Miguel Reyes
Chad Ripley
Nisith Shah
Matt Summers
Aman Verma
Yan Zhang

Honors Thesis Program

Cameron Adler
Raisa Ahmad
Michael Bouey
Colton Bukowsky
Stephen Charnicki
Brian Dekleva
Matthew Dion
Nathan Dunkin
Amber Dunning
David Eaton
Fariha Ejaz
Erin Eppard
Aaron Estes
Amye Farag
Michael Fillman
Jennifer Gamboa
Megan Henriksen
Albert Hsia
Ashley Jaeger
Maneet Kamboj
David Kay
Kenneth Lan
James LeBeau
Edward Lee
Jennifer Lehrman
Tyler Libey
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Colin Mothershead
Stephanie Naufel
Stephanie Ochoa
Christine Parsons
Brian Perea
Jonathan Plasencia
Jose Rios
Shane Sandler
Jonathan Sankman
Jonathan Vahabzadeh
John Wake
Alex Wallace
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FURI Honors Summer Institute

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Kathryn Bratrud
Katherine Cai
Amelia Celoza
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Shawn Haupt
Mark Huerta
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Travel Grant Program

Megan Henriksen
Stephanie Naufel
Kimia Seyedmadani

CSE Research Scholarship

Michael Bartholomew

Synthesis of Metal Complex Based Absorbers for Photovoltaic Applications

Cameron Adler, Bioengineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Jian Li, Materials Science Engineering

The research consists of synthesizing various small parts of potential absorber compounds in photovoltaic applications. Since azaporhyrin based structures have shown great promise, the research has focused on synthesizing small parts of azaporphyrin compounds. So far, the most basic part has been synthesized with relative efficiency, but the second desired structure has not seen efficient synthesis. Future research includes continued work to more efficiently synthesize the second step partial structure, and the synthesis of similar structures with different substituents.

Quantitative Reverse Transcription Polymerase Chain Reaction (qRT-PCR) on Single Bacterial Cells

Raisa Ahmad, Bioengineering
Graduation: May 2011 Hometown: Chandler, Arizona
Mentor: Dr. Weiwen Zhang, Civil and Environmental Engineering

Single-cell analysis of bacteria is essential for studying the genetic heterogeneity of bacterial population and real time physiological response of individual cells to different environmental conditions. In this study, optical tweezers that are capable of manipulating nanometer-sized dielectric particles by small forces via a highly focused laser beam were utilized to capture individual bacterial cells for gene expression analysis. Quantitative reverse transcription polymerase chain reaction (qRT-PCR) was then used to quantitatively determine the expression levels of selected genes in the isolated single bacterial cells. The methodologies developed will allow better understanding of various cell responses at a single-cell level.

Transcutaneous Electrical Nerve Stimulation in Prevention of Raynauds Phenomenon

Hiroko Austin, Bioengineering
Graduation: December 2009 Hometown: Furukawa City, Japan
Mentor: Dr. Bruce Towe and Dr. Richard Herman, Bioengineering

Does transcutaneous electrical nerve stimulation (TENs) of the hand cause vasodilatation to counteract cold-induced vasoconstriction of the fingers in normal human subjects and, if so, does TENs prevent a vasospastic, ischemic event following exposure to cold in human subjects with Raynauds Phenomenon? Different methods to quantify change of blood flow in the finger were tested. Different methods of TENs were tested to determine the most efficient stimulation technique for vasodilatation. The changes of blood flow in two conditions, (10 °C and 23 °C) from five normal human subjects will be compared. Then TENs will be added to test the effects.

Compiling Manpower Loading Curves to Improve Construction Efficiency

Craig Bailey, Construction
Graduation: December 2009 Hometown: Bakersfield, California
Mentor: Dr. Kenneth Sullivan, Construction

A construction project's manpower directly correlates to the project's sequencing, and the traditional method of construction management does not effectively utilize manpower information. By compiling manpower loading curves, a project sequence can be developed. Any issues which produce bottlenecks in this sequence can be noted before they become too costly and resolutions can be implemented for those issues on future comparable projects. Over time, this will drastically increase the accuracy of project sequencing, and thus increase efficiency. Future work will involve researching potential remedies for items negatively impacting construction manpower.

Studying and Improving Current Approaches for Using Bayesian Framework for Modeling Gene Regulatory Networks

Milad Behbahaninia, Bioengineering
Graduation: May 2010 Hometown: Phoenix, Arizona
Mentor: Mr. Michael Verdicchio, Computer Science

Gene regulatory networks (GRNs) are networks of genomic interactions, lending insight into various functions within a cell. Learning new ways in which genes interact can facilitate the discovery of triggering mechanisms and treatments for high-profile diseases such as cancer. There are many ways by which GRNs can be modeled, one of which is a Bayesian network. We incorporate prior knowledge learned from biomedical literature into Bayesian network learning to improve discovery of novel gene interactions. Prior knowledge incorporation is done by verifying gene interactions inferred by Bayesian learning using BASIN, a literature-based gene interaction database.

Investigation of Pressure Profile Systems Sensors

Emma Blass, Mechanical Engineering
Graduation: May 2011 Hometown: Gilbert, Arizona
Mentor: Dr. Veronica Santos, Mechanical and Aerospace Engineering

The object of this research is to determine the tactile limitations of the Pressure Profile Systems (PPS) Digitacts Sensor in relation to center of pressure. The existing interface code will be altered to include calculation of the center of pressure. Calculations made are based on the pressure readings of individual sensor elements (or taxels) within the sensor and in relation to the top corner of the sensing array. The resolution for the location is limited to the center of a single taxel. Future experiments will need to be designed to determine the accuracy and sensitivity of the center of pressure readings.

Active Flow Control

Michael J. Bouey Jr., Mechanical Engineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Praveen Shankar, Mechanical and Aerospace Engineering

Active Flow Control is a process that improves the aerodynamic efficiency through the implementation of a control and sensor system. During the developmental stages of this research, a mass flow experiment has been developed that will permanently be integrated into the control and sensors curriculum. This experiment utilizes an ultrasonic sensor that: detects a light object in a vertical tube, sends the object's displacement information to a servo, which then controls a butterfly valve allowing airflow into the vertical tube. Developing this experiment established a firm understanding of control and sensor systems and preliminary fluid dynamic system analysis.

Muscle Properties and Gait Kinematics after Spinal Cord Injury

Peter Bremer, Bioengineering
Graduation: May 2011 Hometown: Flagstaff, Arizona
Mentor: Dr. Ranu Jung, Bioengineering and Electrical Engineering

The research's specific aim is to quantify changes in active muscle properties and gait kinematics that occur in rodents with an incomplete contusion spinal cord injury. A research protocol was developed and compiled for the Institutional Animal Care and Use Committee, and approval was recently granted. The protocol will be implemented to collect experimental data in the near future. This data will ultimately be used to develop a computational musculoskeletal model based on active properties of muscle tissue. This model could be used to explore changes in the musculoskeletal system induced by spinal cord injury that can affect locomotion.

Anisotropic Wetting of Controllably Wrinkled Surfaces

Colton Bukowsky, Materials Science and Engineering
Graduation: December 2011 Hometown: Cooper City, Florida
Mentor: Dr. Bryan Vogt, Chemical Engineering

Anisotropic wetting on wrinkled oxidized polydimethylsilane (PDMS) surfaces is observed due pinning of the three-phase point. This is characterized using sessile, advancing, and receding water contact angle measurements. Contact angles were measured parallel and perpendicular to the wrinkles to quantify the pinning effect. Since compressive strain of the surface influences the wrinkle amplitude and therefore surface wetting, strain was varied from 0-40%. Effects of surface chemistry were also measured by treating some samples with n-octyltrichlorosilane. Competition between pinning at wrinkles and cracks was measured above 30% strain. Future work will focus on understanding the effects of wetting behavior on these patterned surfaces scales with surface chemistry and wrinkle amplitude.

