19th Annual Gemstone Honors Program Thesis Conference

Friday, April 20, 2018
University of Maryland, College Park
Samuel Riggs IV Alumni Center

Gemstone Staff

Dr. Frank J. Coale, Director
Dr. Kristan C. Skendall, Associate Director
Dr. Vickie E. Hill, Assistant Director for Operations
Leah K. Tobin, Assistant Director for Student Engagement
Jessica Lee, Coordinator for Student Engagement

Please join us…

You are cordially invited to attend

**The 19th Annual
Gemstone Citation Ceremony**
Thursday, May 17, 2018
7:00 PM

*University of Maryland Memorial Chapel
College Park, Maryland*

Thesis Conference Schedule

Time	Team	Room
1:30-2:15 PM	ARM IT	Ballroom A
	DRIVE	Doetsch (B)
	GOLD	Heise (C)
2:45-3:30 PM	BIASES	Ballroom A
	VIRUS	Doetsch (B)
	PHAGE	Heise (C)
4:00-4:45 PM	MATRIX	Ballroom A
	BREATHE	Doetsch (B)
	BioCHIPS	Heise (C)
5:15-6:00 PM	BACTERIA	Ballroom A
	PRINT	Doetsch (B)
	BLOOD	Heise (C)

Throughout the day, please view the work of our first-year students and junior teams, displayed in the Rotunda and in the hallway outside of the presentation rooms.

ARM IT: Stereoscopic Vision in Unmanned Aerial Vehicle Search and Rescue

Research Team
   Ryan P. Collins, Aerospace Engineering
   Joshua C. Gaus, Mechanical Engineering
   Kathryn L. Jahn, Mechanical Engineering
   Michael K. Jurrens, Computer Engineering
   Saimouli Katragadda, Aerospace Engineering; Physics minor
   Kaitlin C. Krejcik, Mechanical Engineering
   Xincheng Li, Electrical Engineering; Physics minor
   Eileen C. Liu, Computer Engineering
   Colin R. McNulty, Computer Science; Mathematics minor
   Benedict A. Mondal, Physics and Mathematics
   Matthew J. Weston-Dawkes, Fire Protection Engineering
   Tiffany S. Yen, Computer Engineering

Faculty Mentor
   Dr. Anil Deane, Associate Research Professor, Institute for Physical Science and Technology;
   Director, Laboratory for Computation and Visualization, UMD

Librarian
   Celina McDonald, University Libraries, UMD

Discussants
   Dr. Yiannis Aloimonos, Professor, Department of Computer Science, UMD
   Ms. Neta Ezer, Senior Systems Architect, Northrop Grumman Mission Systems
   Mr. Jacob Moschler, Project Engineer, University of Maryland UAS Test Site
   Dr. Amitabh Varshney, Director, University of Maryland Institute for Advanced Computer Studies;
   Professor, Department of Computer Science, UMD
   Dr. Huan Xu, Professor, Department of Aerospace Engineering, Institute for Systems Research,
   UMD

Research Description
Search and rescue operations are challenging due to the limited time in which to locate the subject, the hazards imposed on the rescuer and the difficulties of the non-local distribution of the full rescue team. Unmanned aerial vehicles (UAVs) have recently emerged as a safer and more cost-effective alternative to traditional manned methods because they remove the pilot from these dangerous environments. In addition, recent advancements in virtual reality technology such as the release of Oculus Rift have given rise to a new method to survey environments from high altitudes. Team ARM IT has developed a virtual reality interface that controls a mounted camera payload on an unmanned aerial vehicle through a head mounted display. This allows rescuers to manipulate an unmanned aerial vehicle to assist search and rescue missions safely and effectively through telepresence and enhanced situational awareness. We tested our hypotheses by prototyping, testing, and refining individual components of the system through the use of flight simulation software and on-site volunteer testing. By providing a realistic sense of the UAV environment enhanced with relevant information, our project reduces the danger to the rescuers and provide cognitively natural situational awareness.

BACTERIA: Using Enzymatic Combinations to Treat Asphaltene Aggregation

Research Team
    Julia L. Abolafia, Environmental Science & Technology; Statistics minor
    Jack M. Cowan, Computer Science
    Anna E. Harrison, Physiology & Neurobiology; Meteorology minor
    Jackson T. Hensley, Chemistry
    Danme (Tracy) Kim, Criminology & Criminal Justice; Classical Mythology and Geographic Information Sciences minors
    Wing-Mei A. Ko, Civil Engineering
    Megan T. Le, Chemical Engineering
    Hema Manivannan, Chemical Engineering
    Lorena L. Rivera Rubio, Biochemistry
    Prateeti P. Sarker, Economics and Mathematics
    Radhika Tyagi, Biology and English

Faculty Mentor
    Dr. Siddhartha Das, Assistant Professor, Department of Mechanical Engineering, UMD

Librarian
    Eileen Harrington, University Libraries, UMD

Discussants
    Dr. Douglas Julin, Associate Professor, Department of Chemistry and Biochemistry, UMD
    Dr. Amy Karlsson, Assistant Professor, Department of Chemical and Biomolecular Engineering, UMD
    Dr. Jeffery Klauda, Associate Professor, Department. of Chemical and Biomolecular Engineering, UMD
    Dr. Gregory Payne, Professor, Fischell Department of Bioengineering, UMD
    Dr. Ganesh Sriram, Associate Professor, Keystone Professor, Department of Chemical and Biomolecular Engineering, UMD

