



CONGRATULATIONS TO THE GEMSTONE CLASS OF 2022 ON THE RECEIPT OF THEIR CITATIONS

On behalf of the entire Gemstone community, we express our pride in all of you, our 2022 seniors. You have accomplished much, both in your team research, in your respective majors, and on our campus. The University of Maryland is better because of YOU. Now, more than ever, the world needs you—your commitment to intellectual inquiry through research, and the way you have demonstrated your commitment to doing good in your work will make a difference for decades to come.

We have watched you mature into accomplished scholars and leaders. It was evident at our recent Gemstone Thesis Conference that each of your teams worked hard, stuck together and conducted excellent research, all while living through a global pandemic. We are honored to celebrate your accomplishments and to formally recognize all that you have done!

We hope that your experience of working together in teams has given you skills and friendships that will last a lifetime. We also hope you will continue to be active in our Gemstone community, and that you will keep us informed about the exciting developments in your careers and lives.

Our heartfelt congratulations and warm best wishes go with each one of you!

Dr. David Lovell, Director

Dr. Vickie Hill, Assistant Director for Operations

Jalah M. Townsend, M.Ed., Coordinator for Student Engagement

Danielle Walker, M.S.Ed., Communications & Event Coordinator



Team Autocycle

Team Members

Michael Allen, Electrical Engineering
Jacob Bartolomei, Computer Science
Jeremy Carter, Mechanical Engineering
Cooper Grill, Mathematics, and Computer Science;
Sustainability Minor
Mikhail Khrenov, Mechanical Engineering, and Computer
Science
Jack Mirenzi, Mechanical Engineering
Joseph O'Leary, Mechanical Engineering
Isaac Rose, Aerospace Engineering
Evan Ruderman, Aerospace Engineering
Andoni Sanguesa, Computer Science
Logan Swaisgood, Aerospace Engineering



Faculty Mentor

Dr. Romel Gomez, Professor, *Department of Electrical and Computer Engineering, UMD*

Librarian

Ms. Nedelina Tchangalova and Ms. Katie Dohe, *University Libraries, UMD*

Research Title

Design, Construction, and Validation of an Autonomous Bicycle

Research Description

Efficient urban transportation has time and time again proved to be a difficult problem to rectify. One modern solution is the bike-sharing system, where many bicycles are available either at hubs or spread across a city for short-term use. However, usage is limited to those who are located close enough to a bicycle hub that traveling to and from it is time-effective. As for hubless bike-sharing systems, bicycles require redistribution over time to remain conveniently available to many. In this thesis, we propose the concept of a dual-mode bicycle that may either be used by a cyclist manually or operated independently utilizing autonomous locomotion, sensing, and control. Such a bicycle could be implemented into a larger bike-sharing system that autonomously manages balanced redistribution and allows users to summon a bicycle to their location, expanding range of use and encouraging environmentally-friendly transportation solutions in an urban setting. We will explore existing literature that has informed later design choices and data collection methods and discuss our own methodology for designing, creating, and testing an autonomous bicycle.

Acknowledgements

We are extremely thankful to our valuable and generous mentor, Dr. Romel Gomez. Also, thank you so much to our librarian, Ms. Nedelina Tchangalova, for her support and time. Thank you to our committee members for advising us throughout the process and participating in our thesis defense. Thank you to Terrapin Works, the IFL, and our donors from the Gemstone GO Fund for providing the necessary resources. Finally, thank you to Gemstone for the opportunity to work on this research.

TEAM BRAIN (Biomarker Research Applications in Neurocognition)

Team Members

Zofia Cieslak, Biological Sciences: Physiology and Neurobiology; General Business Minor

Danny Hemani, Biological Sciences: General Biology

Anjali Kubli, Biological Sciences: Physiology and Neurobiology; French Minor

So (Danika) Lee, Biological Sciences: Physiology and Neurobiology

Rejoyce Mgboji, Biological Sciences: Physiology and Neurobiology

Madhulika C. Nallani, Cell Biology and Molecular Genetics; Women, Gender, and Sexuality Studies Certificate

Michael J. Park, Biological Sciences: Physiology and Neurobiology; Naval Science Minor

Mahalet Samson, Biological Sciences: Physiology and Neurobiology

Benjamin Wu, Bioengineering



Faculty Mentor

Dr. J. Carson Smith, Associate Professor, *Department of Kinesiology, UMD*

Librarian

Ms. Jodi Coalter, *University Libraries, UMD*

Research Title

Cognitive Testing, Neuroimaging and Blood Biomarkers in the Development and Progress of Alzheimer's Disease

Research Description

Alzheimer's disease (AD) is a progressive neurodegenerative disorder, characterized by significant loss of memory and cognitive dysfunction. It has a significant impact on an individual's health and may financially and socially burden these individuals and their loved ones. Although the disease has been researched extensively, there is still no clear understanding of the proposed mechanisms behind the development of AD, and factors aside from genetics which potentially influence the risk of developing AD. The purpose of our research was to compile and analyze data on early-stage AD patients, including biomarker presence, lifestyle factors, demographics, relationships and more, as recorded on the Alzheimer's Disease Neuroimaging Initiative (ADNI) database. Machine learning is a potential technique of analyzing this data from the ADNI database and developing a model to predict the transition from Mild Cognitive Impairment (MCI) to AD. We hypothesized that there would be a complex relationship between the self-reported lifestyle factors and biomarker data, as some factors can lower risk while others increase risk. Furthermore, we also expected decreased hippocampal volume in structural MRI scans, as well as changing levels of blood biomarkers.

