16th Annual Gemstone Honors Program

Thesis Conference

Friday, April 17, 2015

University of Maryland, College Park

Riggs Alumni Center

Gemstone Staff

Dr. Frank J. Coale, Director

Dr. Kristan Skendall, Associate Director

Vickie Hill, Assistant Director for Operations

Leah Tobin, Assistant Director for Student Engagement

Jessica Lee, Coordinator for Student Engagement

Faith Rusk, Coordinator for Operations and Team Support

Please join us…

You are cordially invited to attend

The Sixteenth Annual
Gemstone Citation Ceremony
Wednesday, May 20, 2015
7:00 PM
University of Maryland Memorial Chapel
College Park, Maryland

Thesis Conference Schedule-at-a-Glance

Time	Team	Room
1:30-2:15 PM	PATH	A
	SILVER	B
	VIRTUAL	C
2:45-3:30 PM	AWE	A
	QUANTUM SEA	B
	SO GREEN	C
4:00-4:45 PM	CLOT	A
	PANCREAS	C
5:15-6:00 PM	Bass	A
	EPIDEMICS	B
	NAVIGATE	C
6:00-7:30 PM	Please join us for a reception in the rotunda	

Throughout the day, please view the work of our junior teams, displayed in the hallway outside of the presentation rooms.

Friday, April 17, 2015
2:45-3:30 PM
Room A

AWE: Optimization of Small Vertical Axis Wind Turbine Placement to Maximize Power Generation due to Architectural and Geographic Interfaces in Urban Areas

Research Team

Jason Burtnick, Aerospace Engineering
Ralph W. Fairbanks, Mechanical Engineering
Francis Gross, Computer Engineering
Edward T. Lin, Materials Science & Engineering
Bethany A. McCrone, General Biology and Accounting
John Osmond, Materials Science & Engineering; Computer Science minor
Zachary Titus, Computer Science

Faculty Mentor

Mr. Bryan Quinn, Director of Technical Operations, Department of Electrical and Computer Engineering and Institute for Systems Research, University of Maryland

Librarian

Ms. Zaida Diaz, University Libraries, University of Maryland

Discussants

Dr. Cinzia Cirillo, Associate Professor, Department of Civil and Environmental Engineering, University of Maryland
Dr. David Lovell, Associate Professor, Department of Civil and Environmental Engineering, University of Maryland
Mr. Shyam Mehrotra, Lab Manager, Department of Electrical and Computer Engineering, University of Maryland

Research Description

Current methods for large-scale wind collection are unviable in urban areas. In order to investigate the feasibility of generating power from winds in these environments, we sought to optimize placements of small vertical-axis wind turbines in areas of artificially-generated winds. We explored both vehicular transportation and architecture as sources of artificial wind, using a combination of anemometer arrays, global positioning system (GPS), and weather report data. We determined that transportation-generated winds were not significant enough for turbine implementation. In addition, safety and administrative concerns restricted the implementation of said wind turbines along roadways for transportation-generated wind collection. Wind measurements from our architecture collection were applied in models that can help predict other similar areas with artificial wind, as well as the optimal placement of a wind turbine in those areas.

Acknowledgements

We thank the faculty and staff we consulted for this project: Dr. David Lovell, Dr. Cinzia Cirillo, Mr. Shyam K. Mehrotra, and Dr. Daniel Lathrop. We also thank the University of Maryland Department of Transportation for allowing our transportation tests. Special thanks to our mentor, Bryan Quinn, and the Gemstone staff for their support.

View Team AWE’s Website

Friday, April 17, 2015
5:15-6:00 PM
Room A

Team Bass: Appropriateness of largemouth bass (Micropterus salmoides) as a model species for detection of endocrine disruption

Research Team

Christine Kim, Accounting
Angela B.T. Leasca, Community Health
Winston W. Liu, Bioengineering
Shivani Patel, Neurobiology & Physiology
Laura E. Poulsen, Mathematics
Shefali Shah, Computer Science and General Biology; Philosophy and Neuroscience minors
Taylor T. Throwe, Business Management
Renuka D. Tripu, Neurobiology & Physiology

Faculty Mentor

Dr. Lance Yonkos, Assistant Professor, Department of Environmental Science and Technology, UMD

Librarian

Ms. Nedelina Tchangalova, University Libraries, UMD

Discussants

Dr. Vicki Blazer, Research Fish Biologist, USGS Leetown Science Center
Dr. Luke Iwanowicz, Research Biologist, USGS Leetown Science Center
Dr. Scott Lynn, Office of Science Coordination and Policy, U.S. Environmental Protection Agency
Dr. Beth McGee, Senior Regional Water Quality Scientist, Chesapeake Bay Foundation
Dr. Ed Orlando, Assistant Professor, Department of Animal and Avian Sciences, UMD
Dr. Fred Pinkney, Senior Biologist, Environmental Contaminants Program, U.S. Fish and Wildlife Service
Mr. Steven Turley, Faculty Research Assistant, Wye Research and Education Center

Research Description

The discovery of intersex in the form of testicular oocytes (TO) and detection of vitellogenin (Vtg) in male largemouth bass (LMB) in the Chesapeake Bay watershed has raised concerns for the aquatic food web and the quality of regional drinking water. Intersex has been correlated with regional intensity of anthropogenic activity but not causally linked to any specific endocrine disrupting chemical. Likewise, windows of particular sensitivity to TO and Vtg induction are not well understood. To address this knowledge gap, discrete groups of hatchery-reared LMB were exposed at ages of 2-3 months post hatch (mph), 5 mph, 12 mph, and 18 mph for 14 days to aqueous poultry litter mixtures, a 17β-estradiol (E2) positive control, and a negative control. A subset of fish was sacrificed at the end of each exposure and plasma analyzed for Vtg. Remaining fish were maintained under control conditions to an age of 21 months before sacrifice and tissue fixation for histological detection of TO. Adult male fathead minnows (FHM) were also exposed to allow inter-species comparison of sensitivity to Vtg induction. Histological examination of LMB gonads suggests minimal prevalence of TO and no apparent treatment effect. Plasma analysis found significant Vtg induction in mature male FHM exposed to the E2 positive control, but only minimal Vtg induction was found in male LMB at any exposure age. Despite frequent occurrence of TO and detection of Vtg in native male LMB, this species may be poorly suited as a model for investigations into endocrine disruption under standard laboratory exposure scenarios.

Acknowledgements

Team Bass would like to thank Curry Woods & Dan Thiesen of Crane Aquaculture facility for sharing their laboratory space; Dr. Luke Iwanowicz and Heather Walsh of Leetown Science Center for teaching us new laboratory techniques; and Dr. Diana Aga of SUNY Buffalo for assisting us with water chemistry tests. You've truly helped to make our project a success!