Research Description

Asphaltenes tend to flocculate to form nanoaggregates on the walls of pipelines, creating both safety and environmental hazards as well as decreasing the efficiency of oil transportation. Conventional methods of asphaltene reduction utilize chemicals that are both energy-intensive and expensive; thus, a biological method of deflocculation would improve the sustainability of oil transportation. In this study, an optimal mixture of enzymes that would effectively and significantly reduce asphaltene aggregates in heavy crude oil was researched. A mixture of enzymes was predicted to to most effectively degrade asphaltenes by working synergistically to reduce asphaltene flocculation due to the decrease in the energy barrier for oxidation. The two enzymes selected for experimentation, chloroperoxidase and laccase, acted as the driving force for the reduction of asphaltenes in microbial-enhanced oil recovery (MEOR), a method of oil refinement. Through experimentation, flocculation curves were determined for the precipitation of asphaltene treated with chloroperoxidase, laccase, and a combination of both enzymes. These curves demonstrate the oxidative effects of the enzymes on asphaltene.

BIASES: Classifying Bias in Large Multilingual Corpora via Crowdsourcing and Topic Modeling

Research Team

Brianna Marie Caljean, Chemistry and Psychology
Katherine M. Calvert, Anthropology; Archaeology minor
Ashley Chang, Mathematics and Computer Science; Business Analytics minor
Elliot Golding Frank, Mathematics and English
Rosana Garay Jáuregui, Computer Science
Geoffrey Harrison Palo, Electrical Engineering; Physics minor
Ryan Louis Rinker, Electrical Engineering; Computer Engineering minor
Gareth Rayburn Weakly, Economics and Mathematics; Creative Writing minor
Nicolette Shannon Wolfrey, Government & Politics; Law & Society minor
William Huasheng Zhang, Computer Engineering

Faculty Mentor

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Librarian

Eric Lindquist, University Libraries, UMD

Discussants

Dr. Brian Butler, Professor and Senior Associate Dean, College of Information Studies, UMD
Dr. Marine Carpuat, Professor, Department of Computer Science, UMD
Dr. Melanie Kill, Professor, Department of English, UMD
Dr. Philip Resnik, Professor, Department of Linguistics; Director, Computational Linguistics and Information Processing, UMD
Mr. Ed Summers, Lead Developer, Maryland Institute for Technology in the Humanities (MITH), UMD

Research Description

Our project extends previous algorithmic approaches to finding bias in large text corpora. We used multilingual topic modeling to examine language-specific bias in the English, Spanish, and Russian versions of Wikipedia. In particular, we placed Spanish articles discussing the Cold War on Russian-English viewpoint spectrum based on similarity in topic distribution. We then crowdsourced human annotations of Spanish Wikipedia articles for comparison to the topic model. Our hypothesis was that although human annotators and topic modeling algorithms detected bias differently, they would provide correlated results. However, that was not the case. Our annotators indicated that humans were more perceptive of sentiment in article text than topic distribution, which suggests that our classifier and humans employ complimentary bias detection techniques.

BioCHIPS: In Situ Electro-Assembly of Redox-Based Glucose Sensors for Microfluidic Applications

Research Team
  Joanne M. Chan, Bioengineering
  Chandni S. Dhamsania, Physiology & Neurobiology
  Monil M. Ghodasra, Bioengineering
  Elana L. Laster, Public Health Science
  Kimberly J. Lo, Chemical Engineering
  Julie P. Mehta, Physiology & Neurobiology; Entrepreneurship and Innovation minor
  Sarah "Sky" Onimus, Aerospace Engineering; Creative Writing minor
  Mayuri N. Patel, Cell Biology & Genetics and Government & Politics
  Veda Ravishankar, Bioengineering; Global Poverty minor
  Samuel B. Rombro, Physics
  Yasasvhinie Santharam, Physiology & Neurobiology; Statistics minor
  Joy Y. Wang, Civil Engineering
  Jessica G. Yau, Bioengineering

Faculty Mentor
  Dr. William E. Bentley, Distinguished Professor, Fischell Department of Bioengineering; Director, Fischell Institute for Biomedical Devices, UMD

Librarian
  Nedelina Tchangalova, University Libraries, UMD

Discussants
  Dr. Xiaolong Luo, Associate Professor, Catholic University of America
  Dr. Gregory Payne, Professor, Fischell Department of Bioengineering, UMD
  Mr. Wu Shang, Ph.D Candidate, Fischell Department of Bioengineering, UMD
  Dr. Ryan Sochol, Assistant Professor, Department of Mechanical Engineering, UMD

Research Description

Creating an in vitro model of the gastrointestinal (GI) tract that mimics the structural, absorptive, pathophysiological and microbial environment of the human gut can revolutionize drug delivery testing and potentially replace animal testing to improve efficiency and efficacy. Current studies on the gut-on-a-chip model consist of microfluidic channels coated with an extracellular matrix that mimic peristalsis. However, this model fails to provide a method to quantitatively measure the effects of a treatment on a disease. This research incorporates catechol-chitosan sensors to quantify the effects of treatments on their respective diseases in a polydimethylsiloxane (PDMS) gut-on-a-chip model lined with epithelial cells. By using sensors to quantify changes in the physiological conditions of the human gut, the efficacy and accuracy of novel drug treatments for GI diseases can be evaluated. Our aims were to: (1) design and create a viable, microfluidic model of the gut integrated with sensors and (2) monitor glucose concentrations in the chip. The chip's efficiency and accuracy were to be determined by comparing readings from the glucose sensors to the results of in vitro and in vivo studies. Future studies may focus on using this improved gut-on-a-chip model to reduce the need for animal testing and accelerate the process for pharmaceutical and biomedical industries to approve new drugs for different GI diseases.

