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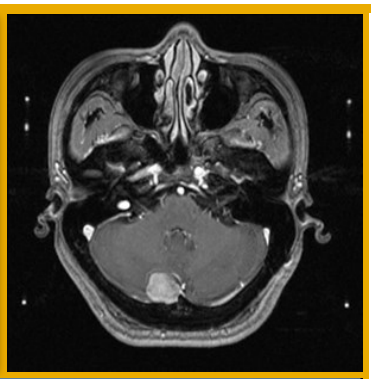

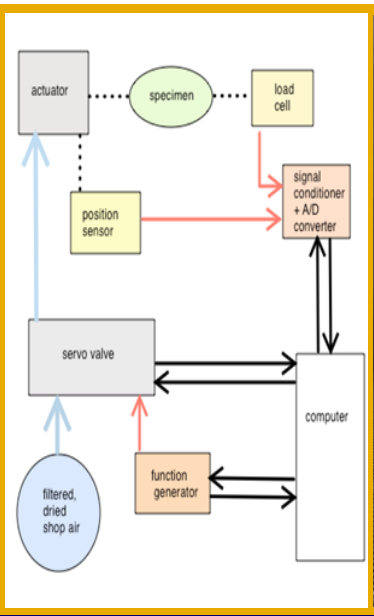

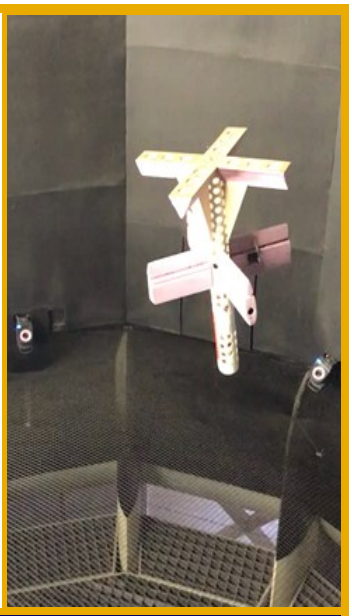

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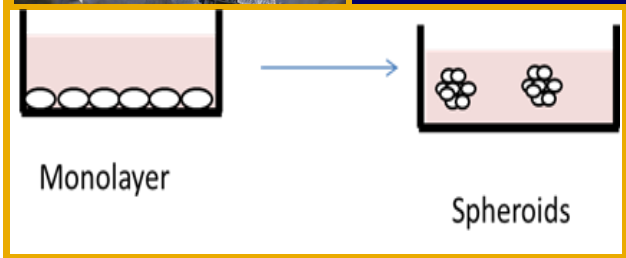
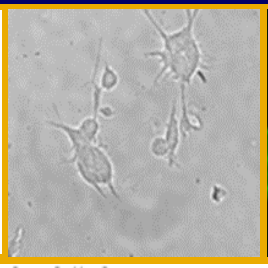
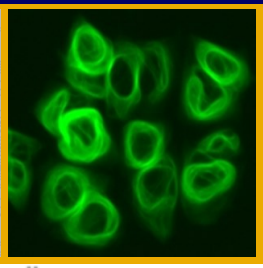
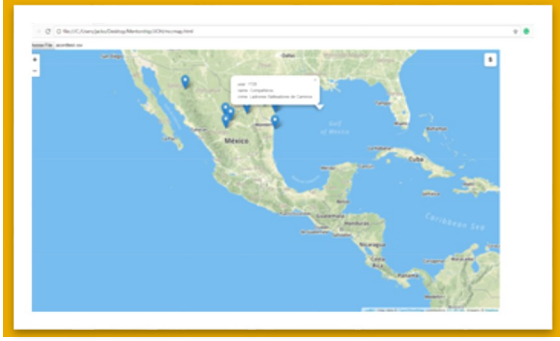
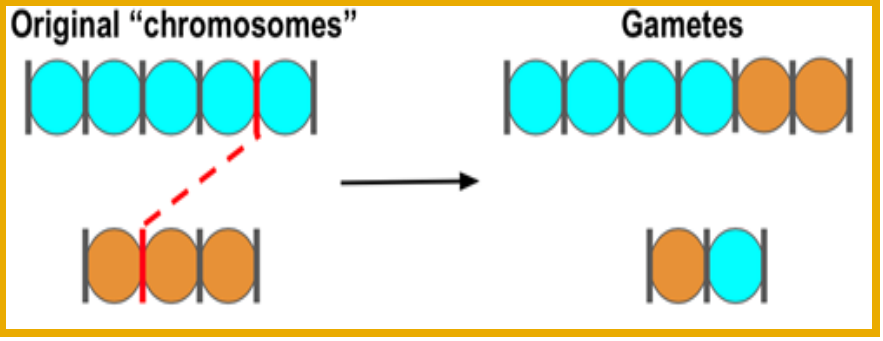