Acknowledgements

First and foremost, we would like to thank Dr. Smith for guiding and mentoring our team over the last four years. We would also like to thank Daniel Callow and Gabriel Pena for their expertise, as well as our librarian, Jodi Coalter. In addition, we would like to thank our discussants, Dr. Prior, Dr. Hall and Dr. Hoffman for providing our team with valuable input and feedback on our thesis. Lastly, we thank the Gemstone staff and faculty, our generous LaunchUMD donors, and family and friends for their continued support.

Team CHANGE (Correcting Hereditary Abnormalities with Novel stem cell Genetic Engineering)

Team Members

Jessica Conway, Bioengineering
Akash Dhamsania, Finance
Eric Fields, Biochemistry, and Computer Science
Michael Jacobsen, Cellular Biology, and Genetics
Yubin Lee, Physiology and Neurobiology, and Psychology
Isabelle Lim, Physiology and Neurobiology; Spanish Minor
Nicole Salib, Psychology
Katie Shrout, Neuroscience; Sustainability Minor
Deepika Tripu, Biochemistry
Erik Vaughan, Bioengineering
Ashley Ji Woo, Physiology and Neurobiology; Spanish Minor



Faculty Mentor

Dr. Kan Cao, Associate Professor, *Department of Cell Biology and Molecular Genetics, UMD*

Librarian

Ms. Jodi Coalter, *University Libraries, UMD*

Research Title

Analysis of Gene Targeting Techniques for Huntington's Disease and Gene Expression in Human Cells

Research Description

Huntington's disease (HD) is an inherited and progressive neurodegenerative disorder that is caused by a CAG trinucleotide repeat expansion in the huntingtin (HTT) gene. Although there are interventions to manage HD symptoms, a cure for the disease has not yet been developed. Our team performed a literature analysis to investigate the current state of research for treating HD and identified a new technology called prime editing that could be applied to HD in combination with single nucleotide polymorphisms (SNPs). To this end, we did preliminary proof of concept investigations to determine how applicable this technology could be for different patients and to compare different cell models of the disease. We found that at least 729 SNPs within the HTT gene are compatible with our proposed approach and that human-derived cells from both skin and neural tissues can serve as rudimentary models for investigating cell-based therapies. We additionally developed a program that could aid in the design of prime editing systems to target diseases other than HD. Our work suggests that prime editing is a promising tool for addressing the basis of a variety of genetic disorders and may inform future efforts to develop related therapeutic approaches.

Acknowledgements

We would first like to thank our mentor, Dr. Kan Cao, for her unwavering and infinite guidance and support throughout the past 3.5 years and for generously providing us the space and resources to run our experiments. We would also like to express our gratitude toward Huijing Xue for not only her work as our discussant but also for being of invaluable assistance both inside and outside of the lab. Further thanks go to our discussants—Dr. Yantenew Gete, Dr. Sahar Vakili, and Dr. Julie Choi—for taking the time to read, listen, and provide feedback on our research. Thank you to our librarian, Jodi Coalter, and to all of our family and friends who continue to support our research efforts. Finally, our thanks to Dr. Kristan Skendall, Dr. David Lovell, Dr. Vickie Hill, Jessica Lee, and the entire Gemstone staff who have made our Gemstone experience so memorable.

Team FLOW

Team Members

Aaliyah G. Adkins, Government and Politics, and Economics
Christina S. Barrett, Cell Biology and Genetics, and Psychology
Gabby M. Fano, Business
Katrina C. Hospes, Cell Biology and Genetics, and Psychology
Christina F. Kilby, Bioengineering
Michael C. Mareno, Government and Politics, and English
Elizabeth L. Ollila, Physiology and Neurobiology, and Public Health Science
Jessica C. Pettit, Public Health Science
Tatiana Rowe, Politics, Philosophy, and Economics
Jayne G. Savoy, English
Lucy A. Wilkerson, Physics, and Astronomy



Faculty Mentor

Dr. Mona Mittal, Associate Professor, *Department of Family Science, UMD*

Librarians

Ms. Judith Markowitz, *University Libraries, UMD*

Research Title

Knowledge, Attitudes, and Practices Towards Teaching of Menstruation and Sexual Health among Parents of Middle School Students

Research Description

Menarche (the onset of menstruation), along with puberty in general, presents as a trying time for adolescents as they adjust to changes occurring in their bodies. Family life and sexual education are imperative during this transitional stage as they set the foundation for future reproductive health decisions adolescents may make. Prior research on menstruation and menstrual hygiene has primarily focused on rural populations in developing countries; few studies on this topic have been conducted in the United States (U.S.). The findings of these studies show disparities in knowledge related to menstruation and menstrual hygiene among different racial and socio-economic groups in the U.S. We added to current literature by conducting a mixed-method study to investigate knowledge, attitudes, beliefs, and parenting practices related to menstruation and sexual health education among the parents of middle school students in the U.S. We conducted an online study and collected survey data from parents of middle school students, followed by qualitative interviews with select parents (those who opted-in for this portion) to gain further insight into the attitudes and sentiments regarding menstruation and menstrual health.

Acknowledgements

We would like to thank our mentor, Dr. Mona Mittal, for providing us with support and guidance throughout this project. We truly appreciate the time and effort she has put into helping this project be the best it can be, and know that we would not have been able to accomplish so much without her. We would also like to thank our librarian, Judith Markowitz, her assistance with our initial research and the writing process, and all of our panelist discussants for taking the time to discuss our research with us today. Additionally, we would like to thank Dr. Kristan Skendall for her support, advice, and guidance navigating the research process. A huge thank you to Dr. Coale, Dr. Lovell, Dr. Tobin, Dr. Hill, and Jalah Townsend for their support over these past four years. Finally, we would like to acknowledge our family and friends for their support and encouragement.