EPON Access Network Transmission Strategies and Evaluation for "Model" Traffic and Real Video Traffic

Stephen Charnicki, Electrical Engineering
Graduation: May 2011 Hometown: Scottsdale, Arizona
Mentor: Dr. Martin Reisslein, Electrical Engineering

The main focus of the research has been on understanding the average upstream packet transmission delay and stability limit for a wavelength division multiplexing Ethernet Passive Optical Network (WDM EPON). Extensive simulations were run to test how packet delays and stability limits change as a function of parameters such as number of optical network units (ONUs), number of channels available for transmission and type of traffic, Poisson or self-similar. Analysis accurately predicted the stability limit for basic Poisson systems with equally loaded ONUs. Future research could examine stability limits for systems with unequally loaded ONUs and video traffic.

Synthesizing Hierarchically Porous Carbon for Lithium Ion Batteries

Regina Arreola Croda, Chemical Engineering
Graduation: May 2011 Hometown: Mexico City, Mexico
Mentor: Dr. Bryan D. Vogt, Chemical Engineering

Porous carbons are attractive in many energy applications such as electrodes in lithium ion rechargeable batteries, but performance is dependent upon porosity, pore size and surface area. In attempts to control the pore morphology in carbons, phase separation of porogen and carbonizable polymer (resol) is examined; specifically the impact of porogen chemistry and molecular weight . Carbon monoliths have been fabricated with three different polymers: poly(hydroxystryene), poly(methylmethacrylate) (PMMA), and poly(2-ethyl-2-oxazoline). Incompatibility between resol and PMMA leads to phase separation that is observable by the naked eye. The porosity and pore size distribution will be examined as a function of the processing variables.

Investigation of Striatal Diffusion Patterns

Brian Dekleva, Bioengineering
Graduation: May 2011 Hometown: Pottstown, Pennsylvania
Mentor: Mr. Nathan Baldwin, Bioengineering

The aim of this project is to investigate fluid dispersion in the striatum by creating and implementing a microfluidic, sequential drug delivery system that can inhibit and then disinhibit striatal neurons in rats. A delivery system was developed to inject Muscimol (neural inhibitor) followed by CSF (flush) without pre-injection mixing. A rat was then implanted with a guide canula for drug delivery as well as a recording array to monitor neural activity. By inhibiting striatal neurons and then flushing out the inhibiting agent, the rate of neural reactivation can be determined and used to verify computationally derived diffusion models.

Nanoparticle-Coated Carbon Microspheres

Matthew Dion, Chemical Engineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Bryan Vogt, Chemical Engineering

A novel route to synthesize nanoparticle-coated carbon microparticles is explored that utilizes the in-situ polymerization of a Pickering emulsion. The emulsion is formed by furfuryl alcohol in water that is stabilized by SiO2 nanoparticles. The furfuryl alcohol is subsequently polymerized using an acid catalyst. These SiO2-coated micron-sized polyfurfuryl alcohol particles can then be carbonized at high temperatures. The resulting carbon microparticles are then characterized with optical and electron microscopy. Future work will include using TiO2 nanoparticles instead of SiO2 nanoparticles for stabilizers. TiO2@Carbon microparticles have potential use as improved electrodes in Li ion battery applications.

Isothermal Amplification Technique for the Detection of Microbial Pathogens

Nate Dunkin, Civil, Environmental and Sustainable Engineering
Graduation: May 2011 Hometown: Peoria, Arizona
Mentor: Dr. Morteza Abbaszadegan, Civil and Environmental Engineering

Isothermal amplification is a simple method for the detection of microbial pathogens. The procedure is being developed to identify the biomarker Bacteroides in water samples. Preliminary culturing of Bacteroides in an anaerobic environment has been carried out. After the specific primer set used for isothermal amplification is designed, the methods will be optimized. Such a protocol could pave the way to assess microbial water quality without expensive laboratory equipment, which would help to reduce the costs and time associated with protecting the public health from waterborne microbial outbreaks.

The Violin Project: Quantifying the Motion of a Learned Behavior

Amber Dunning, Bioengineering
Expected Graduation: May 2011 Hometown: Tempe, Arizona
Mentor: Dr. Stephen Helms Tillery, Bioengineering

In this study, patterns of physical action were investigated in order to gain insight into the complex physiological processes of the brain's underlying movement. Specific patterns of movement of a learned behavior may potentially indicate the most efficient pathway of the action. The goal of this research was to record the paths of motion involved in an action, and compare these motions from individual to individual. This was accomplished by quantifying the movement of bowing a violin using a bow and violin installed with LED lights calibrated to a motion capture system. The angles and velocities of motion were then calculated and compared between experienced and inexperienced violinists.

Aneurysm Treatment with Polymer 0Gels

David Cohlton Eaton, Bioengineering
Graduation: May, 2011 Hometown: Houston, Texas
Mentor: Dr. Brent Vernon, Bioengineering

The objective is to examine the properties of a gel to determine if it can be used to embolize brain aneurysms. Swelling tests were done to determine how gel swelling was affected by mix time. Rheology was done to determine how several variables affect the gelling reaction. Swelling tests show that longer mix time leads to faster swelling. Rheology showed that longer premix times decreased final phase angle. Longer mix times and lower pHs slowed down the reaction. Degradation tests and glass aneurysm models will soon be used to determine if the gelling properties are optimal for aneurysm embolization.

Analysis of Traffic Instabilities in Congested Traffic

Taylor Ehrick, Civil and Environmental Engineering
Graduation: May 2010 Hometown: Phoenix, Arizona
Mentor: Dr. Soyoung Ahn, Civil and Environmental Engineering

The purpose of this research was to analyze changes in macroscopic traffic behavior with respect to lane specific driving behavior and its relation to freeway geometry. Traffic flow and speed data form State Route-99 just outside of Sacramento, California was analyzed using the relative lane utilization concept. The research found that congested traffic flow and speed varied considerably from lane to lane. The findings indicate that the congested traffic exhibits lane-specific behavior unlike the conventional belief that congested traffic behaves according the FIFO principle. Further research will aim to establish the effects of freeway geometry (e.g. merges and diverges) on the extent of heterogeneity across lanes.

Prototyping of Patient Specific Heart Models

Fariha Ejaz, Bioengineering
Graduation: May 2010 Hometown: Gilbert, Arizona
Mentor: Dr. David H. Frakes, Bioengineering

The goal of the project is to prototype heart models that are specific to patients' anatomies. Computed Topography (CT) data have been acquired from patients and have been loaded into Mimics software, which allows the data to be used as a template to build computational models of the heart. One rough model of the normal heart has been generated using such data. Another model will be created for a patient with congenital defects and these models will be translated into tangible models with rapid prototyping technology to serve as surgical planning educational tools.