Acknowledgements

BLOOD: Identification of Secreted Proteins Driving Hematopoiesis in Induced Pluripotent Stem Cells

Research Team
    Michael Berkery Amedeo, General Biology
    Prableen Kaur Chowdhary, Physiology & Neurobiology and Biochemistry
    Aria Jalalian, General Biology
    Wei Chen Lai, Physiology & Neurobiology
    Amil Sahai, Physiology & Neurobiology
    George Matthew Thomas, General Biology; Rhetoric minor
    Akhil Venkat Uppalapati, Government & Politics
    Farah Vejzagic, Bioengineering

Faculty Mentor
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Librarian
    Nedelina Tchangalova, University Libraries, UMD

Discussants
    Dr. Ricardo Feldman, Associate Professor, University of Maryland School of Medicine
    Dr. Marcus Santoro, Post-Doctorate Fellow, Department of Aerospace Engineering, UMD
    Dr. Michal Zalzman, Assistant Professor, University of Maryland School of Medicine
    Dr. Robert Balaban, Senior Investigator, National Institute of Health

Research Description

The goal of our research was to optimize Induced Pluripotent Stem Cell (iPSC) to Hematopoietic Stem Cell (HSC) differentiation by investigating the effects of OP9 mouse stromal cells in induction of this process. Current literature shows that HSCs can be derived from iPSCs by co-culturing the iPSCs with OP9 cells. While this is an effective method of generating HSCs, the mechanism is currently unknown. Our team investigated whether OP9 cells are necessary to induce differentiation or if the proteins that OP9 cells secrete are sufficient themselves. Furthermore, we attempted to isolate and identify the proteins that are responsible for the differentiation of the iPSCs. The results of this research will be critical in further understanding hematopoiesis and the engraftment potential of iPSCs in leukemia patients.

BREATHE: Remediation of Volatile Organic Compounds in Indoor Spaces Using a Novel Biowall Design: A Feasibility Study

Research Team
  Erica Gabriella Brown, Bioengineering; Sustainability Studies minor
  Gabrielle Austin Enguillado, Architecture; Sustainability Studies and Global Poverty minors
  Robert Shea McDermott, Cell Biology & Genetics
  Nicole Theresa Palumbo, Bioengineering
  Jill Sara Smith, Civil Engineering
  Michelle Lynn Stanley, Civil Engineering; Construction Project Management minor
  Morgan Elizabeth Sulzbach, Chemical Engineering; Sustainability Studies and Project Management minors
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Faculty Mentor
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Librarians
  Dr. Svetla Baykoucheva, University Libraries, UMD

Discussants
  Dr. Steve Cohan, Former Professor and Co-Mentor, Department of Plant Sciences and Landscape Architecture, UMD
  Mr. Michael Furbish, President and Founder, Furbish Company, LLC
  Dr. Jennifer German, Student Engagement Coordinator, Maryland Institute of Applied Environmental Health, UMD
  Dr. Jose-Luis Izursa, Lecturer, Department of Environmental Science and Technology, UMD
  Mr. John Pickering, Engineering Technician, Furbish Company, LLC
  Mr. Jason Reed, Ecologist, Furbish Company, LLC

Research Description

Indoor air can contain harmful volatile organic compounds (VOCs) at concentrations averaging ten times higher than outdoor air. These VOCs, originating from common household materials contribute to numerous health problems, including headaches, dizziness, nausea, and in extreme scenarios, cancer. Indoor biowalls present a solution to poor indoor air quality from their ability to bioremediate VOCs via microbial degradation, specifically with *Hyphomicrobium* spp., which exist on plant roots and actively consume many VOCs. In our initial study, we examined by real-time quantitative Polymerase Chain Reaction (qPCR), the population of *Hyphomicrobium* spp. on roots of four morphologically different plant species commonly used in biowalls to determine if any plants were optimal hosts for *Hyphomicrobium* spp. These plants included *Philodendron* 'mini red', *Calathea lancifolia*, *Chlorophytum comosum,* and *Asplenium nidus*. In a following study, enclosed aeroponic chambers were used to expose our test plant's roots to the common indoor VOCs, isopropanol, acetic acid, acetone and toluene, to further test the capability of our plant species to host *Hyphomicrobium* spp. Finally, we designed a novel biowall system that incorporated an air bubbler component into the irrigation reservoir, theoretically dissolving VOCs into solution. The irrigation system delivered water and, theoretically, VOCs to plant roots and their *Hyphomicrobium* spp. colonies. In a growth chamber study comparing the novel biowall to one without the VOC dissolution system, we measured the degradation of injected isopropanol to determine the effectiveness of VOC amelioration from our design.