Team GECKO

Team Members

Elizabeth Carlson, Mechanical Engineering
Anson Chen, Computer Science, and Mathematics
Stephen Chung, Electrical Engineering
Anjali Dhamsania, Chemical and Biomolecular Engineering
William Mah, Materials Science and Engineering
Lillian Mueller, Mechanical Engineering, and Computer Science
Arjun Sivarajan, Aerospace Engineering
John Ting, Electrical Engineering

Faculty Mentor

Dr. Siddhartha Das, Associate Professor, *Department of Mechanical Engineering, UMD*

Librarian

Dr. Sarah Over and Mr. Preston Tobery, *University Libraries, UMD*



Research Title

Fabrication of Soft, Ferromagnetic Films and Devices, And Their Properties, Printability, and Applications

Research Description

Developing materials that enable the fabrication of multifunctional devices has been a cornerstone of present-day materials science and engineering. Such multifunctionality enables these devices to be used for novel applications in fields such as energy, storage, health, security, sensing, and many more. We conducted an extensive literature review into the recent progress in the development of one such material capable of multifunctional device fabrication: elastic magnetic films and devices. These films and devices have two notable properties: first, they are magnetizable; second, they are physically soft and compliant. A literature review was conducted to highlight the materials, fabrication processes, characterization strategies, and resulting interactions harnessed to develop the inks that are used to fabricate these soft and magnetic films. It also discussed different applications of such physically soft and magnetic films and devices, which range from driving the motion of microscale objects, triggering fluid flows and mixing in small channels, to sensing and detection, in various biomedical technologies. In addition to this literature review, we conducted experiments with an Fe₃O₄-PDMS compliant magnetic film to characterize its magnetic properties under various modes of deformation. While undergoing bending and twisting, the magnetic saturation, coercivity, and retentivity were measured using a vibrating sample magnetometer. The results revealed that bent configurations preserved the film's magnetic characteristics better than twisting configurations; out of the twisting angles tested, a rotation of 180 degrees displayed properties closest to that of the undeformed state. Finally, we concluded by describing the potential of future research endeavors in this field.

Acknowledgements

We would like to thank our mentor, Dr. Siddhartha Das, for his counsel and assistance in our research process; none of this would be possible without his unwavering support and the countless resources he has provided. In addition, we are grateful to all of the staff in the Gemstone Honors Program for helping us create and execute an undertaking of this magnitude. We are especially thankful for the indispensable guidance provided by Mr. Swarup Subudhi and Mr. Beihan Zhao, and are grateful for their invaluable knowledge, feedback, and caring attitude towards our team. We thank our librarians, Dr. Sarah Over and Mr. Preston Tobery, as well as all of our discussants, for taking the time to review our final thesis and provide thoughtful feedback. Finally, we thank our friends and family for their generous support and encouragement, making all of this research possible.

Team LEMMA

Team Members

Mitchell Fream, Electrical Engineering, and Mathematics

Nathan Hayes, Mathematics, and Computer Science

Sahil Kochar, Aerospace Engineering, and Mathematics

Paul Kolbeck, Physics, and Computer Science

Charlie Schneider, Mathematics, and Computer Science

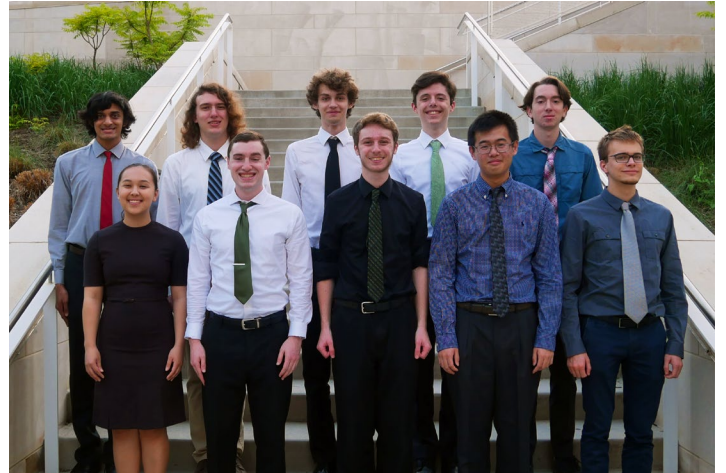
Russell Schwartz, Computer Science, and Mathematics

Olivia Sharon, Psychology; Survey Methodology Minor

Yuang Shen, Mathematics, and Economics

Winslow Weiss, Physics

Robert Wolle, Physics; Creative Writing Minor



Faculty Mentor

Dr. Pierre-Emmanuel Jabin, Professor, *Department of Mathematics and Huck Institutes, Pennsylvania State University*

Librarian

Ms. Isabella Baxter, *University Libraries, UMD*

Research Title

A Data-Driven Approach to Modeling the Spread of Extremism Over Online Platforms

Research Description

The online spread of extremist ideas has been a growing problem. Team LEMMA has worked to quantitatively model the spread of extremist ideas over Reddit in order to gain insight into how they may spread. A modest dataset of Reddit comments were manually rated on the level of extremist rhetoric present and used to train a machine learning algorithm to automatically classify large swaths of Reddit data. These ratings were then fit to a predictive agent-based model with the hopes of better understanding past trends and potentially forecasting future spread of extremism.