Study of Cooling Effects in a Stirling Engine Heat Exchanger Using Cross-Flow, Counterflow, and Parallel Flow

Erin Eppard, Mechanical Engineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Patrick Phelan, Mechanical Engineering

The objective of this research is to identify current limitations on cross-flow cooling used in Stirling Thermal Motor 4-120 coolers and compare the cross-flow cooling efficiency to the cooling efficiencies of counterflow and parallel flow configurations. A full-scale model of the Stirling engine cooler and a test stand are being constructed in order to best simulate the cooler and its working environment in a way that is adaptable to the three different flow configurations tested for this research. Results thus far are inconclusive, but predictive calculations indicate that counterflow is most effective for cooling the working gas. Future work will include a more detailed analysis on heat transfer applying thermodynamic equations and tools more relevant for the analysis of oscillating gas flow that occurs in Stirling engine coolers.

Analysis of Aeroelasticity Effects on a Flapping Wing

Aaron Estes, Mechanical Engineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Michele Milano, Mechanical and Aerospace Engineering

The objective of this research is to investigate the possibility of using aeroelasticity to make a wing flap periodically so as to generate maximal average lift. Experiments conducted in the Biopropulsion lab have isolated spring parameters that produce optimal trajectories for generating lift, and particle image velocimetry has been carried out for the purpose of analyzing the vortical structures associated with these trajectories. Future work will involve the altering of experimental parameters such as aspect ratio and plate orientation to explore other aeroelastic propulsion possibilities.

Can Thermoreversible Enzyme-Sensitive Polymers Be Used as Drug Delivery Vehicles Which Target Migrating Cells?

Amye Farag, Bioengineering
Graduation: May 2012 Hometown: Paradise Valley, Arizona
Mentor: Dr. Harshil Dhruv, Bioengineering

The goal of this work is to synthesize and characterize materials for a resorbable, thermoreversible drug delivery device which degrades and releases drug in response to migrating cells. Synthesized materials based on poly(N-isopropylacrylamide) were designed in order to have increased solubility in the presence of collagenase, an enzyme secreted by migrating cells. Two model enzyme-sensitive polymers were successfully synthesized, as shown by NMR spectroscopy. DSC and cloud point measurements confirmed the synthesis and measured the increased solubility of the polymers after enzyme action. Future goals include creating higher molecular weight materials that will form gels at lower polymer concentrations.

Investigations into UAV Stability Control

Michael Fillman, Aerospace Engineering
Graduation: May 2010 Hometown: Scottsdale, Arizona
Mentor: Dr. Marion Vance, Mechanical and Aerospace Engineering

An emerging class of unmanned aerial vehicles (UAVs) is being motivated toward more unconventional configurations, which create much more complicated control and stability issues. The project seeks to design simple closed-loop control systems to help stabilize the flight of an unconventional design and high-lift capability UAV. Current research is into the creation of a system model, which will be utilized by a feedback-control system to damp the longitudinal phugoid motion of the aircraft during flight.

Fabric Testing and Modeling for Engine Containment Systems

Kyle A. Fortin, Civil Engineering
Graduation: May 2010 Hometown: Glendale, Arizona
Mentor: Dr. S. D. Rajan, Civil and Environmental Engineering

The goal of this FAA-sponsored research is to experimentally obtain mechanical properties of Kevlar. Research conducted so far consists of two sets of experiments - Simple Tension Tests and Adhesive Tests that are used to obtain the stress-strain relationship and the shear strength of adhesives. The research also deals with the use of the experimental data in modeling ballistic testing conducted at NASA-GRC and shows the efficacy and accuracy of the model. Preliminary results show a close match between the model and the experiments. The ultimate goal is to improve the computer modeling of an aircraft engine's containment system.

Lytic Peptides as Cancer Therapeutics

Jennifer Gamboa, Chemical Engineering
Graduation: May 2011 Hometown: Centennial, Colorado
Mentor: Dr. Kaushal Rege, Chemical Engineering

Tumor necrosis factor-related apoptosis-inducing ligand (TRAIL) induced apoptosis is promising in cancer therapy due to selectivity towards malignant cells, but cancer cells are often resistant to TRAIL-induced apoptosis [1]. The lytic peptide, KLA was used in combination with death receptor (DR) antibodies in order to induce apoptosis in LnCap and PC3 PSMA prostate cancer cells. Western analysis of proteins was performed after the treatment of the cells with KLA and DR antibodies, and showed a decrease in cFlip, an increase in Caspase 3, and varying results of Cytochrome C proteins in treatments with greater concentrations of KLA followed by death receptor antibodies.

Modular Flight Computer

Mark Garrison, Electrical Engineering
Graduation: May 2011 Hometown: Glendale, Arizona
Mentor: Dr. Michael Goryll, Electrical Engineering

The modular flight computer's primary purpose is to control an RC helicopter autonomously using inertial sensors. The primary component, the flight management system, has been designed and currently awaits fabrication. Additional modules, including the low power radio transceiver board and the inertial reference sensor board are currently being designed. Research is being conducted on stabilization control systems, which will be the core of the flight computer. At this point, a simple model is being used as the control system in the simulations. Once these systems have been tested, the next stage will be designing the video camera for the helicopter.

Development of a Rocket Deployed UAV

Brad Goodman, Aerospace Engineering
Graduation: May 2010 Hometown: Great Falls, Montana
Mentor: Dr. Marion Vance and Mr. James K. Villarreal, Mechanical and Aerospace Engineering

The major drawbck of Unmanned Aerial Vehicles (UAVs) currently used by the military is that they are relatively slow to deploy. To address this issue, research is focused on the development of a rocket-launched UAV known as the Rapid Ascent Reconnaissance Vehicle (RARV). The airframe design has been finalized and current work is primarily in the area of airframe fabrication. Upon completion of the airframe, research in the spring of 2009 will be focused on integrating the RARV with a solid rocket motor as well as guidance system design. The RARV will fly in June 2010 in Utah.

Design, Development and Evaluation of a Virtual Laparoscopic Suturing Simulator

Susannah Harding, Bioengineering
Graduation: May 2011 Hometown: Mesa, AZ
Dr. Kanav Kahol, Biomedical Informatics

Laparoscopic suturing is a basic, yet extremely difficult skill for surgical residents to learn. Simulation provides an excellent environment for training surgeons to practice and hone this technique. This research project designed a virtual laparoscopic suturing simulator for the training and evaluation of surgeons. It used dynamic, 3D models of human organs for the residents to suture through using a controller. A Sensable Haptic Joystick® provided a touch-based interaction with the virtual models, while a potentiometer implemented into the joystick measured rotations making the controller similar to an actual laparoscope. This design allowed for a complete and realistic suturing simulation. Upon completion of the simulator, it will be tested extensively by multiple first-year general surgery residents to estimate the validity of the developed simulator.

MRI Quantification of Singular Glomerular Function

Megan Henriksen, Bioengineering
Graduation: May 2011 Hometown: Russell, Minnesota
Mentor: Dr. David H. Frakes, Bioengineering

The goal of this work was to quantify glomerular function through the use of contrast agents and image processing techniques. Specifically, parameter mapping was performed to correlate the results from processing image data with histological glomerular analysis. The image processing results are determined using custom software written in Matlab to segment and analyze ex vivo MR image data. Results indicate that single glomerular function can be imaged effectively. Future work will focus on segmentation and analysis of MR images acquired in vivo, and at lower, more clinically relevant resolutions.

Establishing Slip Signatures from Vibration Frequencies of Different Object Textures

Albert Hsia, Bioengineering
Graduation: May 2011 Hometown: Avondale, Arizona
Mentor: Dr. Veronica J. Santos, Mechanical and Aerospace Engineering

The general objective is to understand what is felt by a human finger when it senses a slipping object. To simulate slippage, weighted textures were dragged across a surface to induce vibrations which were picked up by an attached accelerometer. Spectral analyses on the vibrations were performed to observe changes in vibration frequencies during this simulation. Preliminary studies demonstrated that vibration frequencies are noticeable even when textures were dragged across smooth surfaces. Future work consists of incorporating vibration sensing mechanisms onto a robotic hand or prosthesis that will detect whether or not the gripped object is slipping.