Acknowledgements

DRIVE: Rotor Shape Manipulation for the Design of an Alternator-Based Regenerative Braking System

Research Team
Brendan J. Bradley, Mechanical Engineering
Clifton E. Buxbaum, Mechanical Engineering
Dain C. Golsen, Civil & Environmental Engineering; International Engineering minor
Sean S. Haliyur, Aerospace Engineering
Nikhil S. Hosamane, Computer Science; Technology Entrepreneurship minor
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Bryan Zeug, Computer Engineering

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Dr. F. Patrick McCluskey, Professor, Department of Mechanical Engineering, UMD
Dr. Eric Montgomery, Assistant Research Scientist, Institute for Research in Electronics and Applied Physics, UMD
Dr. Vincent Phuc Nguyen, Lecturer, Department of Mechanical Engineering, UMD
Ms. Aynsley Toews, Project Manager, Office of Sustainability, UMD

Research Description
In order to widen the limited scope of hybrid technology, Team DRIVE researched the possibility of implementing a regenerative braking system in the form of an alternator onto the drive shaft of rear-wheel (RWD) and all-wheel drive (AWD) cars. After researching sources of lost energy on the drivetrains of vehicles, the team hypothesized that salient rotors are a better candidate for an alternator-based regenerative braking system than the standard alternator rotor, the Lundell rotor, because of improved efficiency at lower angular velocities. To test the team's hypothesis, the team conducted computer simulations and physical experiments to evaluate the braking torque and power output performance of three electromagnet rotors: a 4-pole salient rotor, an 8-pole salient rotor, and a Lundell rotor. ANSYS Maxwell simulations were used to optimize the geometry of the 4 and 8-pole salient rotors. A custom-built test apparatus was used to determine the braking torque and power output of the Lundell rotor while operating under simulated driving conditions. Recommendations were then made for the implementation of a 4-pole or 8-pole salient rotor in an alternator-based regenerative braking system on a vehicle's drive shaft.

GOLD: Evaluating the Properties of a Gallium-Conjugated Siderophore Complex as an Antibacterial Treatment

Research Team
    Demetri Z. Cendo, Biochemistry
    Parmida Enkeshafi, Philosophy; French Language and Studies minor
    Paul W. Han, Chemical & Biomolecular Engineering
    Cameron R. Harner, Bioengineering
    Rachel J. Herman, Cognitive-Behavioral Neuroscience
    Margo P. Huffman, Physiology & Neurobiology; Human Development minor
    Faith C. Lee, Psychology
    Qing T. Liu, Cell Biology & Genetics; Statistics minor
    Connie P. Nguyen, Bioengineering; LGBT Studies minor

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Librarian
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Discussants
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    Mr. Kevin Knapstein, Laboratory Specialist, Bioprocess Scale-Up Facility
    Dr. Andrew Lees, Founder and Chief Scientific Officer, Fina Biosolutions
    Dr. Daniel Nelson, Associate Professor, Department of Veterinary Medicine, UMD

Research Description
In 2013, the Centers for Disease Control and Prevention estimated that approximately two million individuals in the United States developed antibiotic-resistant infections. The increasing rate of bacterial antibiotic resistance necessitated the development of alternative treatments. Gallium-desferrioxamine (Ga-DFO), a gallium-chelated bacterial siderophore, offered a promising alternative through the exploitation of bacteria's natural iron-uptake pathway to introduce toxic gallium ions into the cytoplasm. Previous research demonstrated the Ga-DFO complex is effective against a limited number of bacterial strains in ideal treatment conditions. Thus, this study aimed to test its effectiveness against additional strains in different growth conditions and mammalian cell culture. If the treatment significantly decreased bacterial cell count without harming mammalian cells, Ga-DFO will have proven to be a viable alternative to traditional antibiotics.

MATRIX: Developing an Extracellular Vesicle Based Treatment for Osteoarthritis

Research Team
   Sumon Bhattacharyya, Microbiology; Spanish Language, Business & Cultures minor
   Allison Y. Chen, Physiology & Neurobiology and Government & Politics
   Stephanie L. Chill, Chemical & Biomolecular Engineering
   Madelyn D. Golding, Bioengineering; Engineering Leadership Development minor
   Danielle J. Lee, Microbiology; Innovations and Entrepreneurship minor
   Thomas R. Mumford, Bioengineering
   Alex Pu, Bioengineering and Computer Science
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Discussants
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   Dr. Philip DeShong, Professor, Department of Chemistry & Biochemistry, UMD
   Dr. James Hagberg, Professor, Department of Kinesiology, UMD
   Dr. R. Frank Henn, Associate Professor, University of Maryland School of Medicine
   Dr. Stephen Mount, Associate Professor, Dept. of Cell Biology and Molecular Genetics, UMD
   Dr. Joseph Stains, Associate Professor, University of Maryland School of Medicine

Research Description
Osteoarthritis (OA), a disease characterized by the degradation of articular cartilage, affects millions worldwide. While treatments such as cortisone shots and joint surgery alleviate OA symptoms, they do not address the root cause of the disease. Manipulating extracellular vesicle (EV) bioactivity provides a platform for stimulating regeneration of articular cartilage and thus reversing OA pathology. EVs are cargo-filled bodies that mediate intercellular communication and are influential in OA pathogenesis. This study utilized parallel methodologies to investigate whether EV signaling can be manipulated to combat OA and ultimately maximize the therapeutic potential of the product. The first approach aimed to identify cells lines that produce EVs with therapeutic activity against OA, while the second introduced miRNA in EVs to induce cartilage regeneration. MiRNAs including miR-125b and miR-140, which are linked to cartilage regeneration and degradative enzyme suppression, were loaded into EVs. EVs derived from synovial fibroblasts (SFBs) induced further inflammation when compared to cells without EV treatment. Bone-derived human mesenchymal stem cells (BD-hMSCs) caused no statistically significant change in inflammation. OA chondrocytes were treated with these EVs, and cellular response was quantified by observing changes in MMP-13 concentration. Results indicated that miRNA did not impact MMP-13 degradative enzyme production. Specifically, SFB-EVs were pro-inflammatory, increasing the amount of MMP-13 present in treated samples. Conversely, MSC EVs stimulated no change in MMP-13 production. Future studies should further characterize these results and improve current therapies to achieve maximum therapeutic impact.