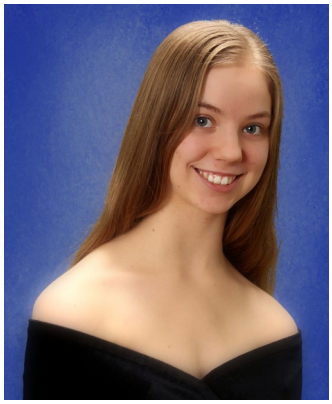








Sensitivity Analysis of Space Radiation Risk of Exposure-Induced Death (REID) Models



Katherine Perkins
Warwick High School
Newport News City Public Schools

Abstract

Astronauts in deep space are exposed to high levels of damaging ionizing radiation. NASA uses the measure risk of exposure-induced death (REID) to represent the risk to astronauts of dying from space radiation exposure. The maximum allowable REID for the career of an astronaut is 3% at the upper bound of a 95% confidence level. REID is determined for each astronaut based on their gender, age at exposure, and smoker/non-smoker status. In addition to these demographic model inputs, NASA researchers must set values for several other variables in the model.

A multivariate sensitivity analysis of the risk code was completed by observing the change in output risk with variations in the values of parameters: age at exposure, the lower limit of summation from an astronaut's exposure, and the upper limit of summation.

With age at exposure set to 35 years, the threshold value for decrease in REID from variation of the upper limit of summation was observed to be 95 years. After this point, the probability of survival for the background population becomes negligible, so there is little additional risk each year. There was little change in REID when varying the value of the upper limit between 40 and 55 years. This is accounted for by the fifteen-year latency period for cancer, after which the occurrence of cancer-induced death greatly increases.

REID decreases consistently with increasing age at exposure, except exposure at 40 years, for which the calculated REID is higher than REID for exposure at 35 years. This increase is caused by a higher background population mortality probability at this age. Additionally, the decrease in REID becomes much smaller at age at exposure 75 years, with the calculated REID staying constant at 10.724% for females and 7.614% for males between ages 75 and 90, the largest tested age. Female values of REID were larger than male values of REID for nearly all values of both the upper and lower limits of summation.

...Astronauts are exposed to high levels of damaging radiation....

"I feel so much more confident in my own capabilities now that I have solved problems alongside a professional. My favorite times in mentorship were when I worked with my mentor to understand and solve a problem that challenged us both. Mentorship was also a great way to network with other NASA researchers, scientists, and engineers. I had three fantastic internship offers for the summer after my senior year because I had the opportunity to talk with people across centers during the school year.

Mentorship also broadened my perspective on careers. I had this assumption before senior year that it was next to impossible to get a job with a degree in math or physics, but at NASA I met physicists and research mathematicians, including my mentor, who were incredibly inspiring and encouraging to me. I am so grateful to Governor's School and my wonderful mentor, who worked to make this year such a positive experience for me."

Katherine will be attending Harvey Mudd College.

Developing a Population Genetics Model for Transposable Elements

Jakob Weiss
Lafayette High School
Williamsburg/James City County Schools

Abstract

Transposons (transposable elements or TEs) are mobile DNA sequences that comprise substantial amounts of the genomes of many organisms. The dominant population genetics model for TEs fails to explain their empirically observed overdispersion and non-uniform distribution in a population of seep monkeyflowers in which many phenomena known to be influenced by TEs have been detected. Three models for TE behavior with progressively greater complexity were developed and simulated to account for TE overdispersion and blocking.

The first model, which represented TEs as "dots," allowed development of a recombination mechanism, used in the subsequent models, in which recombination in the presence of selection could lead to TE loss. The second model, which represented a quasi-chromosome with an initially uniform distribution of TEs, incorporated fitness, selection, and the ability to be simulated for multiple generations. The third model combined several instances of the previous model to form a more realistic quasi-chromosome with blocks of TEs separated by gene islands.

Comparison of results of Monte Carlo simulations of the TE block model with and without recombination suggests that recombination creates and maintains variation of TE loads in a population and is, therefore, chiefly responsible for overdispersion of TEs. The TE block model is able to reproduce overdispersion and is an improvement over the dominant model. In the future, the TE block model will be implemented in an ongoing multi-year investigation at the College of William & Mary into the relationship between TEs and various higher-order genomic phenomena.

...Model is able to reproduce overdispersion of TEs...

"I was honored to work alongside Mr. Ron Smith in the Computational Biology Laboratory at the College of William & Mary this year. Through my mentorship, I gathered various skills and experiences that will be valuable to me in the future. To name a few, I became proficient in MATLAB (especially its modeling and simulation capabilities), learned how to present results graphically in a clear and compelling way, and became acquainted with the realm of possibilities that is emerging as a result of the proliferation of bioinformatics technologies. This mentorship was not in a field similar to the focus of my GSST strand (engineering), but that novelty made it all the more rewarding."

Jakob will be attending Boston College.