Cardiac Health Monitoring

Ashley Jaeger, Bioengineering
Graduation: May 2011 Hometown: Tucson, Arizona
Mentor: Dr. Metin Akay, School of Biological & Health Systems Engineering

Heart failure is one of the leading causes of death in Western countries, with over 500,000 Americans diagnosed with cardiovascular disease each year. In previous studies, we proposed the use of an electronic stethoscope for the analysis of diastolic heart sounds. Our long term goal is to use the stethoscope to monitor cardiac conditions, primarily focusing on the first and second heart sounds, for the early detection of chronic heart valve disease and to monitor cardiac health after surgical procedures. Our current objective is to show the feasibility to detect and analyze first and second heart sounds from a few healthy subjects using the fast Fourier transform analysis of these isolated sounds.

Development of a Smoothed Particle Hydrodynamics code towards the 2-D, Perpendicular Mixing of Two Channel Flows of Different Density Fluids

Calvin Jin, Aerospace Engineering
Graduation: May 2010 Hometown: Glendale, Arizona
Mentor: Dr. Marion Vance, Mechanical and Aerospace Engineering

With the emergence of relatively new interests in microfluidics, the field of computational fluid dynamics helps to simulate flows of such small volumes that may not otherwise be seen. This holds especially in a common case of perpendicular mixing of two channel flows of different density fluids. Current research focuses on developing a Lagrangian method of the Smoothed Particle Hydrodynamics (SPH) type, which is quite effective for fluid flow simulation. The method is being applied to a test case of a two-dimensional, shear-driven cavity where experimental solutions may be compared to widely known solutions. Future research will continue towards the application of the proven SPH method in terms of simulating the 2-D, perpendicular mixing of two channel flows of different density fluids.

Identification and Quantification of Bacteria Living in Synechocystis Sp. PCC 6803-Based Photobioreactors Using the Bacterial 16S rRNA Gene

Galen Toby Johnson-Bates, Chemical Engineering
Graduation: May 2012 Hometown: Scottsdale, Arizona
Mentor: Dr. Rosa Krajmalnik-Brown, Civil and Environmental Engineering

The research objective was to identify and quantify bacteria living in Synechocystis sp. PCC 6803-based photobioreactors using the bacterial 16S rRNA gene. Culture samples containing the cyanobacterium Synechocystis sp. PCC 6803, among other prokaryotes and eukaryotes were taken from several photobioreactors. Extracted community DNA underwent PCR amplification, and T-RFLP analysis to understand shifts in microbial ecology over time. We have concluded that the photobioreactor cultures consist mostly of Synechocystis while in a "healthy" state, and then diversify significantly when the culture "crashes". Future research should include additional analysis of community DNA and further sequencing and cataloging of the 16S ribosomal rRNA gene sequences.

Metallic Conductivity and the Role of Copper in ZnO/Cu/ZnO Thin Films for Flexible Electronics

Maneet Kamboj, Material Science and Engineering
Graduation: May 2010 Hometown: Peoria, Arizona
Mentor: Dr. Terry Alford, Electrical and Materials Science Engineering

The objective of the project is to investigate (1) the role of copper in the transmission properties of ZnO/Cu/ZnO multilayer, and (2) the conduction mechanism of ZnO/Cu/ZnO as a function of copper thickness. A number of ZnO/Cu/ZnO samples with varying thickness of Cu layer have been annealed at different conditions using microwaves. Once all the samples are annealed, they will be characterized using X-Ray Diffractometry, and resistivity measurements will be made using 4-Point Probe and Hall measurements. These results will then be compared to external data available in order to determine the thickness of Cu that yields optimum electrical properties.

Hyperthermic Ablation of Cancer Cells using Gold Nanorods

David Kay, Bioengineering
Graduation: May 2010 Hometown: Tucson, Arizona
Mentor: Dr. Kaushal Rege, Chemical Engineering

Previous work in this project has involved applying laser to thermally ablate cancer cells treated with polymer-coated gold nanorods (GNRs). The objective of this semester's work has been to continue using circular dichroism to demonstrate the denaturing of proteins responsible for this cell death following induced hyperthermia. This has been done by gathering the initial ellipticity curves of proteins, and comparing these curves to proteins that have been heated using GNRs and laser application. Thus far bovine serum albumin and lysozyme have been investigated, and future work will involve other proteins for analysis.

Electrochemical Detection of E. coli in an Integrated Biosensor

Kenneth Lan, Bioengineering and Biology
Graduation: May 2011 Hometown: Tempe, Arizona
Mentor: Dr. Jeffrey La Belle, Bioengineering

The objective of this study is to develop an electrochemical sensor component to detect the bacterium Escherichia coli. Prototype sensor components were constructed by electroplating gold onto copper electrodes and then immobilizing antibodies specific to E. coli onto the gold surface. The electrodes were then exposed to E. coli samples of varying concentrations and characterized by electrochemical impedance spectroscopy. Future work will involve integrating the sensor electrode into a multi-component microbial sensor, demonstrating detection in impure samples of bacteria such as those obtained from blood or urine.

Ordered Porous Carbon Monoliths for Electrochemical Applications

Andrew B. Larson, Chemical Engineering
Graduation: May 2011 Hometown: Glendale, Arizona
Mentor: Dr. Bryan Vogt, Chemical Engineering

The objective of this research is to understand how to control changes in the morphology of colloid or surfactant template ordered carbon monoliths, and determine if this templating yields advantageous electrochemical properties. To date, a successful method to produce ordered monoliths from a low molecular weight phenol-formaldehyde resin has been devised. However the monoliths are of non-uniform density due to the presence of voids, which pose problems in determining porosity. Future work will center on isolating and eliminating these defects so as to enable successful characterization and testing of their electrochemical properties.

Electrochemical Impedance Spectroscopy: a Powerful Tool for Rapid Disease Diagnosis (Targeted protein alpha-synuclein)

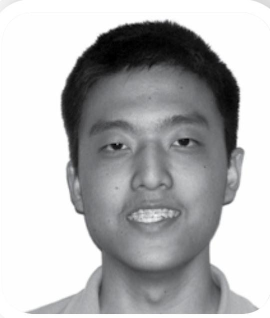
Angel Lastra, Bioengineering
Graduation: May 2012 Hometown: Sonora, Mexico
Mentor: Dr. Shalini Prasad, Electrical Engineering

The goal of this research is to design a point-of-care diagnostics device to detect trace amounts of neuro-degenerative disease protein markers from human serum. This would enable diagnosis of the disease much earlier than the symptoms start expressing in the patient. A nanoporous membrane based electrical biosensor is being developed to enhance the detection sensitivity. Detection of the antigen is achieved by designing an electrical immunoassay which produces specific and measurable impedance changes over a range of concentrations of the antigen. The focus of the research is to demonstrate robust and repeatable detection of the antigen at clinically relevant concentrations.