Acknowledgements

We would like to thank Dr. Pierre-Emmanuel Jabin for his mentorship and support throughout the past three years. We would also like to thank the Gemstone faculty and staff, who have been with us throughout our tenure in the program. Finally, we would like to thank our discussants, Dr. Derek Paley, Dr. Philip Resnik, Dr. Alan Tsang, Dr. Steve S. Sin, and Mr. Rhyner Washburn.

Team MIND (Mental Illness Recognition through Neuroimaging and Deep Learning)

Team Members

Vatsal Agarwal, Computer Science
Sepehr Akhtarkhavari, Physiology and Neurobiology
Evan Ayoroa, Computer Engineering
Ryerson Burdick, Computer Science
Aravind Ganeshan, Computer Science
Shika Inala, Physiology and Neurobiology; Nonprofit Leadership Minor
Caitlin Lee, Electrical Engineering
Sagar Matharu, Bioengineering
Neelesh Mupparapu, Bioengineering
Madhava Paliyam, Computer Science
Sam Wood, Mechanical Engineering; Computer Science Minor



Faculty Mentor

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

Librarian

Mr. Jordan Sly, *University Libraries, UMD*

Research Title

Analysis of Whole-Brain Resting-State MRI using Multi-label Deformable Offset Networks and Segmentation Based Attention with Explorations into the Ethical Implications of Artificial Intelligence in Clinical Psychiatry Settings and Care

Research Description

Due to the poor understanding of the underlying biological mechanisms of psychiatric disorders, diagnoses rely upon symptomatic criteria and clinicians' discretion. Reviews of these criteria have revealed issues of heterogeneity, over and under specificity, and symptom overlap between disorders. Deep learning provides a method to produce quantifiable diagnostic labels based upon biological markers such as specific features of brain anatomy or functionality. In practice, these methods fail to indicate how a particular result was determined, raising major obstacles for clinical implementation. To improve the efficiency and interpretability of existing deep networks, we developed a novel atlas-based attention module to more easily capture global information across different areas of brain function. Furthermore, our model can be extended to symptom level classification using NIMH data to give clinicians usable information outside of broad disorder classification. We have compared our model structure against leading 3D deep learning frameworks. We have embedded our model with elements like deformable convolutions, gradient activation visualizations, and occlusion testing to show model attention and function. In addition to the lack of explainability, addressing the ethical issues surrounding clinical implementation of artificial intelligence is necessary before usage can become a reality. We identified a series of regulatory recommendations to address pertinent ethical concerns of equity and bias during both model development and clinical usage. We propose a standardized protocol for developing a clinical reference standard, the development of diversity reports regarding data used by models, and regulation of usage scenarios to reduce contextual bias.

Acknowledgements

We want to thank Dr. Anil Deane for mentoring our team and guiding us as our project evolved over the last three years. We also want to thank Dr. Ferrante, Dr. Benedek, and Mr. Cunningham for providing us with their thoughts and valuable feedback. We also appreciate Dr. Srivastava, Dr. Ferrante, Dr. Benedek, and Mr. Cunningham for taking time out of their day to be our discussants for our thesis conference. We also would like to thank Dr. Lovell, Dr. Skendall, Dr. Vickie Hill, Dr. Leah Tobin and the rest of the Gemstone program for the last four years.

Team MUTATE (Making Universally Targeted Antiviral Treatments for Epidemic flu)

Team Members

Wellington Acquah, Biochemistry

Cameron Amini, Biological Sciences: Physiology and Neurobiology

Saharsh Buddula, Public Health Science

Michelle Chen, Biological Sciences: Physiology and Neurobiology

Navya Chintala, Biological Sciences: General Biology; History Minor

Catherine Quinn Dang, Microbiology

Noa Ferziger, Philosophy

Grace Hollis, Biological Sciences: General Biology; Global Poverty Minor

Devin Jameison, Biological Sciences: General Biology

Jyotsna Jayaram, Biological Sciences: Physiology and Neurobiology; Professional Writing Minor

Joseph Anthony Manus, Bioengineering

Jacob Rosenberg, Biological Sciences: Physiology and Neurobiology

Julia Zhiteneva, Bioengineering



Faculty Mentor

Dr. Stephanie Yarwood, Associate Professor, *Department of Environmental Science and Technology, UMD*

Librarian

Ms. Nedelina Tchangalova, *University Libraries, UMD*

Research Title

Developing a Broadly Protective Influenza Vaccine: A Review

Research Description

Current influenza vaccines are limited in their efficacy due to antigenic drift of the current target, hemagglutinin, but advances in mRNA technology due to the development of multiple COVID-19 vaccines may provide a viable new direction for influenza vaccines. We evaluated eleven influenza A virus proteins as potential targets for an mRNA vaccine. The proteins were organized into three categories: primary, secondary, and tertiary, according to degree of conservation, immunogenicity, ability to prevent illness and death, and potential as vaccine targets. We recommend future researchers direct their efforts towards developing a tri-sequence mRNA vaccine targeting hemagglutinin (HA), the matrix 2 ectodomain (M2e), and nucleoprotein (NP). Development of a broadly protective influenza vaccine could dramatically improve public health worldwide.

Acknowledgements

We would like to thank our mentor, Dr. Stephanie Yarwood, for her support and contributions to our team over the past several years. We would also like to thank Dr. George Belov, Dr. Steven Jay, Dr. Jennifer German, and Dr. Gregg Duncan for their consultation on our thesis. Additionally, a big thank you to the Gemstone Staff, our librarian Nedelina Tchangalova, and Dr. Kristan Skendall for their guidance.