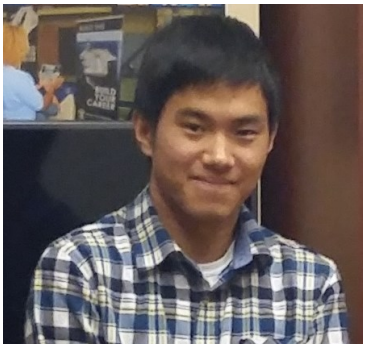
Implementation of Techniques to Create an Interactive Map

Abstract

People use maps in various ways; they allow individuals to see the geographic features of a territory and to find ways to get from one place to another. Maps created by software not only have the features of original maps, but can also determine the shortest path given current traffic conditions, display a description of a location, and calculate the time to get from one place to another. Leaflet is an open source JavaScript library used to build online map applications. It has most of the mapping features developers want, and it has a simple, readable source code and well-documented API. Techniques that can import data to the map and display data through time were developed. Archivo General de la Nacion, 18th century Mexican court case data, and 2016 Democratic Primary data of Fairfax County were used to demonstrate these techniques. A Fairfax County map that can display four different kinds of primary voting results by moving a scroll bar was created. The Mexican court case map was created which allows users to import a csv file. Mexican court case map was tested by importing data in Archivo General de la Nacion and it successfully displayed court cases on the map. The map displayed the information of the court cases using markers. These techniques can be used to create other historical maps to display events or change in territories, and other interactive maps that need display to change when an element is changing.

Taekwan Oh
Tabb High School
York County Public Schools

"It was an amazing experience to work on the project with wonderful people. Dr. Lambert was the best mentor; she always cared about us and did her best for us. We would also like to thank Laurence Carlucci and Sean Workman for giving us huge help throughout the project. We gained knowledge of open source and git, and mainly we developed our JavaScript skills to create an interactive map. We had lots of challenges and had to change direction in the middle, but we managed our situation well and successfully finished our project. It was an unforgettable experience and I believe that most of the people who do mentorship will have a great experience."



Taekhoon Oh
Tabb High School
York County Public Schools

...Court case locations and descriptions are displayed on interactive maps...

"Mentorship was one of the best experiences I had all senior year. I had the honor of working at CNU with Dr. Lynn Lambert and two undergraduate students, Laurence Carlucci and Sean Workman. I enjoyed working as a team with my brother and my time at CNU has allowed me to gain a better understanding of the field of computer science. I learned how to implement my programming skill in real life by developing techniques to create an interactive map and learned how to use Git. I am very grateful for the opportunity I got and I will always remember this experience as a chance that allowed me to become a real researcher."

Taekhoon and Taekwan will be attending Rochester Institute of Technology.

Developing a Story Map on Gerrymandering Using ArcGIS

Elizabeth Schell
Jamestown High School
Williamsburg/James City County Schools

Abstract

The Voting Rights Act was passed in 1965 in an attempt to stop the disenfranchisement of minority voters in the United States. It established that racial gerrymandering was illegal and that citizens could go to court if they felt a district was gerrymandered. In a recent College of William & Mary course, law and undergraduate students redesigned eleven contested districts from the Supreme Court case Bethune Hill v Virginia State Board of Elections. An Esri story map contains educational information on racial gerrymandering and vote dilution as well the maps suggested by students. This was done using ArcGIS and the story map functions available through Esri. Esri story maps allow mixing of maps created with ArcGIS with text and multimedia content. The maps were created using census data and election data. The data and shapefiles were exported to arcOnline where they were manipulated as layers to create interactive maps. Each map had to coincide with a part of the story map and be relevant to the topic. The story map featured thirteen different sections that cover different gerrymandering related topics and nine maps overall. The story map was focused on the Bethune Hill case, but covers the basis and details of redistricting.

...students redesigned eleven contested districts from the Supreme Court case Bethune Hill v Virginia State Board of Elections...

"My mentorship at the College of William and Mary has taught me essential skills not only in advanced technologies, but also how to work in a professional atmosphere and interact with professors. I was able to attend public forums and educate citizens on problems plaguing our government and meet with U.S. Representatives and officials that are making strides in reforming our redistricting policy. My mentorship focus on social studies has inspired me to pursue a career that combines technology and policy. I'm more confident and excited to go to college and continue to research than ever."

Elizabeth will be attending the University of Virginia.

Designing and Programming of a Weight Sensing Post-Op Shoe

Abstract

Many patients coming out of specific surgeries, such as knee and hip replacements, have weight restrictions put in place by health practitioners, meaning that they can only place a certain percentage of their body weight onto the affected foot/leg. Compliance is critical for proper healing. The current method of physical therapists is to have patients stand on a scale until the maximum acceptable weight is displayed so that the patient has a working knowledge of how the amount feels. This method is ineffective in that it does not help assess how much weight is being distributed onto the affected leg during treatment sessions. It is expected that receiving continual feedback of what amount of a patient's weight is placed on the affected foot/leg will help the patient to learn and remember how to correctly walk with their weight restrictions.