[View Team Bass's Website]

Friday, April 17, 2015
4:00-4:45 PM
Room A

CLOT: Zeolite Loaded Chitosan-Alginate Polymer Hydrogel Beads for Hemostatic Application

Research Team

May Bayomi, Microbiology
Yoon Sun Choi, Neurobiology & Physiology; Spanish minor
Katerina Christodoulides, Neurobiology & Physiology; Greek Language & Culture minor
Parinaz Fathi, Mechanical Engineering; Nanoscale Science & Technology and Engineering Leadership Development minors
Anjali Sanjaykumar Ghodasara, General Biology
Jocelyn Carrie Knazik, Cell Biology & Genetics and Theatre
Kristen Renee Langan, Neurobiology & Physiology
Benjamin John Miller, Neurobiology & Physiology
Michael Joseph Sikorski, Bioengineering
Hemi V. Thaker, Neurobiology & Physiology, Spanish Language, and Business; Cultures minor
James Michael Titcomb, Cell Biology & Genetics
Omasiri Adora Wonodi, Neurobiology & Physiology

Faculty Mentors

Mr. Adam Behrens, PhD Candidate
Dr. Peter Kofinas, Associate Dean and Professor, Fischell Department of Bioengineering, UMD

Librarian

Dr. Svetla Baykoucheva, University Libraries, UMD

Discussants

Dr. Mohamad Al-Sheikhly, Professor, Department of Materials Science and Engineering, UMD
Dr. Helim Aranda-Espinoza, Professor, Fischell Department of Bioengineering, UMD
Dr. Robert Briber, Professor, Department of Materials Science and Engineering, UMD
Dr. Isabel Lloyd, Associate Professor, Department of Materials Science and Engineering, UMD
Dr. Richard Payne, Professor, Cell Biology and Physiology, UMD

Research Description

Hemorrhage is the leading cause of preventable death post trauma. Commercial hemostatic agents exist, but have various disadvantages leading to limited use. These disadvantages include high costs and short shelf lives for biologically active surgical hemostats, and reduced hemostatic efficacy and the occurrence of exothermic reactions in common military hemostats. Polymer hydrogels are promising alternatives for promoting hemostasis and controlling hemorrhage. This project aimed to develop a hydrogel that stopped blood loss by using both biological and mechanical mechanisms. This was achieved by the utilization of components that serve as a mechanical barrier to blood loss in addition to activating the coagulation cascade to augment primary and secondary hemostasis. To accomplish this, polymer hydrogels composed of chitosan and alginate, and loaded with a procoagulant, zeolite, were synthesized and characterized. Chitosan and alginate are naturally occurring polysaccharides that were chosen because of their biocompatibility and electrostatic properties, and zeolite is a highly absorbent alluminosilicate. Swelling studies and Scanning Electron Microscopy were used to validate the efficacy of mechanical hemostatic mechanisms and verify bead porosity respectively. Bead composition was verified through the use of both an amine dye and FTIR analysis. In addition, the hemostatic ability of the hydrogel was confirmed by in vitro coagulation studies. Cytotoxicity assays were used to verify in vitro biocompatibility. The results have the potential to translate into a safe, cheap, and effective hemostatic agent with potential use in the military, surgery, and emergency medicine.

Acknowledgements

We would like to thank Zois Tsinas for his generous time and effort, our librarian Dr. Svetla Baykoucheva for her helpful resources, Dr. Frank Coale, Dr. Kristan Skendall and the rest of the Gemstone Staff for their continued support, our experts Dr. Robert Briber, Dr. Richard Payne, Dr. Mohamad Al-Sheikhly, Dr. Helim Aranda-Espinoza, and Dr. Isabel Lloyd for their time and expertise, HHMI for their generous contributions, and our mentors Mr. Adam Behrens and Dr. Peter Kofinas for their dedication, commitment, and support.

[View Team CLOT's Website]

Friday, April 17, 2015
5:15-6:00 PM
Room B

EPIDEMICS: Fabrication of Poly(D, L-lactide-co-glycolic acid) Microparticles for Improved Human Papillomavirus Vaccine Delivery

Research Team

Rachel Elizabeth Brown, Chemistry and Neurobiology & Physiology
Ellen Marie Cesewski, Materials Science & Engineering
Jonathon Fix, Epidemiology & Bioethics
Devon Clemons Freudenberger, Bioengineering
Kara Beth Higgins, Mathematics
Eileen Lynn McMahon, Mechanical Engineering
Vanessa Sandra Niba, Biochemistry and Cell Biology & Molecular Genetics
Hoon Yong Park, Biochemistry
Gabriela Lima Perdomo, Operations Management and Supply Chain Management; Technology Entrepreneurship minor
Anna K. Seo, Neurobiology & Physiology
Avantika Srivastava, Philosophy
Christina C. Tsui, Chemistry and General Biology
Aaron Keith Whiteman, Neurobiology & Physiology; Education & Human Development minor
Rebecca Zubajlo, Bioengineering

Faculty Mentor

Dr. John Fisher, Professor and Associate Chair, Fischell Department of Bioengineering, UMD

Librarian

Ms. Nedelina Tchangalova, University Libraries, UMD

Discussants

Ms. Laura Bracaglia, Graduate Research Assistant, Fischell Department of Bioengineering, UMD
Dr. Robert Briber, Professor and Chair, Department of Materials Science and Engineering, UMD
Dr. Gretchen De Silva, Lecturer and Academic Advisor, School of Public Health, UMD
Ms. Krystina Hess, Graduate Assistant, Fischell Department of Bioengineering, UMD
Dr. Christopher Jewell, Assistant Professor, Fischell Department of Bioengineering, UMD
Dr. Ian White, Associate Professor, Fischell Department of Bioengineering, UMD

Research Description

The human papillomavirus virus (HPV) is the leading cause of cervical cancer and the most prevalent sexually transmitted disease worldwide. The HPV vaccine requires a multi-dose regimen for individuals to gain immunity; however, the multi-dose nature of the vaccine contributes to low patient compliance. We addressed lack of adherence to the multi-dose regimen by formulating biodegradable poly(D,L lactide-co-glycolic acid) (PLGA) microparticles and assessing their viability for a controlled release vaccine. We hypothesized that we could alter fabrication parameters to produce 1-10 μm PLGA microparticles that would encapsulate both our model protein, ovalbumin (OVA), and HPV virus-like particles. We expected these particles to degrade over time and to produce a cellular response. The microparticles were fabricated using a double emulsion process and solvent evaporation method. Size was measured using laser diffraction, and OVA encapsulation efficiency was measured with a BCA and Bradford assay. Increase of polyvinyl alcohol concentration had an inverse effect on both microparticle size and encapsulation. Stirring time had no significant effect on size or encapsulation. Degradation was observed as particle weight loss over time and release was measured with a Bradford assay. JAWS-II cells were induced with the microparticles, and a TNF-α ELISA was used to observe cellular response. The results of this research contribute to the body of knowledge on vaccine delivery mechanisms and controlled-release technology potential in vaccination and medicine, and can be used as a foundation for creating a viable controlled-release HPV vaccine.