PHAGE: Exploring Bacteriophage Disinfectants as a Solution to Listeria monocytogenes Biofilms

Research Team
    Sarah K. Frail, Cell Biology & Genetics; Planetary Sciences minor
    Gina X. Liu, Economics
    Grace C. MacAtee, Mechanical Engineering; International Engineering minor
    Tejas A. Mavanur, Economics and Physiology & Neurobiology
    Kerina A. Ochieng, Physiology & Neurobiology
    Cara L. Purdy, Bioengineering
    Patrick C. Shan, Finance, Mathematics, and Computer Science
    Thomas H. Tran, Physiology & Neurobiology
    Sarah J. Wain, Chemical & Biomoleular Engineering

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Discussants
    Dr. Vinod Nagarajan, Post-Doctoral Research Associate, Department of Avian & Animal Sciences, UMD
    Dr. Daniel Nelson, Associate Professor, Department of Veterinary Medicine, UMD; Head of Laboratory of Antimicrobial Discovery, Institute for Bioscience and Biotechnology Research, UMD
    Mr. Mengfei Peng, Ph.D. Candidate, Dept. of Avian & Animal Sciences, UMD
    Dr. Serajus Salaheen, Postdoctoral Researcher, United States Department of Agriculture

Research Description
Pathogenic foodborne bacteria, particularly species belonging to *Listeria* and *Salmonella*, pose a growing threat to public health because of their ability to form and/or grow within biofilms on various environments, specifically food processing facility. Within a biofilm, bacteria develop increased resistance to common disinfectants, making surface sterilization a challenge for businesses involved in food processing. In order to determine the viability of bacteriophages as an antibiotic alternative, this experiment attempted to explore the bacteriophage growth process as well as bacteriophage efficacy against *Listeria monocyogenes* as compared to *Salmonella enterica* serovar Typhimurium. A511 bacteriophage was grown and tested on *L. monocytogenes*1/2a using previously studied P22 bacteriophage and *S.* Typhimurium as a control case. While this experiment was unable to establish a defined efficacy of A511 against *L. monocytogenes,* repeatable results with *Salmonella* show promising potential for phage therapies.

PRINT: Symbols for Computer Aided Design Software Operations: Selection and Effect on User Retention

Research Team
    David Alcantara, Mechanical Engineering and Computer Science
    Ji Min Chang, Aerospace Engineering
    Brian Choi, Computer Engineering
    Mark Hubbert, Physics and Astronomy
    Caroline Massey, Mechanical Engineering
    Timothy Morrill, Computer Engineering
    Patrick Musselman, Mechanical Engineering
    Alexander Vecchioni, Aerospace Engineering
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Discussants
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    Dr. Linda Schmidt, Professor, Dept. of Mechanical Engineering, UMD
    Dr. Ryan Sochol, Assistant Professor, Dept. of Mechanical Engineering, UMD
    Mr. Preston Tobery, IT Coordinator, UMD

Research Description
Computer Aided Design (CAD) software can be difficult to learn. A major contributor to this entry barrier is CAD interfaces' usage of symbols associated with CAD operations. This paper studies which symbols minimize recall time and optimize retention via two studies. We performed an initial exploratory study to identify which 2D symbols intuitively describe common CAD operations. Then, we conducted a second study with three separate groups using different input methods to test which input method improves retention and recall time. Each group used one of three input methods: choosing preexisting Autodesk CAD operation symbols, choosing our 2D symbols derived from the symbol study, and physically drawing those same symbols. We measured participants' accuracy and time spent on each question. The results indicated that there is a decrease in the time taken to submit responses, which correlates to recall time. The group physically drawing the symbols improved the most compared to the group selecting the symbol study symbols and the group selecting Autodesk operation symbols. For retention, as measured by correctness, our statistical analysis indicates that there does not appear to be a significant difference between the three groups.

VIRUS: Viral Investigation of Regulatory Human Astrocytes to Understand the Glymphatic System

Research Team
   Paul D. Butz, Physiology & Neurobiology and Environmental Health
   Lucas Cheng, Computer Science and Music Performance Bassoon
   Riddhi Gopal, Bioengineering; Art History minor
   Anna N. Lin, General Biology; Asian American Studies minor
   Folarin G. Onifade, Physiology & Neurobiology
   Robin A. Sultan, Materials Science & Engineering

Faculty Mentor
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Librarian
   Kelsey Corlett-Rivera, University Libraries, UMD

Discussants
   Dr. George Belov, Associate Professor, Department of Veterinary Medicine, UMD
   Dr. Jeffrey DeStefano, Professor, Department of Cell Biology and Molecular Genetics, UMD
   Dr. Kara Duffy, Regulatory Health Project Manager, Department of Health and Human Services, Food and Drug Administration (FDA)
   Dr. Sabrina Kramer, Associate Director of Integrated Life Sciences, Honors College, UMD
   Dr. Joshua Levin, Associate Director, Manufacturing Quality, Personal Genome Diagnostics

Research Description

Alzheimer's disease (AD) is a major neurodegenerative disease that is characterized by slow, irreversible deterioration of memory and cognitive function in aged patients, typically over the age of 65. AD results from an extracellular accumulation of beta-amyloid plaques, which are composed of misfolded peptide oligomers of beta-amyloid. The accumulation is thought to be due to the failure of the glymphatic system, a waste clearance system in brain, which contains aquaporin-4 (AQP4) protein water channels. This protein exists as heterotetramers of M21 and M23 isoforms from splice variants of AQP4. Previous studies suggested that Herpes Simplex Virus-1 (HSV-1) infection of the central nervous system (CNS) might contribute to AD development. However, the effect of HSV-1 on the glymphatic system has not been definitively established. The objective of this study was to investigate whether HSV-1 infection interferes with AQP4 expression in human brain-derived glial cells using virology and molecular biology methods. We optimized the inoculum amount and infection time of HSV-1 in the cultured glial cells for the detection of AQP4 RNA and protein levels. HSV-1 infection of the cells reduced the protein level of M23 isoform in a dose- and time-dependent manner. These results suggest that HSV-1 infection potentially interferes with the function of the glymphatic system through the reduction of M23 isoform.