A postoperative shoe retrofitted with load cells connected to a Raspberry Pi was designed to give continuous feedback to therapists and patients. Data representing the plantar pressure are translated and transmitted to both a web-based application on the physical therapist's computer and a screen on the top of the shoe. The program is designed to give real time estimations to the health professional, while the screen is mounted to the shoe for patient viewing. The accuracy of the prototype shoe was tested by measuring the total body weight of three people, weighing 150, 165, and 180 pounds, four separate times. Measurements were accurate within 3-5 pounds for each subject, which is acceptable. The prototype was used by 17 people who walked in it for several minutes to determine its comfort level, and it was determined to be highly comfortable, and therefore unlikely to discourage patients from its use. Finally, provisional patent application was filed, and is pending, to protect the intellectual property of the weight measurement.

...Accurate measurements were obtained and the shoe was highly comfortable...

Gabriel Edwards
Kecoughtan High School
Hampton City Schools

"Through this mentorship, I have learned a great deal about product design and production. One of the most valuable of these things is how to work in conjunction with someone in a different field than myself, which I am sure will serve me greatly in my future career. I have very much enjoyed being able to learn programming skills through this mentorship in both the Python and HTML languages, and I am very thankful for this opportunity. Having the opportunity to present our project at the world's largest modeling and simulation conference in Florida was an amazing experience, and I can safely say that after having presented there, I have not been nervous to give a single presentation."

Nathan Robinson
Kecoughtan High School
Hampton City Schools

Gabriel will be attending the University of Virginia. Nathan will be attending Virginia Tech.

Rates of Selfing and Outcrossing in *Osmunda claytoniana*

Emily Quick-Cole
Kecoughtan High School
Hampton City Schools

Abstract

Within the world of plants exists four main categories: mosses, ferns, gymnosperms, and angiosperms. Among those groups, plants can be further categorized as flowering and nonflowering, with angiosperms falling into the flowering group and mosses, ferns, and gymnosperms falling into the nonflowering group. These classifications are based on a host of differences, one of the most specific being reproduction. Most ferns can be classified as homosporous, meaning they produce spores of one size which grow into bisexual gametophytes. Due to this, ferns are believed to be extremely inbred, with little genetic diversity throughout populations, even though there are three methods of reproduction available to them: intragametophytic selfing, intergametophytic selfing, and intergametophytic outcrossing. This study focused on the species *O. claytoniana*, which grows in temperate climates. The rates of selfing and outcrossing within a population of this fern species were determined by looking at specific alleles of microsatellites and comparing them among the two known parent ferns and the offspring that made up the population. Offspring *O. claytoniana* resulted from intergametophytic outcrossing in 69%, compared to only 31% of offspring resulting from selfing. This indicates that *O. claytoniana* may follow the pattern of being highly outcrossing as seen in other fern species.

...Microsatellite data suggest a high rate of outcrossing in Osmunda fern...

"My mentorship experience with Dr. Janet Steven at Christopher Newport University is one that allowed me to delve into the botanical world while simultaneously learning a multitude of laboratory research techniques. I am grateful for the opportunity to participate in research as a high school senior and look forward to continuing scientific inquiry in college and throughout my professional career."

Emily will be attending the University of Virginia.

Lewis McAllister
Menchville High School
Newport News City Public Schools

Treatment Outcomes of Meningiomas with Gamma Knife Radiosurgery

...Gamma knife radiosurgery is a viable option for treating meningiomas ...

Abstract

Meningiomas, tumors arising from the arachnoidal cells in the meninges, are typically slow growing and have a low fatality. Treatment of meningiomas can be difficult because they are located in the brain or spinal cord and can be in close proximity to important brain and neurological structures, sometimes making surgical removal via a craniotomy not a viable option. Gamma Knife radiosurgery is a form of stereotactic radiosurgery which uses 201 cobalt-60 radiation sources to focus radiation on growths in the brain while limiting radiation and damage to nearby brain structures. A retrospective review of 98 patients who have undergone Gamma Knife radiosurgery at the Riverside Radiosurgery Center assessed whether or not Gamma Knife radiosurgery successfully treated meningiomas and was able to reduce their sizes.

Looking at the initial volume of the meningiomas prior to Gamma Knife surgery and the finding the volume from follow-up MRIs by contouring the meningiomas over the course of three years following initial treatment, it was found that Gamma Knife radiosurgery had a similar tumor control rate as surgical removal. After three years, 86% of meningiomas treated were smaller than they were before treatment and after three years the tumors had a mean decrease in volume of -15.4%. These results indicate that Gamma Knife radiosurgery is a successful medical technique for meningiomas and should be considered a viable option for treating meningiomas.