Acknowledgements

We would like to thank the following people and groups for their support, collaboration, and encouragement over the past three years as we have completed our project: Dr. John Fisher, Bao-Ngoc Nguyen, Dr. Christopher Jewell, Dr. Ian White, Dr. Philip DeShong, the Tissue Engineering and Biomaterials Laboratory, the Jewell Research Lab, the Gemstone staff, HHMI, and ACCIAC.

View Team EPIDEMICS’s Website

NAVIGATE: A Kinect Based Indoor Navigation System for the Blind

Research Team

Alexander G. Belov, Computer Science and Economics
Guodong Fu, Bioengineering
Janani Gururam, Electrical Engineering
Francis C. Hackenburg, Aerospace Engineering
Yael B. Osman, Psychology
John E. Purtilo, Computer Science
Nicholas M. Rossomando, Aerospace Engineering
Ryan M. Sawyer, Electrical Engineering
Ryan P. Shih, Computer Engineering
Emily C. True, Electrical Engineering
Agnes M. Varghese, Psychology and Broadcast Journalism
Yolanda Zhang, Neurobiology & Physiology and Psychology

Faculty Mentor

Dr. Rama Chellappa, Professor and Chair, Department of Electrical and Computer Engineering, University of Maryland

Librarian

Ms. Robin Dasler, University Libraries, University of Maryland

Discussants

Dr. Larry S. Davis, Professor, Department of Computer Science and University of Maryland Institute for Advanced Computer Studies (UMIACS), University of Maryland
Dr. David Jacobs, Professor, Department of Computer Science and University of Maryland Institute for Advanced Computer Studies (UMIAICS), University of Maryland
Dr. Cha-Min Tang, Professor, University of Maryland School of Medicine
Dr. Amitabh Varshney. Professor, Department of Computer Science, University of Maryland; Director of the University of Maryland Institute for Advanced Computer Studies

Research Description

Mobility in one's surroundings is dominated by a person's visual sense. Thus, navigating through unfamiliar environments presents a unique challenge to blind individuals. The Microsoft Kinect is a powerful sensor package with untapped potential to lessen the disabilities associated with blindness. In this project, we sought to determine how to best utilize its multifaceted capabilities for assisting the blind with navigation. After interviews with blind individuals, we identified several key features for an ideal navigational aid. Initial testing with our prototype revealed that users preferred a combination of auditory and haptic feedback to receive cues about the environment. Our initial prototype uses raw depth data from the Microsoft Kinect to perform real-time obstacle avoidance. Our device augments the white cane by performing two significant functions: detecting low-hanging objects and identifying stairs, both of which are tasks that the white cane cannot readily perform. We used vibration motors to indicate the presence of an obstacle and an auditory command that alerts the user of a stair in his or her path. Our project will discuss the iterative design and development of our device and the preliminary results from our testing. In the future, the prototype we designed will contribute to the burgeoning number of applications for the blind community using computer vision techniques.

Acknowledgements

We would like to thank our phenomenal mentor, Dr. Rama Chellappa for his motivation and guidance; this project would not have been possible without him. We thank Dr. Tang of the University of Maryland School of Medicine and our graduate assistant, Lee Stearns, who took time out of their busy schedules to attend so many of our meetings and advise us. We would like to express our thanks to all of our research subjects for their participation in interviews and testing integral to the success of our prototype. We thank Dr. Wallace and Dr. Thomas for their guidance while forming NAVIGATE as well as Dr. Coale, Dr. Skendall, and the entire Gemstone Program for their support and guidance as the project got underway. Last, but certainly not least, we give our heartfelt thanks to our families for their continuing support and enthusiasm towards all our endeavors.

View Team NAVIGATE's Website

Friday, April 17, 2015
4:00-4:45 PM
Room C

PANCREAS: The Effects of Insulin-Induced Moderate Hypoglycemia on Hippocampal Plasticity

Research Team

Joseph Michael Frankel, Government & Politics
Kelley Elizabeth Gunther, Psychology; Neuroscience minor
Lex Michael Matthews, Animal Science
Siddarth Kumar Plakkot, Bioengineering and General Biology
Eileen Taing Ser, Neurobiology & Physiology and Psychology
Melanie Rose Shapiro, Cell Biology & Molecular Genetics
Peter J. Weng, Neurobiology & Physiology and Economics
Danielle Marie Wilkin, General Biology and Secondary Science Education
Linhan Xu, Cell Biology & Molecular Genetics and Economics

Faculty Mentor

Dr. Erica Glasper, Assistant Professor, Department of Psychology, University of Maryland

Librarian

Dr. Svetla Baykoucheva, University Libraries, University of Maryland

Discussants

Dr. Ricardo Araneda, Associate Professor, Department of Biology, University of Maryland
Dr. Justicia Opoku-Edusei, Instructor, Department of Biology, University of Maryland
Dr. Leslie Pick, Professor and Chair, Department of Entomology, University of Maryland
Dr. Matthew Roesch, Associate Professor, Department of Psychology, University of Maryland
Dr. David Yager, Associate Professor, Department of Psychology, University of Maryland
Dr. Richard Yi, Research Associate Professor, Center for Addictions, Personality, and Emotion Research, University of Maryland

Research Description

Type 1 diabetes is an autoimmune disorder that eliminates the pancreas' ability to produce insulin. Self-regulation of blood glucose levels (BGL) with insulin introduces the risk of hypoglycemia, or low levels of blood glucose. Previous studies have shown these episodes can cause necrosis the dentate gyrus, an area of the hippocampus associated with anxiety- and depressive-like behavior. Transient reductions in BGL elicit a stress response, which activates the release of glucocorticoids. Research indicates this can diminish adult neurogenesis in the dentate gyrus. The neurogenesis theory of depression suggests this decrease in the birth and differentiation of new neurons may have behavioral implications in depression. Thus, this study sought to examine whether acute moderate hypoglycemia reduces hippocampal function in terms of behavioral mediation, for depressive-like behavior and anxiety-like behavior due to the high clinical comorbidity. One episode of moderate hypoglycemia was induced in male Sprague-Dawley rats. Twenty-four hours later, hippocampal function was evaluated via the elevated plus maze test to assess anxiety-like behavior and the forced swim test to assess depressive-like behavior. Results were inconclusive due to a small sample size, but trends suggested that acute moderate hypoglycemia may be related to an increase in anxiety- and depressive-like behavior. Future directions, besides increasing the N size, include determining more appropriate methods to monitor BGL and conducting post-mortem analysis of hippocampal tissue via immunohistological staining for bromodeoxyuridine to label new cell survival related to hypoglycemia. These findings may elucidate a relationship between structural damage induced by moderate hypoglycemia and subsequent behavioral deficits.

Acknowledgements

We would like to thank our mentor, Dr. Glasper, for the use of her laboratory and her tireless commitment to providing us with a holistic and educational research experience. In addition, we would like to thank the Glasper Lab graduate students, Molly Hyer and Shannon Sanders, for their support with data collection and analysis. We are very grateful to our librarian, Dr. Baykoucheva, for her assistance with our thesis preparations. We would also like to acknowledge the Gemstone staff for their constant support and the opportunities this program has provided. This has all been possible thanks to the support of the Howard Hughes Medical Institute.