JUNIOR POSTER ABSTRACTS

The Gemstone Honors Program is excited to share the work of the junior class. Attendees are encouraged to view the posters in the hallway outside of the presentation rooms. We hope to see you at next year's Thesis Conference on Friday, April 12, 2019.

CARDIO: Prototyping a piezoelectric energy-harvesting system from the simulated mechanical pulsation of a 3D-printed cardiac model

Team Members: Sarah Asfari, Aishwarrya Jayapal, Sahith Mukku, Bareera Qamar, Divyam Satyarthi, Christina Tous
Faculty Mentor: Dr. Bob Newcomb, Professor, Department of Electrical and Computer Engineering, UMD
Librarian: Jordan Sly, University Libraries, UMD

Research Description
In the US, 100,000 annual deaths were reported from cardiac pacemaker replacement surgeries. Lithium ion batteries, the primary power supply of cardiac pacemakers, had a finite battery life of about 7 years - increasing the need for replacement surgeries and prevalence of deaths from postsurgical complications as patients age. We had prototype an alternative energy supply for cardiac pacemaker technology from the mechanical pulsation of the heart itself. Our study involved preliminary testing of the energy-capture capabilities of piezoelectric materials on the pulsation of a 3D printed heart model. Results of our project indicated limitations of our energy capture system, predominantly on the structural elements of the heart model and properties of the adhesive used to secure the piezomaterials. We will be conducting future testing that will aim to limit these confounds.

DIVA: Data Imaging and Visualization Analysis

Team Members: Theodore Corrales, Erin Estes, Kevin Ho, Austin Hom, Mughil Muthupari, Justin Pan, Justin Shen
Faculty Mentor: Dr. Stephen Penny, Assistant Research Professor, Department of Atmospheric and Oceanic Science, UMD
Librarian: Dr. Kelley O'Neal, University Libraries, UMD

Research Description
Over the last few decades, satellites have collected vast quantities of climate and weather data, providing a better picture of Earth's global and regional climates. Interest in understanding Earth's climate has risen in light of human-fueled climate change, which poses an existential threat to the human population in the form of extreme droughts, floods, and other natural disasters. However, little effort has been spent to develop effective visualization tools that allow researchers or the general public to understand climate data thoroughly. Today, climate scientists are still using software with basic plotting capabilities and limited interactivity and comprehensibility. We have proposed a new visualization tool utilizing Virtual Reality (VR) to fully immerse a user into an interactive and intuitive data analysis environment. With such technology, climate data will become more understandable and accessible, allowing a larger audience of both technical and non-technical individuals to be educated about certain climate issues facing the Earth.

JUNIOR POSTER ABSTRACTS

The Gemstone Honors Program is excited to share the work of the junior class. Attendees are encouraged to view the posters in the hallway outside of the presentation rooms. We hope to see you at next year's Thesis Conference on Friday, April 12, 2019.

MELTS: Molecular Engineering of Less Toxic Salt

Team Members Surjo Bandyopadhyay, Danielle Firer, Amanda Hamilton, Gregory Krasnoff, Harrison Kraus, Eric McKenna, Evan Quartner, Soma Umeozulu
Faculty Mentor: Dr. Kaye Brubaker, Associate Professor, Department of Civil and Environmental Engineering, UMD
Librarian: Kelsey Corlett-Rivera, University Libraries, UMD

Research Description
Approximately 17 million tons of road salt (NaCl) are used each year across the United States to deice roads during winter storms. This high quantity of salt dissolves and subsequently runs off the road into stormwater drains which feed into nearby freshwater bodies. Due to the high cost and energy demand of current desalination processes, this salty runoff lacks any suitable treatment method. Our team's research focused on examining the suitability of ion exchange resins to function as a small scale roadside stormwater drain desalination system. To evaluate the resins' desalination potential, we passed various concentrations of sodium chloride solutions through gravity flow columns and performed a mass balance to determine the total sodium and chloride ions bounded by the resins. By subjecting the resins to repeated cycles of salt solution we hoped to determine their desalination efficiency and capacity, as well as suitability for future implementation.

META: Constructing a Memristor for a Photonic Circuit

Team Members: Alison Duck, Giovanni Fevola, Daniel Lay, Thomas Liu, Vineet Pande, Phillip Shulman, Humza Yahya
Faculty Mentor: Dr. Min Ouyang, Associate Professor, Department of Physics, UMD
Librarian: Nevenka Zdravkovska, University Libraries, UMD

Research Description
We have proposed two methods for constructing a memristor for a photonic circuit, both of which were based off an array of silver nanorods. The silver nanorod structure was chosen as a starting point because it had useful transmission effects when light was applied in the infrared-visible range. The first method focused on increasing the aspect ratio of the system by pushing the nanorods apart, using a heat-sensitive polymer. Multiple polymers, including AMPA-NIPAM mixtures, have been considered, based on the ease of production, and the expansive effects. The change in aspect ratio generates a change in transmission, resulting in a memristive effect. The second method focused on embedding the nanorod structure in a layer of mica, and applying a voltage to the structure. Nanofilaments arise depending on the applied voltage, changing the permittivity of the structure, and creating a memristive effect. Construction and testing of both structures is ongoing.