"My mentorship was a great opportunity to see inside the medical field and develop a deeper understanding of the tumor condition I studied and the radiation oncology field. I would definitely say that while it was difficult and time-consuming, it was a fascinating and stimulating experience that has been eye-opening and has influenced what I plan to study in college and pursue as a career. Being able to work at the Riverside Radiation Oncology Center was an opportunity I would not pass up if offered again and this mentorship enhanced the Governor's School experience."

Lewis will be attending Harvard University.

Evaluation of Calculation and Implementation Errors in a Hospital Setting

Hailey Joyce
Smithfield High School
Isle of Wight County Schools

Abstract

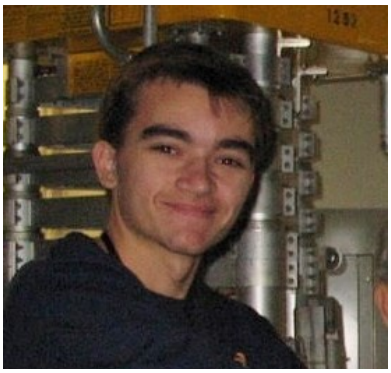
Falling could be a major cause of additional injury within a hospital and can cause lengthened recovery times for patients and liability issues for the hospitals. Over the past year, a local hospital in Virginia reported 92 patient falls, with 22 resulting in injury. The administration wanted to determine if the fall risk calculation system that the hospital utilizes, The Johns Hopkins Fall Risk Assessment Test (JHFRAT), was correctly calculated and updated. Alternately, hospital staff themselves may not be following policies regarding fall risk. The frequency of error within the fall score calculations and proportion of non-implementation of the four main intended precautions (yellow non-skid socks, bed alarm, yellow armband, and fall sign) were determined by tracking the proportion of flawed calculations to total audits. The study was conducted over a period of six months, and 279 charts were audited and 109 rooms were visited. The average recorded fall risk score was 2.04 points too low due to input errors. Among audited patients, the most common incorrect category was the high-risk medication; among visited patients, the most commonly ignored precaution was the bed alarm. There were an average of 1.5 errors per patient in their chart calculations and precautions, so the problem was not able to be attributed to an outside source. New methods of accountability are being implemented to decrease these errors, such as checklists, personal reprimands, and increased managerial oversight, but they have had no effect thus far.

...Errors were observed for high-risk medications and bed alarms...

"My mentorship allowed me to interact with patients and see the inner machinations of an institution that garners much respect. Every day was a new adventure with new personalities and new challenges to overcome, but it reaffirmed my career path and taught me a lot."

Hailey will be attending the University of Virginia.

Developing a Mechanical Test Frame



Adam Tyler
Poquoson High School
Poquoson Public Schools

Abstract

Rubber is widely used because of its durability and ability to withstand large strains without being permanently damaged. In use, rubber is often subjected to large, time varying strains, making long term durability an extremely important factor. To address this concern, engineers must have a model for the fatigue of rubber, which is provided by testing rubber over two distinct phases. During the first phase, cracks appear in regions of a rubber that were initially free of cracks. In the second phase, the growth of these cracks causes failure of the rubber.

To obtain data for this model of rubber fatigue, a mechanical test frame was built that can conduct fatigue tests and apply oscillating loads and displacements to specimens. A versatile fatigue test frame can be constructed using servo control technology, which functions by giving the actuator a command and using a displacement sensor to return the position of the cylinder. The difference between the command and actual displacement is evaluated and used to drive the servo valve. At the conclusion of the project, a fully functional mechanical test frame has been created that is able to perform simple constant rate tension tests. It also tests constant-amplitude notched and unnotched oscillating fatigue. The distortion of the movement of the actuator was modeled using a Fourier analysis, which compares the feedback signal to a smooth curve.

This modular design of a pneumatic test frame cannot output as much force as a hydraulic frame, but it is much cheaper. The most expensive, high-end frames will cost up to 60,000 dollars, whereas this design was under 3000. A lower cost test frame could make materials testing more accessible to more business, and could improve the rate at which materials are tested.

...Engineers must have a model for the fatigue of rubber...

"My mentorship was very informative, as I learned both what it is like to work in a research environment as well as many important engineering principles. I feel that the time I put into mentorship was rewarding and also enjoyable."

Adam will be attending Virginia Tech.

Modifying the Kinova MICO^2 Arm to Predict user Intent

Jenny Gu
Tabb High School
York County Public Schools

"This mentorship has given me the opportunity to work with a Kinova robot arm and software such as Gazebo, MoveIt!, and FlexBE. I explored my interest in robotics, and Dr. Conner was great at explaining new concepts, answering questions, and guiding us through this entire process. I have learned so much this year and am even more amazed at the incredible power of robotics to transform our future!"

Julie Gates
Smithfield High School
Isle of Wight County Schools

"Being able to have a mentorship this year has been a truly invaluable experience. I feel that I have learned a great deal about robotics and how to work in a professional environment; I have gained many skills that I am sure to carry with me through college and the rest of my life."