View Team PANCREAS's Website

Friday, April 17, 2015
1:30-2:15 PM
Room A

PATH: Modeling the Effects of Landscape Fragmentation on the Movement of the Mongolian Gazelle in the Eastern Mongolian Steppe

Research Team

Connor M. Gibb, Computer Engineering and Mathematics
Michael A. Kleyman, Biological Sciences and Computer Science
Maria C. Koelbel, Mathematics and Economics
Rebecca J. Natoli, Environmental Science & Policy and Spanish
Kyle R. Orlando, Computer Engineering and Mathematics
Matthew D. Rice, Materials Science & Engineering
Claire Weber, Geography
William P. Weston-Dawkes, Mechanical Engineering; Computer Science minor

Faculty Mentor

Dr. Bill Fagan, Professor and Department Chair, Biology, University of Maryland

Librarian

Mr. Otis Chadley, University Libraries, University of Maryland

Discussants

Dr. Eliezer Gurarie, Post-doctoral Researcher, Department of Biology, University of Maryland
Dr. Allison Howard, Post-doctoral Researcher, Bill Fagan Lab, University of Maryland
Dr. Thomas Mueller, Bosch Junior-Professor, Senckenberg Biodiversity and Climate Research Centre and Department of Biological Sciences, Goethe University
Mr. Brian Phillips, Chief Software Engineer, Department of Civil and Environmental Engineering, University of Maryland
Dr. William Rand, Assistant Professor and Director, Center for Complexity in Business, Robert H. Smith School of Business, University of Maryland

Research Description

The Mongolian gazelle resides in the immense and dynamic ecosystem of the Eastern Mongolian Steppe. The unique geography of vegetation in the Mongolian Steppe changes rapidly and drastically due to chaotic weather patterns, influencing making the ability to predict Mongolian gazelle's capacity to access vegetation a complex problem that requires a sophisticated model. Furthermore, rampant habitat fragmentation due to human development projects is a serious threat to the nomadic Mongolian gazelle because it inhibits individuals from obtaining essential resources. We created a model using an Individual-based Neural Network Genetic Algorithm (ING) to predict how habitat fragmentation affects animal movement, using the Mongolian Steppe as a model ecosystem. We used data garnered from satellite collars to "train" our general model specifically to the Mongolian Steppe. Finally, we will use our findings to provide recommendations to relevant government and conservation groups to assist in mitigating the disruptive effects of future human development projects.

Acknowledgements

We would like to sincerely thank.. Our mentor, Dr. Bill Fagan for his outstanding help and guidance throughout this project. We are lucky to have had such an engaged and dedicated mentor. Dr. Coale, Dr. Skendall, Vickie Hill, and the Gemstone staff for their constant support of our project. Dr. Thomas Mueller and Dr. Kirk Olsen for their helpful input and knowledge The National Socio-Environmental Synthesis Center (SESYNC) for allowing us to use their computer and data resources. The National Science Foundation for the funding we received. Elie Guarie, Allison Howard, Brian Phillips and William Rand for agreeing to be our discussants and giving us valuable suggestions and feedback. Otis Chadley, our team's librarian.

View Team PATH's Website

Friday, April 17, 2015
2:45-3:30 PM
Room B

QUANTUM SEA: Theoretical Limits for Efficiency Increase from Quantum Dot Fluorescing Layers on Solar Cells

Research Team

James Ye Chen, Mathematics and Economics
David W. Gagner, Mechanical Engineering; Nanotechnology minor
Kevin T. Griffiths, Mechanical Engineering; Physics minor
Emily Michelle Hitz, Electrical Engineering
Akira Horiguchi, Mathematics
Ryan T. Joyce, Aerospace Engineering
Byung Yub Kim, Mechanical Engineering
Michael J. Lee, Civil Engineering
Seongwoo C. Lee, Materials Science & Engineering
Alexander T. Raul, Aerospace Engineering
DoRonne Shyu, Materials Science & Engineering
Zachary E. Siegel, Physics, Computer Science and Mathematics
Steven J. Silberholz, Computer Science and History
Douglas H. Tran, Neurobiology & Physiology; LGBT Studies minor

Faculty Mentor

Dr. Jeremy Munday, Assistant Professor, Electrical Engineering Department, University of Maryland

Librarian

Ms. Nevenka Zdravkovska, University Libraries, University of Maryland

Discussants

Dr. Raymond Adomaitis, Professor, Department of Chemical and Biomolecular Engineering, University of Maryland
Dr. Mario Dagenais, Professor, Department of Electrical and Computer Engineering, Laboratory for Green Nanophotonics, Optoelect, University of Maryland
Dr. Liangbing Hu, Professor, Department of Materials Science and Engineering, University of Maryland

Research Description

To advance solar power as an energy source, we sought to improve the efficiency of photovoltaic (PV) cells using a frequency downshifting anti-reflection coating composed of luminescent quantum dots (nanoscale semiconductor particles). High energy photons are typically absorbed near the top surface of a solar cell, and the generated carriers recombine before they can be collected at the contacts. However, when a quantum dot layer is placed on top of the cell, it can absorb the high energy photons and re-emit them into the cell at longer wavelengths, which enable more efficient carrier collection. We coated films of quantum dots on the top surface of commercial-grade cells already treated with traditional anti-reflection coatings. Our theoretical model suggests that to improve the efficiency of existing PV cells, quantum dots must have high quantum yield (>80%). Furthermore, low quality quantum dots may in fact worsen cell efficiency. Hence only quantum dots with high quantum yield should be used for these photovoltaics applications.

Acknowledgements

We thank our mentor Professor Jeremy Munday for giving us the freedom to pursue our ambitions while advising us through our problems and goals, which granted us the truest research experience an undergraduate team could have. We also thank Joe Murray for helping us build our own problem solving skills when it would have been faster for him to fix problems himself, Dongheon Ha for his lab expertise, Yunlu Xu for his help implementing the Drude-Lorenz model, and Professor Min Ouyang for his quantum dot fabrication expertise. We thank the Fablab for providing crucial lab space and equipment. We thank UMD’s Office of Sustainability and ACC Fellows Program in Creativity and Innovation for funding our lab time and materials. Finally, we thank the Gemstone Program for uniting 15 strangers toward a shared goal.