Force of Grasp in Non-Human Primates

James LeBeau, Bioengineering Engineering
Graduation: May 2011 Hometown: Tempe, Arizona
Mentor: Dr. Stephen Helms Tillery, Bioengineering

The objective of this research is to develop a force-sensing device to test the grasp of non-human primates. SolidWorks modeling has begun on a device which can be calibrated to record the force of a grasp. In order for ease, consistency, and accuracy of calibration, the device must present an object of definable volume and a grasp region of consistent surface area. With these constraints, multiple models are being designed to discover more efficient and accurate ways to measure force using this sensor. This project is part of an overall effort in neural prosthesis design.



A Novel Active Matrix Pixel Sensor using Thin-Film Transistors for Neutron Radiation Detection for Countering Radiological WMDs

Edward Lee, Electrical Engineering
Graduation: May 2012 Hometown: Chandler, Arizona
Mentor: Dr. David Allee, Electrical Engineering

This project intends to design, simulate, and fabricate a working imaging sensor circuit using a-Si:H TFTs that is used to amplify an extremely low-current signal in a high-noise background generated by the creation of electron-hole pairs in a diode that is bombarded with high-energy neutron(s). To minimize Nyquist-thermal, flicker, amplifier, reset noise in the circuit based on 16 parameters, a noise simulator was programmed in MATLAB. A set of optimized parameters determined will later be used this semester to design the layout of the circuit. Most probably two sets of designs will be used to fabricate working models and tested.

Transgene Expression of Small Molecules in Prostate Cancer Cells

Jennifer Lehrman, Bioengineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Kaushal Rege, Chemical Engineering

The success of non-viral gene delivery systems has been challenging in clinical applications because of their poor gene transfer efficiency. The proposed research will explore the identification of a library of small molecules in order to enhance polymer-mediated gene delivery in prostate cancer cells. Previous experiments have shown up to 3000-fold higher transgene expression in prostate cancer cells than a commercially available polymer, using a synthesized polymer in combination with histone deacetylase inhibitor molecules. A library of other molecular agents will be tested in a high throughput manner to enhance transgene expression.

Modeling Drug Delivery for the Treatment of Glioblastoma Multiforme

Tyler Libey, Bioengineering
Graduation: May 2011 Hometown: Chandler, Arizona
Mentor: Dr. Michael Caplan, Bioengineering

Glioblastoma multiforme (GBM) is a type of aggressive brain tumor that rapidly invades tissue surrounding the primary tumor site. Current methods deliver drugs in too low of a concentration throughout the brain tissue or in too localized of an area for proper treatment. As such, drug delivery could be improved through convection enhanced delivery (CED), which relies on pressure gradients created by catheters in the brain. COMSOL Multiphysics© was used to predict the delivery of the drug to the brain while varying catheter placement. Tumor cells and corresponding drug interactions were initially modeled in two dimensions. Similar variables are currently being applied to the three dimensional model.

Concentrated Solar Power Thermal Energy Storage Technologies

Brian Lines, Chemical Engineering
Graduation: May 2010 Hometown: Tucson, Arizona
Mentor: Dr. Kenneth Sullivan, Construction

Thermal energy storage (TES) technologies aim to store the thermal energy generated by concentrated solar power (CSP) plants. Storage of thermal energy enables solar plants to discharge energy at times of low solar radiation, or provide additional energy reserves during peak load hours. The proposed research explores the development of new TES technologies that are able to store thermal energy in a cheap and environmentally benign manner. This research focuses on the major design options and technical issues presented by two TES technology concepts: the single tank thermocline, and a new sand-shifter heat exchanger.

Server/Client based Multi-threading Robot Interface

Yen-Ting "Patrick" Lu, Computer Systems Engineering
Graduation: Spring 2011 Hometown: Kaohsiung, Taiwan
Mentor: Dr. Winslow Burleson, Computer Science and Engineering

The research intends to build a multi-threading robot server with high efficiency and flexible interface for future implementation. A core set of threads has been created to communicate with other research projects. The system is able to receive commands and perform action on the robot as well as send out robots' sensor status to various applications. With this multi-threading approach, it is easy to add features to the system without breaking it. Everything is a module that can be easily "plugged" and "unplugged". The future work will include stabilizing thread objects and adding new modules to the system.

Collaborative Knowledge Extraction Platform

Barry Lumpkin, Computer Science
Graduation: Spring 2010 Hometown: Mesa, Arizona
Mentor: Dr. Chitta Baral, Computer Science and Engineering

The previously developed Collaborative Bio Curation (CBioC) project was designed to facilitate research on bioentities and their relationships found in medical articles. Systems have been created to extract and store these relationships from the PubMed database, an online repository of biomedical articles. Due to its preliminary state, an initial online version of the web interface for CBioC is not widely advertised. While work is being done to bring this system to a version ready for public release, the current focus is generalizing the system to allow for use across varied domains of research both within and beyond medical research.

Design of Apparatus for Human Hand Reflex Study

Ryan Manis, Mechanical Engineering
Graduation: May 2010 Hometown: Elk Grove, Illinois
Mentor: Dr. Veronica Santos, Mechanical and Aerospace Engineering

The research is being done to find human hand reflex data to be implemented into a prosthetic in the future. Human subject experiments have been completed, but new experimental setup is required. The new setup will allow for fully randomized hand reflex testing, giving better data for future prosthetic use. This improves upon the current design, in which the subject knows the direction of perturbation. The motor system required has been chosen, so the next step is to create an interface to control the motor, and have it perturb the test object in any of five different directions.

Cutting Edge Blood Separations for Use in Microfluidic Devices

Kenyon McAferty, Bioengineering
Graduation: May 2011 Hometown: Mesa, Arizona
Mentor: Dr. Jeffrey La Belle, Bioengineering

The object of this semester's project was to evaluate blood separation strategies for use in handheld diagnostics. Magnetic separation and filtration design concepts have been built and tested. The device materials have been tested and adjusted for appropriate strength and flexibility. The elastic modulus of the device material was found to be 0.24 MPa, within an order of magnitude of silicone rubber's modulus. The filter prototype successfully pumped 1 mL of blood through the channel, and the filters demonstrated partial filtration.
Future work will focus on filter optimization and integrating the device with optical, chemical, and/or electrochemical assays.

Removal of Organic Contaminants from Water using Aerogels in an Inversely Fluidized Bed

Elisabeth McLaughlin, Chemical Engineering
Graduation: Spring 2012 Hometown: Arvada, Colorado
Mentor: Dr. Robert Pfeffer, Chemical Engineering

The research goal is to find a more efficient way of removing organic contaminants from water. Research has consisted of running experiments to find the adsorption capacities of hydrophobic silica aerogels for several different contaminants and correlating results using the Freundlich isotherm. Results indicate that aerogels are much better adsorbents than granulated activated carbon, which is currently used to remove chemical contaminants from water. The next step is to test the adsorption of the contaminants by the aerogels in a continuously running inverse fluidized bed rather than in small batch solutions to see if the adsorption capacity is further improved.

A Data Collection Framework for Facilitating Research to Communicate Facial Emotions to Individuals Who Are Blind

Kevin McMillin, Computer Science
Expected Graduation: May 2011 Hometown: Ottumwa, Iowa
Mentor: Mr. Sreekar Krishna, Electrical Engineering

Individuals who are blind often have difficulty perceiving facial emotions during social interaction, thus losing a crucial aspect of nonverbal communication. This project involves merging two technologies—eye tracking and facial fiducial tracking—into a single system capable of real-time use of both. Tests are conducted by showing sighted individuals a series of images proven by psychology researchers to induce distinct facial emotions; the data recorded are logged along with video of the test subject. Future work will include pattern identification of this data to allow real-time conveyance of facial emotion to individuals who are blind.