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MICRO: Microphysiological in-Vitro Cultures Resembling Organs

Team Members: Cara Brainerd, Megan Donovan, Viswanath Gorti, Morgan Janes, Katherine Jones, Shireen Khayat, Andrew Liu, Madeleine Noonan-Shueh, Sahana Rao
Faculty Mentors: Dr. Ryan Sochol, Assistant Professor, Department of Mechanical Engineering, UMD
Librarian: Nedelina Tchangalova, University Libraries, UMD

Research Description

In the process of drug development, current in-vitro platforms used to test candidate medications in the laboratory do not fully resemble cellular microenvironments that occur in vivo. Organ-on-a-chip devices introduce complex microarchitectures and flow conditions that can be tuned to replicate certain cellular environments. Here we show progress in the creation of a liver-on-a-chip device featuring nano-3D printed microchannels designed to resemble liver sinusoids. The device was fabricated through soft lithography and the tubules were printed using a Nanoscribe 3D Photonic Professional GT. The ANSYS suite was used to simulate an evenly fenestrated channel within a cell chamber. Velocity vector magnitude and contour plots were generated to visualize fluid flow and diffusion through the fenestrae with the use of biologically accurate parameters. Thus far, a fenestrated tubule with 5 µm diameter pores has been successfully printed with IPL780, a biocompatible photoresist, outside of a device. In addition, solid tubules have been printed inside of the fluidic device microchannels. The simulations show a decrease in fluid distribution to the extracellular space as the channel length increases, suggesting that cells closer to the end of the channel would receive less media. Future analysis of fluid dispersion through the channel is being conducted, with the aim to optimize fluid flow through the fenestrae such that all cells within the model are exposed to an equivalent volume of media. Experiments will then be conducted to test how the 3D-printed bioarchitectures impact the viability and function of the liver cells in comparison to the body.

OMEGA: Genetic Modification of Lactobacillus casei to Produce Omega-3 Fatty Acids

Team Members: Julianna Greenberg, Neha Kalla, Roja Kambhampati, Erin Murphy, Aasheen Qadri, Mateo Reveiz
Faculty Mentors: Dr. Debabrata Biswas, Associate Professor, Department of Animal & Avian Sciences, UMD
Librarian: Stephanie Ritchie, University Libraries, UMD

Research Description

Omega-3 (Ω-3) fatty acids are an essential component of the human diet. Ω-3 fatty acids have been linked to reduced risk of both neurological and cardiovascular diseases in humans. Although fatty fish contain gut symbionts that produce Ω-3, such as Shewanella baltica (S. baltica), many of these fish are expensive and inaccessible to most of the population. To address this, lactic acid bacteria will be modulated to produce Ω-3, which can then be applied to various food products. The bacteria will be modulated by: 1) isolating the Ω-3 producing gene cluster from S. baltica and inserting the cluster into Escherichia coli; 2) transferring the genes to Lactobacillus casei, our lactic acid bacteria; and 3) measuring Ω-3 production in the bacteria through mass spectrometry and high-performance liquid chromatography (HPLC). If the genes are successfully transferred to L. casei, then the mass spectrometry and HPLC should indicate Ω-3 production. If lactic acid bacteria are modified to produce Ω-3, the bacteria can be applied to fermented foods like yogurt. This new application would not only increase access to Ω-3, but also provide a significant environmental benefit through reduced overfishing currently caused by the mass production of fish products for their Ω-3 benefits.

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OYSTERS: Rethinking Oyster Restoration

Team Members: Myles Arrington, Aaron Auerbach, Nellie Gold-Pastor, Nathan Mengers, Cara Schiksnis, Caroline Simon
Faculty Mentor: Dr. Kennedy Paynter, Research Associate Professor and Director, Marine Estuarine Environment Sciences Program (MEES), UMD
Librarian: Stephanie Ritchie, University Libraries, UMD

Research Description

Team Oysters is exploring the use of 3D printing as a method for oyster restoration in the Chesapeake Bay for the declining Eastern oyster population. The population of the Eastern oyster has collapsed dramatically over the past century, raising risks for the surrounding ecology in the Bay, and an economic crisis for Bay industries. Negative shell budgets for oysters generate a critical problem as larvae are unable to find sites for settlement and growth. Currently, the most widely utilized methods for large-scale oyster restoration use recycled oyster shell. However, as oyster populations continue to decline, this is an inefficient and unsustainable resource. Other methods include the use of inorganic substrates, such as concrete, however these techniques are less attractive for oyster spat as they do not contain the natural substrate preferred by larvae.

Utilizing a filament containing calcium carbonate, LayBrick, Team Oysters is printing oyster shells that will be tested for spat settlement and later for growth and natural recruitment of oysters in the Bay. Due to the success of previous materials that contain calcium carbonate, such as experiments conducted by Piazza et al. 2009, and Hilbertz & Goreau (1996), the use of a 3D printing filament containing calcium carbonate should provide an alternative substrate for oyster restoration that is more efficient than other inorganic substrates. The goals of this research are to create ecologically beneficial, cost-efficient, and more successful methods for future oyster restoration efforts.