View Team QUANTUM SEA’s Website

Silver: Effects of Desferrioxamine-gallium compounds on bacteria

Research Team

Mohammad Ahmed, Neurobiology & Physiology
Emily K. Brode, Kinesiology
Thomas P. Brown, Jr., Microbiology and Psychology
Somayah M. Eltoweissy, Biochemistry; Global Poverty minor
Stephanie E. Gross, Psychology
Seth D. Markowitz, Economics; Computer Science minor
Michael A. McCutchen, Chemical & Biomolecular Engineering
Reed M. Portney, Mechanical Engineering
Jacob L. Reinhart, Chemical and Biomolecular Engineering
Cristian F. Salgado, Microbiology
Melissa J. Walsh, Cell Biology & Molecular Genetics
Sean M.J. Wassel, Neurobiology & Physiology

Faculty Mentor

Mr. Ben Woodard, Director, Biotechnology Research and Education Program, UMD

Librarian

Ms. Nedelina Tchangalova, University Libraries, UMD

Discussants

Dr. Steven Hutcheson, Professor BISI - BISI-Molecular & Cellular Biology (MOCB), UMD
Mr. John Kerwin, Manager, Biopharmaceutical Advancement Facility, UMD
Dr. Andy Lees, Scientific Director and Founder of Fina Biosolutions
Dr. David Rozak, Principle Investigator, Deputy Director, President, United States Army Medical Research Institute of Infectious Diseases (USAMRIID), Unified Culture Collection, Diagnostic Systems Division, USAMRIID, Ars Biotechnica
Ms. Marybeth Shea, Lecturer, Department of English, UMD

Research Description

Over 70% of nosocomial infections in the United States are resistant to one or more traditional antibiotics; yet there continues to be an insufficient variety of treatments. In the United States alone, bacterial infections caused by methicillin-resistant Staphylococcus aureus (MRSA) contribute to 90,000 deaths annually. Metal ions are theorized to render bacterial cells non-viable by three different methods: breaking the bacterium cell wall, inhibiting vital enzymatic functioning, or directly attacking the bacterium DNA. Due to the variety of mechanisms with which metal ions attack bacteria and the current lack of significant resistance to these metal-based methods, these treatments are an attractive alternative to traditional antibiotics. Our study aims to chelate gallium (Ga) onto siderophore compounds, specifically desferrioxamine (DFO), in order to effectively treat resistant bacteria. Once synthesized, the DFO-Ga complex will be tested against Corynebacterium xerosis, Mycobacterium smegmatis, Alcaligenes faecalis, Enterobacter aerogenes, Staphylococcus aureus, and Staphylococcus epidermidis as model strains for siderophore piracy to determine the specificity of siderophore uptake. This “Trojan Horse” method is hypothesized to be more effective in evading the development of new resistance in the treatment of strains of resistant pathogens. Our research aims to prove the feasibility of siderophore piracy, a mechanism that allows for the uptake of iron into bacterial cultures through secondary means, to enable more cost efficient and readily producible alternative treatment routes. In showing the feasibility of siderophore piracy mechanisms, our research will enable the development of future avenues of protecting against resistant nosocomial infections.

Acknowledgements

We would like to thank our mentor, Ben Woodard, for his support, hard work, and dedication to the team. We thank Kevin Knapstein, Dr. John Buchner, John Kerwin, and Jamal D. Rich for their assistance in our laboratory research. They have provided many contributions to the team and were always available for help. We thank Dr. Frank Coale, and Dr. Kristan Skendall for their wonderful coordination of the Gemstone Program, and Vickie Hill for supporting the team. We thank our librarian, Nedelina Tchangalova for all of the initial research advice. We thank our helpful thesis proposal and thesis defense panel members. Finally, we thank our ever-supportive friends and family!

View Team Silver’s Website

Friday, April 17, 2015
2:45-3:30 PM
Room C

SO GREEN: Evaluating the Feasibility of Implementing a Green Roof Retrofit on Pitched Residential Roofs

Research Team

Ben Barrett Borchers, Electrical Engineering
Connie Chow, Civil & Environmental Engineering
Matthew B. Doelp, Civil & Environmental Engineering
Lawrence J. Ent, Mechanical Engineering
Raquel S.P. Hakes, Fire Protection Engineering
Chung Heo, Civil Engineering
Kenneth C. Hunsley, Aerospace Engineering; Project Management minor
Sree Sinha, Psychology; Sustainability minor
Courtney A. Swaim, Civil & Environmental Engineering
Anna A. Whittaker, Civil & Environmental Engineering

Faculty Mentor

Dr. Andrew Ristvey, Senior Agent & Regional Extension Specialist; Commercial Horticulture at the Wye Research and Education Center

Librarian

Mr. Alex Carroll, University Libraries, University of Maryland

Discussants

Dr. Victoria Chanse, Assistant Professor, Department of Plant Science and Landscape Architecture, University of Maryland
Mr. Michael Furbish, President, Furbish Co.
Ms. Whitney Griffin, Field Expert, Furbish Co.
Mr. Ed Snodgrass, Field Expert, Emory Knoll Farms
Dr. Jack Sullivan, Associate Professor, Department of Plant Science and Landscape Architecture, University of Maryland
Dr. David Tilley, Associate Professor, Department of Environmental Science and Technology, University of Maryland

Research Description

Erosion, air, and water pollution due to stormwater runoff are major problems in the Mid-Atlantic region. One solution to these problems is the installation of green roofs; however, the majority of these green roofs are only implemented on flat, commercial buildings. We seek to create a green roof retrofit that could be implemented on sloped residential roofs, thereby filling the gap in green roof use and availability. We will create and test lightweight substrate mixes, grow several modules of plants at various slopes, and design and build our own retrofit. An economic comparison will be made comparing our retrofit to traditional roofs to demonstrate the cost to a consumer. In addition, we will gauge consumer interest and aesthetic preferences to determine whether our product could be marketable. We hope that our research will fill the hole in green roof availability by proving a lightweight retrofit can be used by homeowners.

Acknowledgements

We would like to give many thanks to Dr. Coale, Dr. Skendall, Ms. Tobin and the rest of the Gemstone Staff, Dr. Ristvey, Mr. Carroll, Ed Snodgrass and Emory Knoll Farms, Michael Furbish and the Furbish Company, Whitney Griffin, Olyssa Starry, Charlie Miller, Mr. Swaim, Mr. Hodgson, the UMD Greenhouse Staff, the University of Maryland Sustainability Fund, and all of our family and friends who have supported us for four years.

View Team SO GREEN’s Website

Friday, April 17, 2015
1:30-2:15 PM
Room C

VIRTUAL: Adapting Behavioral Parent Training as an Interactive Computer Game

Research Team

Emily C. Cheung, Psychology and Chinese
Chris Lim, Astronomy
Sharise N. Marshall, Psychology and Family Science
Chris B. Purdy, Computer Science and Mathematics
Christina R. Winkler, Special Education and Hearing & Speech Sciences

Faculty Mentor

Dr. Yiannis Aloimonos, Professor, Department of Computer Science

Librarian

Mr. Glenn Moreton, University Libraries, University of Maryland

Discussants

Dr. Andrea Chronis-Tuscano, Professor, Department of Psychology; Director of Maryland ADHD Program, University of Maryland
Dr. Kate Degnan, Research Assistant Professor, Department of Human Development and Quantum Methods (HDQM); Child Development Lab, University of Maryland
Dr. Tahli Frenkel, Department of Human Development and Quantitative Methodology, University of Maryland
Dr. David Mount, Professor, Department of Computer Science, University of Maryland
Dr. Kent Norman, Professor, Department of Psychology, University of Maryland