Using Fabrics for Engine Containment Systems

Jacob Mickle, Civil Engineering
Graduation: May 2012 Hometown: Cottonwood, Arizona
Mentor: Dr. S. D. Rajan, Civil Engineering

The goal of this FAA-sponsored research is to experimentally obtain mechanical properties of Kevlar. Research conducted so far consists of two sets of experiments - Simple Tension Tests and Adhesive Tests that are used to obtain the stress-strain relationship and the shear strength of adhesives. The research also deals with the use of the experimental data in modeling ballistic testing conducted at NASA-GRC and shows the efficacy and accuracy of the model. Preliminary results show a close match between the model and the experiments. The ultimate goal is to improve the computer modeling of an aircraft engine's containment system.

Growth of Piezoelectric Nanowires for Enhanced Active Nanocomposites

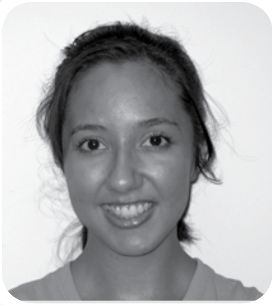
Colin Mothershead, Aerospace Engineering (Astronautics)
Graduation: May 2012 Hometown: Mesa, Arizona
Mentor: Dr. Henry Sodano, Mechanical and Aerospace Engineering

The objective of this research is to harvest clean energy from mechanical vibrations through the use of piezoelectric materials. Research has been focused on the generation of piezoelectric nanowires and nanocomposites. This has concluded that the cheapest and simplest piezoelectric nanowires consist of lead zirconate titanate (PZT) and are grown through a process called hydrothermal synthesis. Research has also been done on creating nanocomposite materials with embedded PZT nanowires. Future work in this area will include testing the efficiency of electrical energy production from the piezoelectric nanocomposites.

Evaluating Performance in Object Discrimination Tasks for Neuroprosthetic Hand Research

Stephanie Naufel, Bioengineering
Graduation: May 2010 Hometown: Tempe, Arizona
Mentors: Dr. Steve I. Helms Tillery, Bioengineering and Dr. Veronica J. Santos, Mechanical and Aerospace Engineering

Developing a viable neuroprosthetic hand requires a focus on sensation in addition to motor control. This research aims at understanding sensation by evaluating performance in object discrimination tasks. The first step in reaching this goal is to present objects of different textures to a subject, and record the forces applied to the textured grip plates. Sensors on the object are calibrated to translate the voltage output to applied force, and data is recorded from grasps executed by the subject. Future work will use data to replay the same force profiles on objects of similar textures using tactile sensors on a robotic hand.



Hydrodynamic Characteristics of Aerogels and Nanopowders in a Fluidized Bed

Stephanie Ochoa, Industrial Engineering
Graduation: May 2011 Hometown: Portland, Texas
Mentor: Dr. Robert Pfeffer and Ms. Teresa Rosa, Chemical Engineering

Hydrophobic silica aerogels modified with amines will be used as a sorbent to remove CO2 from flue gas in a fluidized bed. Aerogels have a low density, very high surface area and porosity, and are easily fluidized. The hydrodynamic characteristics of silica and titania nanopowders and unmodified nanostructured aerogels (65-150 microns) were measured, including pressure drop, minimum fluidization velocity, bed expansion, and the effect of adding a micro-jet flow. Alcohol absorption on the aerogels was also studied. Future work will include measuring the hydrodynamic characteristics of amine enriched aerogels and the adsorption of other organic materials by the aerogels.

The Efficacy of Bleomycin Analogs as Sensitizing Agents for TRAIL-Induced Apoptosis in Prostate Cancer Cells

Christine Parsons, Chemical Engineering
Graduation: May 2010 Hometown: Vancouver, Washington
Mentor: Dr. Kaushal Rege, Chemical Engineering

The proposed research explores the apoptotic efficacy of a set of Bleomycin (BLM) analogs as sensitizers of tumor necrosis factor–related apoptosis-inducing ligand (TRAIL) as combination treatments in prostate cancer cells. Research indicates that BLMA2 worked synergistically with TRAIL to induce greater apoptosis as a combination treatment compared to the sum of the individual treatments in the PC3-PSMA cell line. Research aims to explore if this synergistic effect is mirrored in other prostate cancer cell lines. Future research involves determining the mechanisms of sensitization, including clustering of TRAIL (death) receptors, mitochondrial depolarization, overexpression of TRAIL receptors, and activation of caspases.

Self-Assembly of Two-Dimensional Multi-Component Colloidal Lattices at the Water-Air Interface

Brian Perea, Chemical Engineering
Graduation: May 2012 Hometown: Denver, Colorado
Mentor: Dr. Lenore Dai, Chemical Engineering

The objective of this research is to self-assemble multi-component colloidal lattices and provide a fundamental understanding of their formation and properties. The surface pressure-area isotherms of one-component sulphate, carboxylate, and aldehyde sulfate-treated polystyrene systems, and a two-component aldehyde sulphate/sulphate system were measured using a Langmuir-Blodgett trough with motorized barriers. The measured isotherms of two-component aldehyde sulphate/sulphate systems suggest potential lattice hybridization. Future work will attempt to characterize particle monolayer structures from the air-water interface using a confocal laser scanning microscope.

Using Rigid Body Transformations to Identify Interest Points in Stereotactic Frame Space from Interest Point Coordinates in Image Space

Jonathan Plasencia, Bioengineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. David H. Frakes, Bioengineering and Electrical Engineering

The objective was to create a tool that is capable of getting interest point coordinates from medical images and to use this information to drive stereotactic positioning. MATLAB code has been written, incorporating a graphical user interface, to achieve the required task of going from image to frame space coordinates with the use of a rigid body transformation. Immediate future work will involve validating the effectiveness of this tool in locating interest points in frame space. Once proven to be accurate, this tool can be used for future experiments that involve taking in vivo tissue biopsies.

Exploring New Acceptor Materials for Organic Solar Cells

Miguel Reyes, Industrial Engineering
Graduation: May 2009 Hometown: Scottsdale, Arizona
Mentor: Dr. Hanqing Jiang, Mechanical and Aerospace Engineering

Organic photovoltaics have showed a lot of promise in low-cost applications but are not yet commercially feasible due to instability and low efficiency. The goal of this research is to investigate different organic materials by characterizing their electrical and optical properties. Thin neat film devices were fabricated using thermal evaporation in high vacuum and then tested under 1.5 AMG solar illumination. The data gathered analyzed according to certain device metrics such as open circuit voltage, current density, and fill factor. Future work will include implementing a different device structure.

Using Signal Analysis Techniques to Assess the Effect of Therapy for Neurological Diseases

José L. Rios, Bioengineering
Graduation: May 2010 Hometown: Mazatlán, Sinaloa, México
Mentor: Dr. David Frakes, Bioengineering and Electrical Engineering

It was hypothesized that signal analysis techniques could be used to quantify the effects of therapy on neurological diseases. fMRI data were provided by the Barrow Neurological Institute. MATLAB code for an algorithm called Approximate Entropy (ApEn) was programmed. ApEn is an algorithm that quantifies the randomness of a signal. Known test signals were analyzed with ApEn with and without random noise. It was shown that as the amount of random noise increased so did the values of ApEn, up to a certain point. These results showed that ApEn has potential to quantify the effects of therapy.