Team PASS (Password Alternative Security Systems)

Team Members

Zach Breit, Computer Engineering
Evan Hunter Dean, Physics
Tai-Juan Generette, Civil Engineering
Samuel Howard, Computer Science; Math Minor
Balaji Kodali, Computer Science, and Mathematics
Jim Kong, Computer Science; Statistics Minor
Jonah Tash, Computer Science, and Mathematics; Art History Minor
Philip Wang, Computer Science, and Mathematics
John Wu, Computer Engineering



Faculty Mentor

Dr. John Baras, Professor and Founding Director, *Institute for Systems Research, Department of Electrical and Computer Engineering, UMD*

Librarian

Ms. Suzy Wilson, *University Libraries, UMD*

Research Title

Exploration of the Security and Usability of the FIDO2 Authentication Protocol

Research Description

Fast Identity Online (FIDO) is a passwordless authentication protocol for the web that leverages public key cryptography and trusted devices to avoid shared secrets on servers. The current version of FIDO, FIDO2, has become widespread and is directly integrated into popular systems such as Windows Hello and Android OS. This thesis details two contributions to the advancement of FIDO2. The first is a modification to the protocol which uses Trusted Execution Environments to resolve security vulnerabilities in the Client To Authenticator Protocol Version 2 (CTAP2), which is a component of FIDO2. It is formally demonstrated that this modification provides a stronger security assumption than CTAP2. The second contribution is an outline of procedures and resources for future researchers to carry out a study of the usability of FIDO2 authenticators via a within-subjects experiment. In the study, subjects register an account on a custom web app using both passwords and FIDO2 credentials. The web app collects metrics about user behavior such as timing information for authentication sessions. Over the course of a week, subjects log in to the same web app every day using both authentication methods. Subjects complete entrance and exit surveys based on the System Usability Scale (SUS) according to their experiences. The surveys and user metrics would then be analyzed to determine whether users perceive FIDO2 as more usable than passwords.

Acknowledgements

First and foremost, we would like to thank Dr. John Baras, for his mentorship over the last four years. We would also like to acknowledge Asim Zoukarni and Mahshid Noorani for sharing their expertise and providing invaluable contributions to our work. We would like to thank Dr. Kristen Skendall for her guidance on our project and assistance navigating the IRB process. We would like to acknowledge Dr. David Lovell and the Gemstone staff for all of their support. For their assistance serving on our thesis defense panel, we would like to thank Dr. Jonathan Katz, Dr. Michelle Mazurek, Dr. Michael Marsh, and Dr. Dave Levin. We would like to thank Ms. Suzy Wilson for serving as our team librarian.

Team PRINT (Printing Reparatively with IN-situ Technology)

Team Members

Rohith Chintala, Mechanical Engineering

Brendan Cutick, Aerospace Engineering

Tyler Han, Aerospace Engineering, and Computer Science;
Mathematics Minor

Elizabeth Myers, Aerospace Engineering

Eric Oh, Aerospace Engineering; Philosophy Minor

Aidan Sandman-Long, Aerospace Engineering

Cynthia Sheng, Computer Science; Innovation and
Entrepreneurship Minor

Nathan Spicer-Davis, Mechanical Engineering, and
Mathematics



Faculty Mentor

Dr. Steve Mitchell, Lecturer, *Department of Mechanical Engineering, UMD*

Librarian

Dr. Sarah Over, *University Libraries, UMD*

Research Title

In-situ Conformal 3D Printing for Targeted Repairs

Research Description

Additive manufacturing is an emerging technology whose users seek to benefit from repair methods to reduce time and material costs. We explore an application of the technology to targeted repairs, such as mending holes or cracks, on 3D printed parts by using conformal tool-pathing, combining the precision of additive manufacturing with the strength and homogeneity of material adhesion. To characterize the efficacy of targeted 3D printing repair for FFF plastics, repair configurations varying in shape, size, material, infill, and loading type are tested in 3-point bending for structural strength and strain. We provide and summarize the collected data in addition to structural analysis and optimization of parameters relevant to reparative 3D printing. The collected data found that 3D printed repairs were effective in replacing the strength properties of a damaged area.

Acknowledgements

We would like to thank the Gemstone program for guidance throughout our research journey and support throughout a global pandemic. We would also like to thank Dr. Mitchell and David Edelen for playing an integral part in guiding our project since its inception. And lastly, we would like to thank Dr. Sarah Over for aiding in our literature research.

Team PRODUCE (PLA Radiation to Optimize Degradation, Understanding Concern for the Environment)

Team Members

Christopher Acha, Chemical and Biomolecular Engineering

Robert Blanchard, Materials Science and Engineering;
Nanoscale Science and Technology Minor

Jonathan Brodsky, Chemistry

Lilly Ding, Accounting, and Information Systems

Andrea Fox, Chemical and Biomolecular Engineering

Kalina Gibson, Economics, and Environmental Science and
Policy

Eleanor Grosvenor, Materials Science and Engineering

Ann Hoy, Materials Science and Engineering

Justin Hughes, Materials Science and Engineering

Kristen Lee, Neurobiology and Physiology

Olivia Mihok, Biology, and Environmental Science and
Technology

Cade Stanfield, Chemistry; History Minor

Ananya Uniyal, Mechanical Engineering, and Computer Science

Sydney Whitaker, Nutritional Science; General Business Minor



Faculty Mentor

Dr. Mohamad Al-Sheikhly, Professor, *Department of Materials Science and Engineering, UMD*; and Professor, *Department of Chemical and Biomolecular Engineering, UMD*

Librarian

Ms. Marcella Stranieri, *University Libraries, UMD*

Research Title

On the Mechanism of Electron Beam Radiation-Induced Modification of Poly(lactic Acid) for Applications in Biodegradable Food Packaging