Research Description

Parenting techniques strongly influence child behavior and poor parenting habits predict negative child outcomes. Behavioral Parent Training (BPT) is a well-established therapy that reduces child externalized behaviors and parent stress. Although BPT was originally developed for children with defiant behavior disorders, the program's key concepts are relevant and helpful to parenting all types of children. Factors such as cost and program location can prevent parents from fully utilizing BPT. To address this issue we created online game as a potential low-cost and easily accessible alternative or complement to current BPT models. This game teaches the five key BPT skills, allows participants to interact with a child avatar, and provides immediate auditory and visual feedback for correct responses. All participants were undergraduate students at the University of Maryland and were randomly sorted into a control or experimental condition. Participants in both conditions took surveys on core BPT knowledge, while only the experimental group played through the entire game. At the completion of the game, participants completed a survey to indicate their satisfaction with the program, content, dialogue, and graphics. The experimental group demonstrated higher levels of BPT knowledge than the control group, while also indicating high levels of satisfaction with the game platform. Initial results suggest that an interactive, online BPT platform is an engaging and accessible way for parents to learn key BPT concepts.

Acknowledgements

We would like to thank our mentor, Dr. Yiannis Aloimonos, for his continued guidance over the past three years. We would like to thank Greg Kramida and Anupam Guha for all of their time and expertise. We would like to thank Emily Winner for lending us her time to help code and edit our game. Additionally, we would like to thank Dr. Andrea Chronis-Tuscano for providing us insight into the latest research and understanding in the field of Behavioral Parent Training. We would also like to thank the Sigma Xi Research Society for providing funding for our project. Finally, we would like to thank the Gemstone Program staff for their support throughout the course of our Gemstone careers.

View Team VIRTUAL's Website

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 for next year's Thesis Conference on Friday, April 15, 2016.

ATTENT: Attention Deficit Hyperactivity Disorder: Neural and Behavioral Effects of Tartrazine in Spontaneously Hypertensive Rats

Team Members: Shoshana Bloom, Kevin Chiang, Sharlene Demehri, Alexander Grillo, Sara Kreshpanji, Erin McCaffrey, Karishma Patel, Tracy Sebastian, Salwa Shan, Leah Sukri
Faculty Mentor: Dr. Thomas Castonguay, Professor, Department of Nutrition and Food Sciences, University of Maryland
Librarian: Ms. Celina Nichols, University Libraries, University of Maryland

Research Description
As holistic treatments gain popularity, there is a need for further investigation into the influence diet has on Attention Deficit Hyperactive Disorder (ADHD) symptoms. This experiment explores how tartrazine, commonly known as Yellow No. 5 and found in many processed foods, impacts impulsivity and hyperactivity. Researchers administered varying concentrations of tartrazine to Spontaneously Hypertensive Rats (SHR) which mimic human ADHD behavioral symptoms. We examined the biochemical effects of tartrazine by measuring dopamine levels in the ventral tegmental area, striatum, nucleus accumbens, and substantia nigra using Enzyme-Linked Immunosorbent Assay (ELISA) analysis. We then used a T-maze and open field chamber to measure impulsivity and hyperactivity respectively. Further research should be conducted on the dopaminergic pathway present in the brain in relation to human subjects to conclusively determine whether or not tartrazine should be removed from ADHD patients' diets.

BASIC: Effects of pH on Antitumor Immunity

Team Members: Subul Beg, Alice Chang, Ciara Egan, Lienna Feleke-Eshete, Allen Kao, James Martinson, Waheed Sehareen, Benjamin Tunick, Julia Wainger
Faculty Mentor: Dr. Zhengguo Xiao, Associate Professor, Department of Animal and Avian Sciences, University of Maryland
Librarian: Ms. Eileen Harrington, University Libraries, University of Maryland

Research Description
Cancers cause many deaths each year. Common treatments for cancers, such as chemotherapy and radiation therapy, cause debilitating side effects because they affect and damage areas other than the tumor site. Adoptive Cell Transfer (ACT) therapy is a novel cancer treatment that uses targeted therapy to restrict the treatment to the tumor site. ACT stimulates the body's own immune system to recognize and destroy tumors. However, it is inefficient on its own and requires too much time to perform. Therefore, it has a high cost with regards to money and lives. We hypothesized that this inefficiency derives from an acidic extracellular environment that is characteristic to cancer cells. We used both in-vitro and in-vivo experiments to test whether buffering the pH of cancers to reduce the acidity will enhance the efficiency of the stimulated immune cells, using B16-OVA melanoma and EG-7 lymphoma as a model.

BIKES: Bikeshare Intended Keyless Encrypted Smartlock

Team Members: Luke Boegner, Peter Cho, Nick Fleming, Tyler Gilman, Teng Huang, Kyle King, Nathaniel Kruder, Joshua Lafond, Tim McLaughlin, Isaac Noh, Will Poh, Evan Qi, Emily Ruppel, Libby Wei

Faculty Mentor: Dr. Robert W. Newcomb, Microsystems Laboratory Director, Professor, Department of Electrical and Computer Engineering, University of Maryland

Librarian: Ms. Robin Dasler, University Libraries, University of Maryland

Research Description

In order to create a functioning stationless bikeshare, team BIKES will create a Smartlock that bikeshare operators can permanently attach to each bicycle. These Smartlocks will provide security for the bicycle that other systems find in docking stations, but with significant cost savings. The main focuses of designing the lock are theft prevention, ease of implementation and use. Therefore, the lock will rely on RFID technology for user confirmation, a Zigbee mesh network for secure communication, and an ergonomic physical design. The successful implementation of a stationless bikeshare program relies on the creation of a reasonably priced smart lock with integrated technology. To achieve this goal, the team will complete the necessary research and the resulting product development amongst four subgroups: lock design, access control, geolocation, and marketing. The division of work will allow members of each team to become an expert in the specific field of their research. Weekly, each subgroup briefs the team on current research progress, such that every member will have a general understanding of the project at all times without needing to be concerned about specific details of every component.

BRAIN BLAST

Team Members: Tanya Bagheri, Vincent Bennett, Annelise Buck, Kelles Gordge, Ilana Green, Eric Kang, Nahye Kim, Caroline McCue, Unnati Mehta, Shannon Morken, Mayumi Rezwan, Ashley Zachery

Faculty Mentor: Dr. Kara Duffy, Faculty at the Center for Biomolecular Therapeutics

Librarian: Ms. Nedelina Tchangalova, University Libraries, University of Maryland

Research Description

Alzheimer's Disease (AD) is the sixth leading cause of death in the United States and the only disease in the top 10 causes of death with no treatment or cure. Both AD and Type II diabetes are characterized by problems in glucose metabolism. Current AD research demonstrates that increasing insulin levels in an AD brain decreases disease pathology, although the exact mechanism for this remains unknown. Thiazolidinediones (TZDs), a class of diabetes drug that stimulate glucose metabolism through the insulin signaling pathway, have been shown to affect the AD brain in a way similar to insulin. We aimed to use TZDs with insulin in order to investigate the insulin signaling pathway's role in AD pathology. In addition, we aimed to track the long-term effects of these drugs on AD pathology. Our study was novel in using TZDs in conjunction with insulin, as well as administering these drugs intranasally, which ensured that the drugs acted directly on the brains of transgenic AD mice. If the combination of TZD and insulin treatments result in a significant decrease in pathology, this suggests that downstream mechanisms in the insulin-signaling pathway are implicated in the development of AD pathology. Preliminary results showed that a 60μg dose of TZD showed the highest increase in the amino acid Alanine (an indicator of glucose uptake), and was statistically significant with a p-value of less than 0.05. This indicated that the treatment worked, and that higher doses of intranasal TZD significantly increased glucose metabolism.