Developing an Apparatus for Testing Grip Control Algorithms of Artificial Hands

Chad W. Ripley, Mechanical Engineering
Graduation: May 2011 Hometown: Arlington, Texas
Mentor: Dr. Veronica Santos, Mechanical and Aerospace Engineering

In the field of prosthetics, engineers have yet to replicate the sensory-reflex patterns of human hands, which allow for elegant subconscious grip control. Using hand experiments' data, researchers are developing algorithms, in conjunction with novel tactile sensor arrays in artificial hands, to improve grip control. To validate and evolve these algorithms, an apparatus for testing an artificial hand against slip perturbations is being developed. Tests have been performed to select motor and control equipment to create the appropriate slip perturbations. An end goal is to create a software-controlled system for quickly conducting repeatable trials and collecting data.

Canopy Trek

Shane Sandler, Mechanical Engineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Winslow Burleson, Computer Science and Engineering

Canopy Trek intends to help raise awareness of forest canopy climate with an automated sensing robot. This semester the Canopy-Bot has had its descent mechanism completely redesigned. Additionally, testing and building the new descender has begun. In the spring semester of 2010, the robot will be completed so that it can be tested and deployed in a field setting. The work involves the integration of a complex multifaceted electromechanical system and coordination with a transdisciplinary team of engineers and scientists to advance the instrument and verify its scientific value.

Medical Bioremediation of Lipofuscin in Human Retinal Pigment Epithelial Cells
Jonathan Sankman, Bioengineering
Graduation: 2012 Hometown: Phoenix, Arizona
Mentor: Dr. Bruce Rittmann, Environmental Engineering and Mr. John Schloendorn, Civil Engineering

Eliminating lipofuscin residue found in mammalian cells may have great therapeutic benefit as it is generally believed to be associated with a number of age related maladies ranging from macular degeneration to Alzheimer's disease. A suspected lipofucin degrading enzyme referred to as Crocus Sativus Zeaxanthin Cleavage Dioxygenase (CsZCD) has been produced in E. coli and purified using nickel-nitrilotriacetic (Ni-NTA) spin columns and PD-10 desalting columns. The activity of CsZCD is under investigation using ultra-performance liquid chromatography (UPLC). Future work will use immunofluorescence to investigate the ability to deliver the enzyme to mammalian cells utilizing glycosylation-independent lysosomal targeting (GILT).

Synthesis and Characterization of Inorganic Nanowires

Nisith Shah, Electrical Engineering
Graduation:December 2009 Hometown: Gilbert, AZ
Mentor: Dr. Hongbin Yu, Electrical Engineering

Engineers and physicists have been studying magnetic materials for years due to their various applications. Magnetic materials are required to create a higher density recording media in this age of computing power growth. The discovery of giant magnetoresistance (GMR) sparked the development of new technologies for magnetic recording, in which a non-magnetic layer is sandwiched between magnetic layers. In this project copper was synthesized in the alumina membrane to grow zinc oxide nanowire. In addition, Co-Cu multilayer magnetic nanowires with diameters of 250nm, 35nm, and 18nm have been electrochemically synthesized in alumina membrane. Magnetic characterization has been done using Vibrating Sample Magnetometry (VSM).

Laboratory-Scale Hybrid Rocket Test Stand & Characterization of Swirl Injectors

Matt H. Summers, Aerospace Engineering (Astronautics)
Graduation: May 2011 Hometown: Mattawan, Michigan
Mentor: Mr. James Kendall Villarreal, Aerospace Engineering

Extensive small-scale investigation of swirl injectors in a hybrid rocket engine will further enable the characterization of a variation of injector designs and their effects on the engine performance. Design, development and testing of the small-scale hybrid rocket engine is complete, along with the design and development of the injectors. CFD analysis was performed on the injectors prior to the final selection process to ensure a selection of experimental injectors that will provide the largest increase in engine performance. Following cold-flow and calibration experiments, hot-fire testing will verify our findings, and an up-scaled hybrid engine flight test for dynamic testing.

H.264 Video Traffic Characterization and Transport Mechanisms

Jonathan Francis Vahabzadeh, Electrical Engineering
Graduation: May 2011 Hometown: Scottsdale, Arizona
Mentor: Dr. Martin Reisslein, Electrical Engineering

The main goal of the proposed research is to thoroughly characterize the video traffic variability and network capacity of both the H.264/AVC and H.264 SVC codecs. The network capacity is characterized by analyzing the number of video streams of a prescribed video quality that can simultaneously be transmitted through a given network transmission rate (channel capacity). Statistical multiplexing strategies are analyzed and developed to increase this network capacity for both the H.264/AVC and SVC codecs. In the future, it will be beneficial to investigate active buffer management in stride to perfecting buffered multiplexing.

Development of a Pathogen Detection Device Utilizing Optical Microscopy

Aman Verma, Bioengineering
Graduation: May 2010 Hometown: Scottsdale, Arizona
Mentor: Dr. Jeffrey La Belle, Bioengineering

This research investigates how different sputtering patterns on microscope slides relate to theoretical surface area coverage and capture of E. coli O-111:B4 using a monoclonal antibody. Different sputtering geometries were prepared using mask on microscope slides, and the antibody was immobilized. Various concentrations of E. coli were added to the slides and were gram stained and imaged. Cell counting was then performed and compared to theoretical surface area calculations. It was found that at various concentrations; approximately 10% of the cells were captured. This work will be incorporated next semester in the development of a pathogen detection device.

Development and Fabrication of a Fluidics Device for Point-of-Care Infection Diagnosis

John Wake, Bioengineering
Graduation: May 2010 Hometown: Phoenix, Arizona
Mentor: Dr. Jeffrey T. LaBelle, Bioengineering

This project aims to design a fluidics device which receives a patient sample of blood, and filters and delivers the blood to specialized point at which bacteria in the blood may be detected, as well as design the fabrication method for such device. Initial designs were developed using CAD software, and different materials were researched. Prototypes have been produced which were molded using SEBS, a flexible thermoplastic, and have proved successful in transferring the required volume of liquid across the device. Future work will include testing the device with blood, and refining the specifications of the device accordingly.

Improving Hindsight Optimization with Adaptive Sampling and Confidence Measures

Alex Wallace, Computer Science
Graduation: May 2010 Hometown: Cave Creek, Arizona
Mentor Name: Dr. Subbarao Kambhampati, Computer Science and Engineering

The sampling method used in FF-Hindsight, a stochastic planner using determinizations and hindsight, is uniform and insufficient for effective sampling. This research builds a series of adaptive sampling methods around FF-Hindsight to improve the quantity and quality of samples taken in the stochastic problem space. Adding statistics taken on plans returned from the integrated deterministic planner together with a model of the probabilistic space, should allow the planner to intelligently choose which actions to sample next. This will, in turn, lower the number of samples needed, improve the quality of plans returned and reduce the time needed to generate these plans.

Advanced Simulation of Large Scale Computational Fluid Dynamics Datasets

Susanna Young, Mechanical Engineering
Graduation: May 2011 Hometown: Phoenix, Arizona
Mentor: Dr. Kyle Squires and Mr. Clinton Smith, Mechanical and Aerospace Engineering

The project goal is to apply high-fidelity visualization techniques to the dataset obtained from direct numerical simulation of the flow over a golf ball. In the research thus far, two processes for running Fieldview Parallel on the Saguaro supercomputer in the Goldwater Center have been established. Successful visualizations of the instantaneous flow and animations of the temporally-evolving solution have been generated. Achievement of these milestones has improved understanding of the flow and also provided an efficient approach to visualization of enormous datasets. Suggested further work includes refining the procedure for submitting batch processes to generate animations that synthesize hundreds of files.