Research Description

Poly(lactic acid) (PLA) is a biodegradable polymer used for food packaging. The effects of electron beam radiation on the chemical and physical properties of amorphous PLA were studied. In this study, amorphous, racemic PLA was irradiated at doses of 5, 10, 15, and 20 kGy in the absence of oxygen. Utilizing electron paramagnetic resonance spectrometry, it was found that alkoxyl radicals are initially formed as a result of C-O-C bond scissions on the backbone of the PLA. The dominant radiation mechanism was determined to be H-abstraction by alkoxyl radicals to form C-centered radicals. The C-centered radicals undergo a subsequent peroxidation reaction with oxygen. The gel permeation chromatography (GPC) results indicate reduction in polymer molecular mass. The differential scanning calorimetry and X-ray diffraction results showed a subtle increase in crystallinity of the irradiated PLA. Water vapor transmission rates were unaffected by irradiation. In conclusion, these results support that irradiated PLA is a suitable material for applications in irradiation of food packaging, including food sterilization and biodegradation.

Acknowledgements

We would like to thank our mentor, Dr. Mohamad Al-Sheikhly, for providing us with support and guidance throughout the past four years; Lorelis González López, Catherine Lewis, Dr. Kim Morehouse, Steven Guerin, Zois Tsinas, Aiysha Ashfaq, and Eli Fastow for training us in lab skills and protocol; Dr. Lawrence Sita, Charlotte Wentz, Dr. Stas Stoliarov, Jacques De Beer, Dr. You Zhou, Dr. Peter Kofinas, and Kyle Ludwig for their generosity in allowing us to use their lab equipment; Dr. Fred Bateman and the Dosimetry Group within the Radiation Physics Division at the National Institute of Standards and Technology; our librarians, Ms. Stephanie Ritchie and Ms. Marcella Stranieri, for helping us conduct our literature review and propose our research; and the Gemstone staff and faculty— Dr. Kristan Skendall, Dr. David Lovell, Dr. Leah Tobin, Dr. Vickie Hill, Jalah Townsend, and Jessica Lee— for supporting our research endeavors.

Team REACH (Researching Efficacy and Cognitive Workload in Human-Machine Interface)

Team Members

Maxine Asenso, Economics, and Philosophy Politics
Economics; French Studies Minor

McCaughey Brown, Cell Biology and Genetics, and Spanish
and Latin American Literature, Culture, and Media

Gabriel Dayanim, Neuroscience; Philosophy Minor

Erin Doyle, Neuroscience; Hearing and Speech Sciences
Minor

Maya Greenbaum, Kinesiology

Gabrielle Lavarias, Bioengineering

Natalia Nava Mercado, Biochemistry

Christina Nguyen, Biochemistry; Spanish Minor

Anagha Rama Varma, Bioengineering; French Studies Minor

Ashley Russell, Physiology & Neurobiology

Alexys Still, Economics

Carolyn Subramaniam, Public Health Science; Sustainability Studies Minor



Faculty Mentor

Dr. Rodolphe Gentili, Associate Professor, *Department of Kinesiology, UMD*

Librarian

Ms. Jodi Coalter, *University Libraries, UMD*

Research Title

Measuring Mental Workload and Brain Dynamics in Prosthesis Motor Learning Over Multi-Session Practice

Research Description

The acquisition of novel motor skills involves complex brain dynamics that include cognitive and psychological processes. This is particularly true for upper limb amputees learning to use a prosthetic device. An important factor affecting motor learning outcomes is mental workload, or the amount of mental resources that must be devoted to a given task demand. Existing literature on upper limb prosthesis learning is limited. Many studies have primarily examined either the behavioral components of learning or the cortical dynamics underlying the process. The present study has taken a combined approach to study the relationship between the brain dynamics, motor learning, and motor performance of an upper limb prosthesis user over multiple practice sessions. Participants in this study used a bypass prosthetic device to perform various tasks over the course of 6-10 weeks. Performance was assessed using objective kinematic data measurements and subjective surveys. Cortical dynamics were measured using electroencephalography. We hypothesized that as motor performance improved, mental workload would decrease, and that motor performance would improve at a faster rate than mental workload.

Acknowledgements

We would like to thank our mentor, Dr. Rodolphe Gentili, for all of the guidance, expertise, and enthusiasm he has offered our team over the past four years. We are also grateful to Christopher Gaskins, Dr. Isabelle Shuggi, Anna Packy, and Alexandra Shaver for teaching us many of the technical methods used in our project. We are thankful for the invaluable knowledge and feedback provided by our team librarian, Jodi Coalter. Thank you to the donors who supported our LaunchUMD campaign and made our research possible. We are grateful to our discussants for generously lending their time and expertise to our team at the Thesis Conference. Finally, we would like to recognize the Gemstone staff members, past and present, who facilitated our success every step of the way. To Dr. Kristan Skendall, Dr. Vickie Hill, Jalah Townsend, Dr. Leah Kreimer Tobin, Jessica Lee, and Dr. David Lovell – thank you!

Gemstone Award Descriptions & Past Gemstone Award Winners

*Special thank you to our Gemstone Awards Committee
Dr. David Lovell, Dr. Vickie Hill, Jalah Townsend, Zeke Gonzalez '16, and Edward Lin '15*

Gemstone Rookie of the Year

This award recognizes an outstanding first year Gemstone student who has demonstrated enthusiasm for interdisciplinary research and commitment to involvement in the Gemstone Honors Program.