Abstract

Assistive robots can give those who are disabled capabilities that they would not otherwise have. Robot arms, like the Kinova MICO², can be mounted onto a wheelchair and give those with upper limb impairments the ability to grab objects and complete simple tasks without the help of a caregiver. However, the joystick used to control the Kinova MICO² arm requires the user to manually switch control modes, which is not intuitive. To solve this problem, new FlexBE states have been programmed. These states correspond with MoveIt! capabilities and allow users to use the FlexBE app to simply drag and drop the appropriate states into the editor to program robot behaviors. Action interfaces were programmed to replace the existing service interfaces so that users could receive feedback during execution. MoveIt! capabilities were then created to use the action interfaces. Corresponding FlexBE states to access the MoveIt! capabilities were also made. For testing, a FlexBE behavior using the state to be tested was created, and a successful state would result in a "Done" outcome. Ten out of the twenty states executed successfully, and the other ten states need further changes and testing. Using the new states, a successful FlexBE behavior moving the robot arm to a custom position was created. Another behavior was programmed to use a decision state so that users could choose which location for the arm to move to next. The states programmed could be used to easily program robot behaviors and give users the appropriate level of autonomy when controlling the robot arm.

...States programmed could give users a level of autonomy when controlling the robot arm...

Jenny will be attending Harvard University. Julie will be attending Massachusetts Institute of Technology.

Mechanisms of the Interplay of Tau and Alpha-Synuclien on Tubulin Polymerization-Promoting Protein (TPPP/P25)

Anjali Patel
Windsor High School
Isle of Wight County Public Schools

Abstract

In neurodegenerative diseases such as Parkinson's disease (PD), the misfolding and deposition of proteins α-synuclein and tau are hallmarks. Conformational changes in native unfolded proteins, tau and α-synuclein lead to abnormal proteinaceous deposits called Lewy bodies (LBs) and neurofibrillary tangles (NFTs), respectively. An intermediate structure (oligomers) in route to large fibrillar deposit is considered responsible for neuronal loss in PD. Although a crosstalk between, tau and α-synuclein oligomers has been suggested, the mechanism of toxicity remains unclear. TPPP/p25, an unfolded protein found in the oligodendrocytes of the normal brain, appears within the neurons in PD cases. Studies have shown that α-synuclein induces the misfolding of TPPP/p25. Whether tau oligomers can induce the misfolding of TPPP/p25 remains unclear. To further study the mechanism by which tau and α -synuclein induce the misfolding and aggregation of TPPP/p25, experiments were performed *in vitro*. A stable cell line was generated, overexpressing TPPP/p25 fused with GFP. Cells were exposed to tau and α-synuclein monomers, oligomers, and fibrils. Immunostaining and toxicity assays suggest that tau oligomers can induce the misfolding and aggregation of TPPP/p25. This is the first evidence showing the role of tau oligomers in the TPPP/p25 aggregation pathway. Furthermore, the results confirmed that the oligomeric structure of α-synuclein triggers the misfolding of TPPP/25 *in vitro*. These results, indicate that both tau oligomers and α-synuclein oligomers likely play a critical role in the progression of Parkinson's disease.

...Conformational changes in native unfolded proteins lead to abnormal proteinaceous deposits...

"I had the pleasure to work with Dr. Castillo-Carranza at Hampton University. From the start, all the lab work was hands on, and she gave me the opportunity to learn from multiple trials and errors. I spent months training in lab protocols and equipment, and eventually became confident in lab work that I had once thought of as nearly impossible. I had the opportunity to participate in science fairs, present at symposiums at universities, and even a chance to publish the work. The mentorship program gave me an opportunity to explore deeper in a specialized field and look into actual professional careers, which has helped me decide on what I want to do in college. I was exposed to real world problems like how to manage a tight schedule, commuting to an actual workplace multiple times in a week, being able to properly convey the research to different audiences, and also learning how to actually understand and present scientific material. The knowledge and experience I have gained from this mentorship will undoubtedly help me in my future aspirations, and has now become a part of who I am."

Anjali will be attending the University of Virginia.

John Grant
Kecoughtan High School
Hampton City Schools

Characterization of Small Scale Pistons with Rubber Elastics and Phase Change Materials

Abstract

Pistons are common devices used in mechanical systems to transfer force and energy. While pistons contain many different sources of motion, such as gasses and liquids, rubber elastics are of interest for this study. A piston can be assessed for quality through many different factors. Three main factors to be observed in this study are efficiency, stroke force, and heat storage. Efficiency, in this context, is the ratio of output force/work to input force/work. In a rubber and phase change material-based piston, the force that is produced by the expanding material would be identified as the input force. This is measured with a dynamic mechanical analyzer (DMA). The output force would be the final force value of the arm of the piston, which is also known as the stroke force. The stroke force is another determinant of the quality of a piston. Ideally, the highest quality piston will have the greatest stroke force. This is assessed by heating the rubber with the DMA, which measures the subsequent force value produced from the expansion of the piston arm. Before being able to accurately characterize the efficiency, stroke force, and heat storage, the inner materials of the pistons must be assessed. Various pistons were differentiated by their source of motion (material) to determine whether natural rubber or polyethylene glycol produced the optimal efficiency, stroke force, and heat storage. Assessment of rubber slices was done through two main procedures, a set of iso-strain processes and a 16-hour temperature cycle. Characterization of polyethylene glycol was completed using an MDSC. Data from these processes were used to calculate the values of the three main areas of interest.