Electrodeposited Silicon Films for Low Cost Solar Cells

Yan Zhang, Electrical Engineering
Graduation: December 2011 Hometown: Jiangsu, China
Mentor: Dr. Ronald J. Roedel, Electrical Engineering

The objective of the research is to grow high quality silicon film on various substrates for low cost solar cells. Variation of parameters in electrochemical deposition has been studied and several attempts of silicon deposition have been made. Silicon deposition requires a relatively high electrode potential (negative than -2.5V in organic solvents). Extra action has been taken to isolate oxygen and water from the electrolysis process because of the high reactivity of Silicon. Ionic liquid will be used for future deposition and characterization techniques will be also applied.

Using Optical Sensor Nanoparticles as an Intracellular Ion Concentration Metric

Andrew J. Payne, Chemical Engineering
Graduation: May 2010 Hometown: Mesa, Arizona
Mentor: Dr. Shalini Prasad, Electrical Engineering

In this work, a series of sodium, potassium, and calcium selective optical sensor nanoparticles, or optodes, were investigated for their potential use as an intracellular ion metric. Healthy Chinese Hamster Ovary (CHO) cells were exposed to varying concentrations of optodes, and the viability of the resulting cell population was measured. It was shown that the optodes are not significantly toxic to the CHO cells within the operating concentrations of the optodes. Future work will be conducted to examine the cellular uptake patterns and intracellular behavior of the optodes at different intracellular ionic concentrations.

FURI Robotics 2009 "Fists of FURI"

Kelsey Booth, Chris Guise, Electrical Engineering
Graduation: May 2013 Hometown: Phoenix and Scottsdale, Arizona
Mentor: Dr. Yinong Chen, Computer Science and Engineering

Robots are utilized in a great variety of applications within modern technology. A modifiable robot, developed under the LEGO Mindstorms platform, was designed to conquer three separate challenges. The first problem to be attacked was a wooden maze. Through the use of a touch sensor, a hard-coding nightmare was simplified by advantageously using the flat, 90-degree test environment. The second challenge was a "sumo"-style robot battle within a circular ring. Light-detection software and a large size were the main design points. The final challenge was remote-control ball collection contest, which used available materials and a multi-axial control program.

Construction and Programming of Lego NXT Robots

Katherine Cai, Electrical Engineering; Pankti Shah, Bioengineering
Graduation: May 2013 Hometown: Chandler, Arizona
Mentor: Dr. Yinong Chen, Computer Science and Engineering

This project involved programming with NXT-G graphical programming language and with Robotics Studio Visual Programming Language (VPL). The mission of the project was to complete a number of robotics challenges, which included navigating a maze using artificial intelligence, competing in a ball collecting game, and battling other robots. It was necessary to assemble a Lego NXT Robots and find the optimal design for each challenge. After assembling the Lego NXT Robot and finding the optimal design, different sensors such as ultrasonic, touch, and light sensors were installed to aid in each task. These activities introduced knowledge in both the programming and construction of robots.

Robotics: Design and Programming

Amelia Celoza, Mechanical Engineering; Darcy Frear, Bioengineering
Graduation: May 2013 Hometown: Phoenix, Arizona
Mentor: Dr. Yinong Chen, Computer Science and Engineering

The object of this research was to design and program a robot to complete various tasks. NXT-G programming language was utilized to program the robot to traverse a maze and battle another autonomously. A Visual Programming Language (VPL) program was used to control the robot to retrieve balls and return them. Through trial and error, a touch sensor was the best tool in the maze and the sumo fight. Complicated programs did not yield the best results. The next step is a more in-depth study of the different programming languages and other robotics designs.


Lego NXT Robot

Katlin Forster, Aerospace Engineering; Mark Huerta, Bioengineering
Graduation: May 2013 Hometown: Scottsdale, Arizona
Mentor: Dr. Yinong Chen, Computer Science and Engineering

The objective was to create a Lego NXT Robot that would engage in various competitions. The robot was meticulously constructed and programmed to go through a maze, fight other robots, and collect objects. Through the NXT program, the robot could perform in an autonomous mode with multiple sensors. The completed robot was able to successfully finish all parts of the competition receiving first prize. Although this was the extent of the project, valued skills such as team work and programming were also learned.


Constructing and Programming Lego Mindstorms Robots to Overcome Obstacles

Shawn Haupt, Bioengineering; Beth Magerman, Mechanical Engineering
Graduation: May 2012 Hometown: Goodyear and Phoenix, Arizona
Mentor: Dr. Yinong Chen, Computer Science and Engineering

The objective was to design, construct, program, and adapt robots to overcome various obstacles. Ultrasonic sensors, light sensors and measured rotations were possible techniques utilized to successfully complete a maze. In a ball collecting competition, an original scoop claw design was made and a keyboard remote control program was used. In a challenge to overpower another robot, a light sensor and random movement design were used. In the maze, what works in theory needs to be tested through application. For ball collecting, moving balls easily is more important than capturing them. Finally, simple programs work about half the time.


Investigations into Service Oriented Architecture and Robotics

Spencer Prost, Computer Science; Neil Saez, Bioengineering
Graduation: 2013 Hometown: Scottsdale, Arizona; Irvine, California
Mentor: Dr. Yinong Chen, Computer Science and Engineering

The Lego Mindstorm NXT robot needed to be programmed and designed to gather balls, traverse a maze, and battle another robot in a Sumo Bowl. Service-oriented architecture was utilized in the creation of an application to remotely control the robot for the ball-catching competition. The maze competition relied on hard coding, and the Sumo Bowl relied on heuristic programming. Application showed that heuristic systems and design adaptability are critical to success. Future research in this area could focus on the practical limit of the NXT brick in executing lengthy heuristic programs.

FURI Honors Summer Institute

Lego MindStorm

Kathryn Bratrud, Materials Science Engineering
Graduation: May 2013 Hometown: Mesa, AZ
Mentor: Dr. Yinong Chen, Computer Science and Engineering

The goal of this project was to experience teamwork with Lego MindStorm robotics. The results showed an increase in knowledge about computer programming as well as problem solving.

CSE Research Scholarship

Grounding Methods in ASP

Michael Bartholomew, Computer Science
Graduation: Spring 2010 Hometown: Tachikawa, Japan
Mentor: Dr. Joohyung Lee, Computer Science

In the area of knowledge representation, it is widely accepted that function constants are a vital element to expressivity but currently, the limitations in existing implementations are too stringent or not theoretically justified. This research attempts to rectify both problems. Theoretical work has placed certain limitations on programs with function constants to guarantee finite grounding the substitution of variables for valid constant, or ground terms, for property that is generally undecidable. The goal of this research is to extend the existing implementations to allow general formulas while also allowing function constants under more relaxed restrictions.

Travel Grant Program

The Design of a Cost-Efficient Prosthetic Gripper

Kimia Seyedmadani, Bioengineering
Graduation: May 2010 Hometown: Tehran, Iran
Mentor: Dr. Stephen Helms Tillery, Bioengieering

The objective of this research was to design and construct an inexpensive prosthesis that would allow hand injury patients to grasp lightweight and small-diameter objects. Material selection, and mechanical reliability, and electrical were carefully considered during the design process in order to limit cost. Our initial design, implemented in 3-D CAD software (SolidWorks®), allows for one degree of freedom. The gripper portion of the prosthesis consisted of metal, polymer, and hydro gel, fabric, and strap material. The future goal for this research is to be able control the device automatically, and have forced feedback from the object under the task of grasping.

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