FORGET IT: A Study of Pathophysiological Factors and Potential Protection Regarding Repeated Concussions

Team Members: Taleeah Allen-Wright, Marta Cherpak, Hyunjo Choi, Peter Fairbanks, Jonathan Huang, Anna Patnaik, Ashwin Reddi, Shradha Sahani, Charlie Urrutia
Faculty Mentors: Dr. Silvia Muro, Associate Professor, Institute for Bioscience and Biotechnology Research (IBBR) and Ms. Rachel Manthe, Graduate Student Assistant
Librarian: Ms. Nevenka Zdravkovska, University Libraries, University of Maryland

Research Description
Concussions cause stretching of the neuronal axons in the brain, which creates oxidative stress, interferes with glucose transport across the blood brain barrier (BBB) and brain parenchyma, and reduces cell viability. Our research aimed to examine the effect of a concussion in regards to these parameters for cells present in the BBB: endothelial cells, astrocytes, and neurons. We utilized human brain microvascular endothelial cells (HBMECS), astrocytes (ACs) and neurons, and examined the effects of oxidative stress (mimicked by H2O2) on expression and localization of the GLUT1 transport protein, reactive oxygen species (ROS) production, and cell viability and morphology. By western blot, we found H2O2 injury increases the expression of GLUT1 in HBMECs. However, using immunofluorescence we did not see this same effect. We have also found via western blot an increase in GLUT1 in ACs, which is supported by immunostaining. Although additional experiments are required, we have also observed increased GLUT1 expression in neurons with injury. In all three cell types, the localization of GLUT1 (entire cell vs. perinuclear) was also impacted by H2O2 injury. As well, both HBMECs and ACs exhibited reduced cell area, increased Feret diameter, decreased cell circularity, increased gap distance between cells, increased cell roundness, and decreased cell viability as a result of H2O2 injury. Lastly, injury decreased ROS production in HBMECs, which is contrary to increased ROS production in ACs and neurons. Overall, these results supported that oxidative stress may alter glucose transport element production, and decrease overall cell health and viability.

Haptic

Team Members: Andrea Bajcsy, Amelia Bateman, Alexa Cohen, Emily Horton, Mathew Jennings, Anish Khattar, Ryan Kuo, Felix Lee, Meilin Lim, Laura Migasiuk, Ramkesh Renganathan, Bryan Toth, Amy Zhang, Oliver Zhao
Faculty Mentor: Dr. Marcio Oliveira, Executive Director, Division of Information and Technology
Librarian: Ms. Robin Dasler, University Libraries, University of Maryland

Research Description
Students with visual impairments face unique educational challenges when learning elementary mathematical concepts, which rely heavily on visual perception of equations, data, graphs, and geometric drawings. Our project aims to incorporate both easy-to-use tactile technologies and dynamic haptic solutions in order to facilitate the learning of mathematical concepts. Our goal is to develop and validate an assistive device that will consist of an electrostatic touchscreen display and compatible image-to-touch and audio software in order to provide the user with auditory, tactile, and visual output. Our study is divided into three phases: (1) design of an electrostatic touchscreen display and corresponding image-to-touch and audio conversion software, (2) a pilot test to evaluate the device with blind student users in order to gain additional feedback on the device design, and (3) a learning study to assess the effectiveness of the device in the classroom. We anticipate that the integration of haptic devices in classrooms will improve acquisition and retention of mathematical concepts for visually impaired students.

JUDGMENT: Justification of Using Decision Gauged Methods to Extract Neurological Tendencies

Team Members: Arjun Adapa, Christopher Caporale, Natalie Griffin, Morgan Hrab, Christian Jeong, Minhwan Kim, Fonda Martino, Rachel O'Meara, Austin Russell, Rahul Srinivas, Rebecca Vanarsdall
Faculty Mentor: Dr. Richard Yi, Research Associate Professor, Psychology Department (BSOS)
Librarian: Mr. Eric Lindquist, Ms. Judith Markowitz, University Libraries, University of Maryland

Research Description
To address the pressing threat of violent extremism, research on the cognitive and decision-making processes of individuals choosing to engage in violent extremism is necessary. The present research applies Construal Level Theory to determine likelihood to engage in violent extremism. Specifically, Construal Level Theory states that an abstract mindset (high-level construal), compared to a concrete mindset (low-level construal), is associated with greater likelihood of engaging in motivated, self-controlled behaviors. To the extent that violence associated with extremism is typically goal-directed, high-level construal should result in an increased likelihood of engaging ideologically-based violence. In a pilot study of 153 participants, 24 vignettes covering controversial topics were assessed on features such as relatability, emotional impact, and capacity to elicit a violent reaction. The ten most impactful vignettes were selected for use in the study proper. A high, low, or no construal manipulation is being implemented, between-groups, while reading two vignettes, followed by an assessment of likelihood of engaging in ideologically-based violence. Data collection is in progress, and preliminary results indicate that participants who received any sort of construal were less likely to engage in violence.

MUSIC: Methodology for Understanding Songs by Incorporating Computers

Team Members: Monique Dalton, Ethan Ferraro, Meg Galuardi, Andrew Gast, Michael Robinson, Abigail Stauffer, Mackenzie Walls
Faculty Mentor: Dr. Ramani Duraiswami, Professor, Computer Science and UMIACS
Librarian: Mr. Steve Henry, University Libraries, University of Maryland

Research Description

Integration of music perception into song recommendation In the field of music information retrieval, there is much research on developing effective music recommendation systems; however, most recommendation engines fail to take into account the quantitative musical elements in songs in conjunction with human perception of music. Recommendations usually rely on mining user trends and intrinsic features of a piece with a five factor model of music preferences (called MUSIC) proposed by Rentfrow ambiguous descriptors, neglecting to address the individuality of the user. We aimed to unite musically et al. to yield music recommendations that we hypothesized would more accurately represent a user's musical inclinations. This study consisted of four ongoing experiments, the first two of which are the main focus of this presentation. In Experiment 1, via a focus group study, we assessed how users felt about the performance of current recommendation systems; furthermore, we determined which features users focused on when listening to music. In Experiment 2, we began composing an online survey, with song data from Rentfrow et al., to investigate how the MUSIC model could be used to effectively predict recommendations. In Experiment 3, we will investigate the predictive nature of computer-generated music features for the MUSIC model, and develop a method to predict MUSIC-type values for a wide array of songs. In Experiment 4, another online survey will be used to determine the accuracy of our model for song prediction.