...The highest quality piston will have the greatest stroke force...

"Despite not completely finishing our study, both my mentor and I took a lot from the process and procedures. I learned an immense amount of information on subjects that are more technical and specialized than those taught in school. I feel that I have a much better idea of the professional environment in an engineering job/career."

John will be attending the University of Virginia.

Chemoresistance of Lung Cancer Floating Spheroids in Serum-Containing Culture Media

Lillian Way
Tabb High School
York County Public Schools

Abstract

Many people are diagnosed with lung cancer every year. Due to these high rates, cancer stem cell (CSC) research has experienced a surge of attention recently. CSCs are unspecialized cells that give rise to the differentiated cells of a tumor that have properties of chemoresistance. Floating tumorspheres generated in serum-free media and spheroids grown in serum-containing media are 3D culture models used to study CSCs. Tumorspheres display chemoresistant properties to anticancer drugs. Spheroids were generated in media containing serum and tested for chemoresistance to common anti-cancer drugs and a combination of two drugs. It was hypothesized that spheroids grown in the presence of serum would also display high levels of chemoresistance to these drugs. Spheroids were grown and treated with anti-cancer drugs in complete media and then tested for chemoresistance using viability assays. Spheroids grown in complete media were chemoresistant to the drugs Obatoclax (OBT), Colchicine (CX), and Hydroxyurea (HU), but not to Nigericin (NIG), and the combination of OBT with NIG did not work to decrease cell viability further. These results match previous experiments done involving chemoresistant tumorspheres. Tumorspheres and spheroids are commonly used as systems models for anti-cancer drug screening since they are grown in a 3D form that takes into account the natural microenvironment of the cancer cell. Therefore, testing cells grown in conditions, including the presence of serum, that mimic what would be found in a cancer patient's body is advantageous to being able to understand the properties of spheroids and the CSCs they contain and develop new drugs to treat cancer.

...Testing cells grown in conditions that mimic cancer in the body is advantageous...

"I had an incredible experience working with my mentor, Dr. Yakisich, at Hampton University this past year. I learned so much about cell culture and cancer, areas that I knew nothing about before. I have also been introduced to the scientific research process and have learned many valuable laboratory skills. Working with professionals in a lab is a very unique opportunity that not many high school students have. What I have gained from my mentorship will help me far into the future, and I am so grateful to have had this opportunity."

Lillian will be attending the University of Virginia.

Comparison of Coatings from the Boeing EcoDemonstrator 2015

Abigail Goetsch
Lafayette High School
Williamsburg/James City County Schools

...Improved laminar flow over aircraft wings would allow decreased fuel consumption and environmental impact...

Abstract

Attempting to maintain laminar flow over an airfoil in a cost-effective way has been a challenge since the late 1940s. If insect residue accretion over the airfoil is eliminated, that will decrease the drag on the airplane and allow it to fly farther on the same amount of fuel. Coating effectiveness to minimize insect residues (i.e., numbers, residue height, and areal coverage) and maintain the laminar flow over the airfoil was investigated. Panels from the Boeing EcoDemonstrator 2015 flight tests were used for comparison of data obtained from partial panels of different coatings to determine which reduced insect accretion the best. An optical profilometer was used to scan each insect residue to find the heights and areal coverages. Comparative analysis was done among panels of different flights and coatings to determine which coating worked best.

Results were no significant differences in insect residue height among the coated panels when compared with each other, or when compared with the control panels. One coating had a statistically significant difference in areal insect residue coverage when compared to the uncoated panels. Despite the differences in the mean being too small to be significant, all coated panels showed decrease in height and areal coverage when compared to the control panels. There are many factors involved in these results. For height, the most important factors proved to be where the insect was on the plane, as well as the daily conditions at the airport. In other words, the factors that most affected height were uncontrollable. For areal coverage, the factor that most affected it was the coating, which works well because that is something that can be easily controlled. Continued study to improve laminar flow over the wings of aircraft will allow for decreased fuel consumption and environmental impact.

"I had the privilege of working with Dr. Smith and Dr. Wohl at NASA Langley Research Center. It was a very enlightening experience, being in a professional lab instead of the classroom. Mentorship taught me to think for myself, ask appropriate research questions that I could go on to answer, and persevere even when things don't work or we don't get the results we expected/hoped for. I learned more about bug splats and statistical analysis than ever expected, but it was all so worth it. The skills I learned at mentorship will definitely carry over into college and beyond, and I am so grateful that I had this opportunity."