2013	Emily Ruppel	2018	David Polefrone & Mansu Shrestha
2014	Pradip Ramamurti	2019	Logan Swaisgod
2015	Eliot Frank	2020	Ethan Green
2016	Saul Schaffer	2021	Joshua DiGiorgio
2017	Eli Fastow		

Most Valuable Team Member Award

This award recognizes a student who has demonstrated excellent organizational, interpersonal, and communication skills and has played a key role in clearly motivating his or her team over the past year.

Sophomore Winners

2013	Devon Freudenberger	2018	Linnea Warburton
2014	Parinaz Fathi	2019	Stephanie Moy
2015	Adam Berger	2020	Gillian Lee
2016	Prateeti Sarkar	2021	Joanna Ihm
2017	Thea Ornstein		

Junior Winners

2013	Eric Kazyak & Natalie Anzures	2018	Greg Krasnoff
2014	Timothy McLaughlin	2019	Abdulfatal Fakoya
2015	Isha Agarwal	2020	Aranya Banerjee
2016	Chris Rother	2021	Mikhail "Misha" Khrenov
2017	Cassidy Ladilaw		

Mentor of the Year (Sophomore and Junior Teams)

This award recognizes an outstanding Gemstone faculty mentor who has provided dedicated service to a sophomore or junior Gemstone team.

2013	Dr. Lance Yonkos & Dr. Matthew Roesch	2018	Dr. Lex Schultheis
2014	Dr. Tom Miller & Adam Behrens	2019	Dr. Margret Bjarnadottir, Dr. Sean Barnes, & John Daristotle
2015	Dr. Susan Dwyer & Dr. Zhengguo Xiao	2020	Stephanie Yarwood
2016	Dr. Debu Biswas & Jon Hoffman	2021	Dr. Mary Beth Furst & Dr. Romel Gomez
2017	Dr. Ryan Sochol & Dr. Mark Fuge		

Gems Camp Leader of the Year

This award recognizes an outstanding Gems Camp Leader who has demonstrated enthusiasm for the program and eagerness to orient and interact with first-year students at Gemstone's annual Gems Camp.

2015	Eileen Ser	2018	Emma Margolis
2016	Becky Vanarsdall	2019	Divya Kapoor
2017	Caroline Simon	2020	Michael Piqué

Outstanding CONNECT Mentor

This award recognizes an outstanding CONNECT peer mentor, who has demonstrated enthusiasm for the program, eagerness to orient first-year students, and dedication to working with other mentees to enhance the experience.

2015	Tracy Sebastian	2019	Haley Mullen
2016	Erin Verni	2020	Imran Khawaja
2017	Kayla Sukri	2021	Imran Khawaja
2018	Humza Yahya		

Outstanding Section Leader

This award recognizes an outstanding section leader (GEMS100, GEMS102, GEMS104, or GEMS202) who has demonstrated enthusiasm for the program and has gone above and beyond with their teaching responsibilities.

2015	Kara Higgins	2019	Soma Umeozulu
2016	Annelise Buck & Elizabeth Corley	2020	Haley Mullen
2017	Alex Boukhvalova & Lara Fu	2021	Aarushi Maholtra
2018	Shireen Khayat		

Robert McDermott Fearless Award

This award was created in 2018 in remembrance of Robert McDermott. Each year, this award is given to the Gemstone student that best exemplifies the qualities that made Robert such a valued member of our community. Nominees must exhibit general optimism, resilience, and dedication in the face of adversity with a sense of self-awareness of their strengths and weaknesses that allows them to provide creative solutions to adapt their own skills and abilities for the purposes of their project. Above all, nominees should be those that bring a “can do” attitude to any challenge they face and prioritize their Gemstone project throughout their time in their program.

2018	Robert McDermott	2020	Ria Sebastian
2019	Daniel Lay	2021	Class of 2021

Gemstone Senior Awards

Outstanding Gemstone Citizen and Leader

This Program could not function without the involvement of so many students. This award goes to a graduating student who has demonstrated enthusiasm, constant involvement and leadership within the Gemstone Program. Those considered for this award are nominate by their peers and have been very involved in the Gemstone Program outside of his or her team by holding positions of leadership, planning events, or serving as a positive role model for the Program.

2002	Jeremy Rachlin	2012	Jillian L. Chavis & Joshua G. Lacey
2003	Sara McKelvey & Soroush Rais-Bahrami	2013	Jaishri Shankar
2004	Emily Beckstrom & Andy Smith	2014	Jessica Lee & Taylor Hearn
2005	Thomas Haun	2015	Ed Lin
2006	Ryan Hoffmaster & Justin Waltrous	2016	Ilana Green & Zeke Gonzalez
2007	Nikhil Joshi & Greg Teitelbaum	2017	Marquise Singleterry
2008	Anita Kohli & Teddy Tien	2018	Allison Chen
2009	Pratik Davè & Lindsey Mooney	2019	Cristina Hnatov
2010	Hannah Tolley	2020	Emma Margolis
2011	Akhila Iruku & Katherine Mann	2021	Ria Sebastian

Outstanding Gemstone Team Scholar

This honor will be awarded to a student who has been intellectually engaged and highly involved on their Gemstone team. This award goes beyond the normal leadership behavior of organizing the group, motivating members and running meetings. Nominees for this award should be students that have taken the intellectual leadership role and have served as a driving force behind the topic and content of the research. We strive to give the award to a student who demonstrated passion for the team's topic and was truly engaged in the subject matter.