PANACEA: Promoting a Novel Approach to Cellular Gene Expression Alteration

Team Members: Joseph Dong, Christopher Giromini, Woojin Han, Sonja Hatten, Ki Kim, Autusa Pahlavan, Rajan Patel, LeAnne Young, Aniekanabasi Ufot, LeAnne Young
Faculty Mentor: Dr. Jonathan Dinman, Professor and Chair, Cell Biology and Molecular Genetics
Librarian: Ms. Nedalina Tchengalova, University Libraries, University of Maryland

Research Description

A novel method for delivering small interfering RNA (siRNA) to alter cellular gene expression was recently developed at the NIH. This method uses a modular vehicle consisting of a specific ligand coupled to a Hepatitis B Virus-derived RNA binding domain (HPV-RBD). The system enables researchers to deliver siRNAs to specific cell types through cell-specific receptor/ligand interactions. These interactions trigger cells to internalize the receptor/ligand complex via receptor-mediated endocytosis (RME). When the delivery vehicle is internalized, so is the RNA cargo bound to HPV-RBD. The research objective is to develop and refine this novel small-molecule delivery system. Two novel recombinant delivery proteins are being developed: One with Interleukin-8 fused to the HPV-RBD, the other with Machupo Virus GP1 joined to HPV-RBD. After incubating with specific siRNA cargo, the recombinant proteins will be exposed to CEM (a human T-cell line) or HeLa (epithelial) cell cultures. We predict the IL-8 vehicle will specifically deliver RNAs to T-cells through the IL8 receptors CXCR1 and CXCR2, while the Machupo virus GP1, which targets the ubiquitous transferrin receptor, will deliver RNAs to all cells. qRT-PCR will be used to measure changes in specific mRNA levels in both the CEM and HeLa cells. A major limitation to safe, effective, and targeted delivery of therapeutic RNA to living cells is the harshness of conventional techniques. The gentle nature of this technology has the potential to overcome this limitation and could provide a platform for the expansion of personalized medicine.

SAVIOR: Snakehead Analysis Via Investigation and Organic Reactions

Team Members: Isha Agarwal, Lauren Amrhein, Robert Fitzgerald, Skyler Golt, Zeke Gonzalez, Yasmine Hentati, Brian Kang, Yvette Mann, Gregory Mathews, Trevor Mills, Natalie Watts, Mentored by Dr. Thomas Miller

Faculty Mentor: Dr. Thomas Miller, Director of the Chesapeake Biological Laboratory, Professor, University of Maryland Center for Environmental Science

Librarian: Mr. Alex Carroll and Ms. Eileen Harrington, University Libraries, University of Maryland

Research Description

Our research addresses the extent to which the Northern snakehead, an invasive fish species, represents a threat to the Potomac River ecosystem. One goal of our research was to determine the perceptions and opinions of recreational anglers on the snakehead population's effect on the Potomac River. To determine angler perceptions, we created and administered surveys which we based off of the MFRO Creel surveys. The results of these surveys were analyzed using SPSS. These survey results showed that there has been a decrease in target species, specifically largemouth bass, according to recreational angler perceptions. A second goal of our research was to determine the health and potential for expansion of the snakehead population. We genetically analyzed snakehead from the Potomac River. We used microsatellites derived from previous research to compare to DNA samples from harvested snakehead tissue and analyzed our results with MATLAB algorithms. Our genetic analysis supports the hypothesis that there are multiple introductions of Northern snakehead into the Potomac River.

TESLA: Time-Reversed Energy Sourced through Localized Antennas

Team Members: Dan Bolton, Frank Cangialosi, Anu Challa, Tim Furman, Tyler Grover, Patrick Healey, Ben Philip, Brett Potter, Scott Roman, Andrew Simon, Alex Tabatabai, Liangcheng Tao

Faculty Mentor: Dr. Steven Anlage, Member Center for Nanophysics and Advanced Materials, Physics Department, Faculty Affiliate of the Department of Electrical and Computer Engineering, Member of the Maryland NanoCenter

Librarian: Ms. Nevenka Zdravkovska, University Libraries, University of Maryland

Research Description

We are researching a potential technological advance in Wireless Power Transmission (WPT) technology. Pre-existing methods have a maximum transfer range of ~2 meters, with most functioning in the ~1-3 cm range. Applying a process called nonlinear time reversal (NLTR) may push the maximum range in WPT past these distances. NLTR is very similar to the echolocation process that dolphins and bats use to find other animals. An initial pulse is emitted, creating a unique signal from a target device based on the environment. By listening to this signal, we are able to selectively send information and power to this specific target. The NLTR process has been both automated and optimized for speed, allowing the entire process to occur in

umdRoute

Team Members: Emily Chen, Dafydd Durairaj, Bohr Hew, Mark Hoppel, Paula Huang

Faculty Mentor: Dr. Aravind Srinivasan, Professor,Computer Science and the Institute for Advanced Computer Studies, University of Maryland

Librarian: Mr. Alex Carroll, University Libraries, University of Maryland

Research Description

The goal of this project is to create a wearable device to detect driver drowsiness. We compared two potential alertness detectors: (1) Electroencephalograph (EEG), which measures a person's brainwaves, and (2) Glasses-mounted webcam, which tracks eye movement. We successfully showed that the Neurosky Mindwave Mobile, a single-electrode EEG consumer device, can distinguish between drowsy and alert states after collecting data for two minutes. The device has a single sensor positioned on the forehead and senses small changes in voltage across the skin. The head-mounted camera can be used to detect eye movement and eye blinks. The Vestibulo-Ocular Reflex (VOR) happens when the eyes counterbalance head movements in order to focus on a stationary point. When a person becomes drowsy, this reflex begins to slow down, and the eye overcompensates when tracking the object. We showed that the camera can be used to detect these changes in VOR to detect drowsiness.

GEMSTONE
Honors College
University of Maryland

The **Gemstone Honors Program** is a unique multidisciplinary four-year research program for selected undergraduate honors students of all majors. Under guidance of faculty mentors and Gemstone staff, teams of students design, direct and conduct significant research, often but not exclusively exploring the interdependence of science and technology with society. Gemstone students are members of a living-learning community comprised of fellow students, faculty and staff who work together to enrich the undergraduate experience. This community challenges and supports the students in the development of their research, teamwork, communication and leadership skills. In the fourth year, each team of students presents its research in the form of a thesis to experts, and the students complete the program with a citation and a tangible sense of accomplishment.

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The Gemstone Honors Program engages students in a rigorous and rewarding undergraduate research experience utilizing a multidisciplinary team approach. In partnership with extraordinary faculty, Gemstone research teams advance knowledge and explore society's urgent questions. The Gemstone Honors Program challenges and supports student growth and learning in a community that values leadership, mentoring and relationship building.