PRESSURE: Investigating Methods of Blood Pressure Measurement

Team Members: Aman Anand, Shereen Ashai, Michael Bent, West Foster, Ryan Goldberg, Eric Murray, Jonathan Sandoval, David Stein, Sarah Weatherly, Ezra Weener, Nicholas Youngs
Faculty Mentor: Dr. Jin-Oh Hahn, Assistant Professor, Department of Mechanical Engineering, UMD
Librarian: Elizabeth Soergel, University Libraries, UMD

Research Description

Blood pressure is the primary vital sign to assess one's health by clinicians. However, the measurement of blood pressure via inflatable cuff is cumbersome and inconvenient. A possible alternative is to indirectly measure blood pressure by assessing the time it takes for a blood pressure wave to travel between two sites in the arterial tree – called pulse transit time. Pulse transit time can be easily measured by, e.g. putting photoplethysmographic sensors (for example, pulse oximeters) at two different body locations, such as ear, finger, and toe. The purpose of this study is to understand how pulse transit time changes with blood pressure over a wide range of age (20 yrs-70 yrs) and blood pressure as well as to discover new surrogates of blood pressure from a range of physiological signals that can be conveniently measured from mobile devices.

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PURIFY: Greywater and Rainwater Domestic Filtration Technologies

Team Members: Denise Alving, Ry Arnold, John Hunsicker, Yoseph Kebede, Sean Naimi, John (Jack) Perry, Shaina Rudman
Faculty Mentors: Mike Binder, Lecturer, School of Architecture, Planning & Preservation, UMD
Dr. Ray Adomaitis, Professor, Department of Chemical and Biomolecular Engineering, Institute for Systems Research, UMD
Librarian: Cynthia Frank, University Libraries, UMD

Research Description
As global population and adverse climate changes have increased, finding sources of sustainably purified clean water has become more crucial than ever. Many undeveloped nations lack the infrastructure to provide reliable water resources to all citizens. Even developed nations have failed to provide clean water from time to time, as evidenced by recent droughts throughout the world. Team Purify has proposed a sustainable water filtration system which utilizes greywater recycling and rainwater harvesting to reduce and eventually eliminate net water consumption on a domestic scale. Team Purify has designed and built a system consisting of a series of water filters each addressing several common contaminants. Each of the components themselves are sustainably produced and require minimal maintenance. In previous literature there is precedent for non-chemical domestic filtration systems that are able to effectively filter rainwater to potable standards, however, there is little precedent for filtering greywater to potable standards on a domestic scale without chemical treatment. For this reason, Team Purify's primary research focus was on developing a system that will effectively purify greywater to potable standards as defined by the EPA. Future research will involve rigorous testing and evaluation of influent and effluent water from this system.

SPACE: Spacesuit Prototype to Augment Capability on EVA

Team Members: Harrison Bartlett, Joseph Bowser, Carlos Callejon Hierro, Sarah Garner, Lawrence Guloy, Christina Hnatov, Jonathan Kalman, Baram Sosis
Faculty Mentor: Dr. David Akin, Associate Professor, Director of Space Systems Laboratory, Department of Aerospace Engineering, UMD
Librarian: Elizabeth Soergel, University Libraries, UMD

Research Description
Human exploration of Mars will pose new demands on spacesuits that current designs are unable to overcome, including the need for in-situ replacement/repair of suit components. A reasonable alternative to the soft or hybrid suits currently in use are rigid hard suits, but they are prohibitively large and heavy. These issues can be mitigated by producing components using additive manufacturing, making hard suits a viable option for long duration missions. This project focused on the elbow joint due to its utility and relative simplicity. The joint consisted of three wedge elements that were connected through integrated ball bearings. All components were additively manufactured, except the steel balls inside the rotary bearings. Seals were made using a mixture of flexible materials; other components were printed in Duraform GF, a cheaper analog to materials already qualified for space. Materials testing ensured the structural integrity of the components and their ability to hold the required differential pressure. Pressurization and friction testing ensured acceptable seal performance in the suit's operating environment. The prototype was then tested to ensure it meets the mobility and lifetime requirements of a spacesuit. We believe additively manufactured hard suits have the potential to reduce or eliminate both the logistical issues with current spacesuits for long term settlement and the design challenges presented by previous hard suit designs. While further performance evaluation of additively manufactured suits is needed to assess their feasibility for such a mission, our initial tests proved the basic functionality of additively manufactured spacesuit components.

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VOLTAGE: Low-Power, Bistable Electrowetting Displays

Team Members: Trinish Chatterjee, Nazifa Chowdhury, Christopher Hallock, Jason Ittner, Alexander Jiao, Isaac Lee, David Nguyen, Karam Singh, Alexander (Zander) Weatherford
Faculty Mentor: Dr. Pamela Abshire, Professor, Department of Electrical and Computer Engineering, Institute for Systems Research, UMD
Librarian: Celina McDonald, University Libraries, UMD

Research Description
Electrowetting is the use of an electric field to change the spread of a microfluidic drop on a surface. A commercially viable electrowetting-based display would have high contrast with little to no power consumption when the pixel state is constant. Team VOLTAGE is aiming to create an electrowetting-based display that consumes less power while being cost efficient to mass produce. Photolithography, spin coating, acid etching, fluid dosing, and sealing are investigated as fabrication methods for the various components. Bistability, where a constant pixel state requires no additional power, will be used to achieve lower power consumption. Preliminary research has shown SU-8 as a promising material for use in the main pixel structure. Further testing and discussion with industry experts will guide future research.

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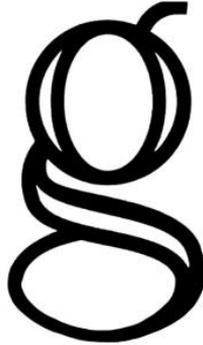
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