2002	Elizabeth Flynn and Philip Jones	2012	Matthew Conway
2003	Robert Schroll	2013	Alex Mamunes
2004	Christian Klein	2014	Sudi Jawahery
2005	Gregory Crosswhite & Ashley Naimaster	2015	Katerina Christodoulides
2006	Alan O'Connor	2016	Andrea Bajcsy
2007	Emma Simson & Travis Young	2017	Megan Dang & Elfadil Osman
2008	Neil Agarwal & Robert Vocke III	2018	Prableen Chowdhary & Sarah Frail
2009	David Chen & Gregory Hitz	2019	Morgan Janes
2010	Stephanie Galanie & Ben Tousley	2020	Shifali Mathews
2011	Junjie Hao & Angela Lee	2021	Sam Klueter

Outstanding Gemstone Team Leader

This award recognizes a student who has demonstrated excellent organizational, interpersonal, and communication skills and has played a key role in clearly motivating his or her team over the past three years.

2004	Jamille Bigio & Phil de Souza	2013	Sebastian Serrano
2005	Philip Brazio & Lauren Schlanger	2014	Yoon Shin
2006	Sumair Akhtar & Margaret Distler	2015	Devon Freudenberger
2007	Kristin Freese & Patrick Hughes	2016	Natalie Griffin
2008	Christina Walsh	2017	Meredith Pecukonis
2009	Elizabeth Dillon & Lee Stearns	2018	Anna Harrison
2010	Nick Asendorf & Kelsey Merrick	2019	Cara Schiksnis
2011	Jasjeet Khural & Adam Pampori	2020	Linnea Warburton
2012	Timothy L. Crisci & Tina Zhang	2021	Aranya Banerjee

Outstanding Gemstone Team Presentation

As a requirement of the Gemstone Program, teams are expected to write and defend a thesis. Teams are given 25 minutes at the Thesis Conference to communicate three years' worth of research to an audience of experts, families, and friends. The honor of the Outstanding Presentation is awarded based on a team's clarity, creativity and overall presentation style. No nomination is required to be considered for this award.

2002	Non-Lethal Weapons	2012	FLIP
2003	Global Ed-Venture	2013	KERMIT
2004	Innovations	2014	ADDICT
2005	SmartRoads	2015	Bass
2006	PlayInc	2016	Brain Blast
2007	Team URBAN	2017	NATURE
2008	Binge Drinking	2018	GOLD
2009	iGem	2019	SPACE
2010	IMAC	2020	LYTIC
2011	Cogeneration Technology	2021	FORMULA

Gemstone Team of the Year

A new addition to the annual recognition of exceptional students, teams, mentors and librarians, this award recognizes a team that truly exemplifies the values of the program.

2014	MEGA	2018	VIRUS
2015	VIRTUAL	2019	OYSTERS
2016	SAVIOR	2020	ART
2017	PIEZO	2021	IPOV

Outstanding Gemstone Mentor

This award recognizes an outstanding Gemstone faculty mentor who has provided dedicated service to and demonstrated exemplary support and guidance of his or her team. This honor is based on nominations from the students

2002	Dr. Greg Baecher	2012	Sameer Shah
2003	Dr. Colleen Farmer	2013	Dr. Stephanie Grutzmacher
2004	Dr. Ray Adomaitis & Dr. Linda Schmidt	2014	Dr. Peter Mallios
2005	Dr. Gilmer Blankenship	2015	Dr. Andrew Ristvey
2006	Dr. Frank J. Coale, Dr. Francey Kohl, & Dr. Jim Purtilo	2016	Dr. Marcio Oliveira
2007	Ms. Karen Thornton & Dr. James Milke	2017	Dr. Matthew Roesch
2008	Dr. David Tilley	2018	Bryan Quinn
2009	Dr. Lowell Adams & Dr. Rama Chellappa	2019	Dr. Jin-Oh Hahn
2010	L. Curry Woods	2020	Joanna Goger
2011	Dr. Kevin Sellner & Dr. Charlie Carr	2021	Dr. Natasha Andrade

Gemstone Librarian of the Year

This award recognizes an outstanding librarian for his or her dedication to the Gemstone Program and team research. It is awarded to the librarian who has demonstrated exemplary support and guidance of his or her senior team. This honor is based on nominations from the students.

2014	Nevenka Zdravkovska	2018	Kelsey Corlett-Rivera
2015	Robin Dasler	2019	Dr. Sarah Over
2016	Celina McDonald	2020	Nevenka Zdravkovska
2017	Eric Cartier	2021	Jodi Coalter

James M. Wallace Outstanding Gemstone Team Thesis

This award recognizes the team with the best submitted thesis based upon feedback from discussants, mentors, and the Gemstone staff. No nomination is required to be considered for this award.

2002	Fish Sustainability and Innovative Tracking Systems	2012	FACE
2003	Ecodynamics and Universal Playgrounds	2013	Solar Campus
2004	GEMS: Generating Eager Minded Students	2014	ELECTRODE
2005	SWAMP	2015	CLOT
2006	Phosphorus Agriculture Runoff Management	2016	Haptic
2007	TRACK	2017	INJECT
2008	CRABS	2018	ARM IT
2009	Renewables at UMD	2019	DIVA
2010	CHIP	2020	VISOR
2011	BREATHE	2021	ASTRO

Stay Connected with the Gemstone Honors Program!



GEMSTONE
Honors College
University of Maryland

0100 Ellicott Hall
4052 Stadium Drive
College Park, MD 20742
301-458-0784 | gems@umd.edu

Website: gemstone.umd.edu
Facebook: facebook.com/GemstoneProgram
Twitter: twitter.com/GemstoneProgram
Instagram: instagram.com/GemstoneProgram