Abigail will be attending the United States Coast Guard Academy.

Mentorship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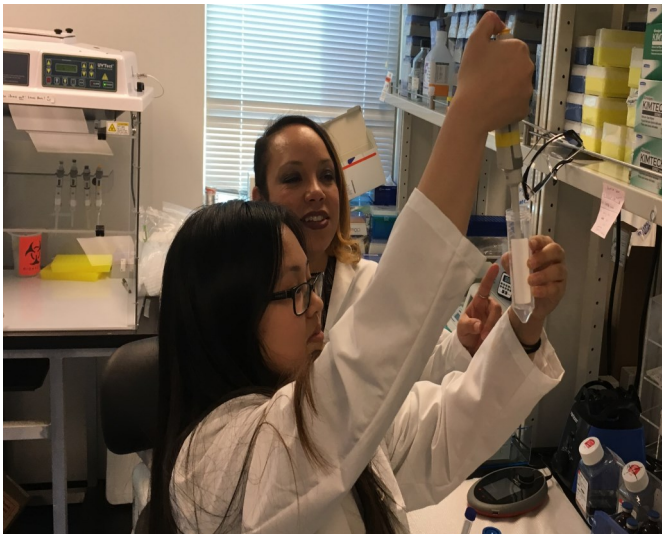


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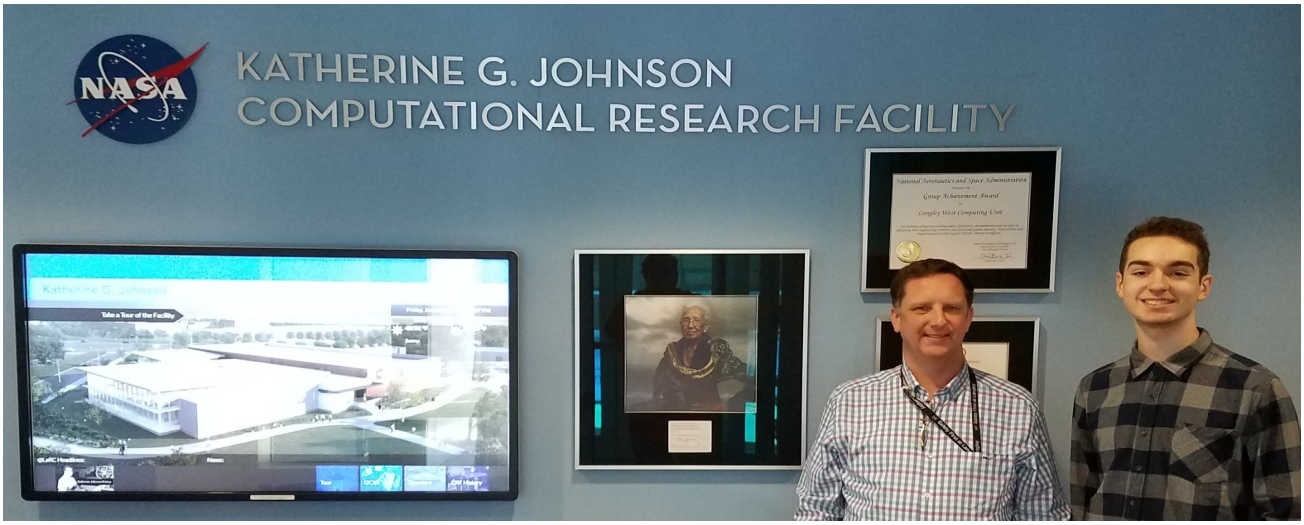
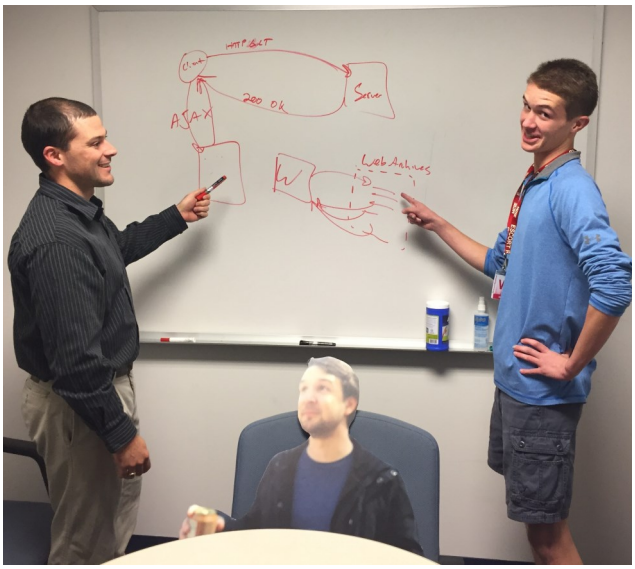
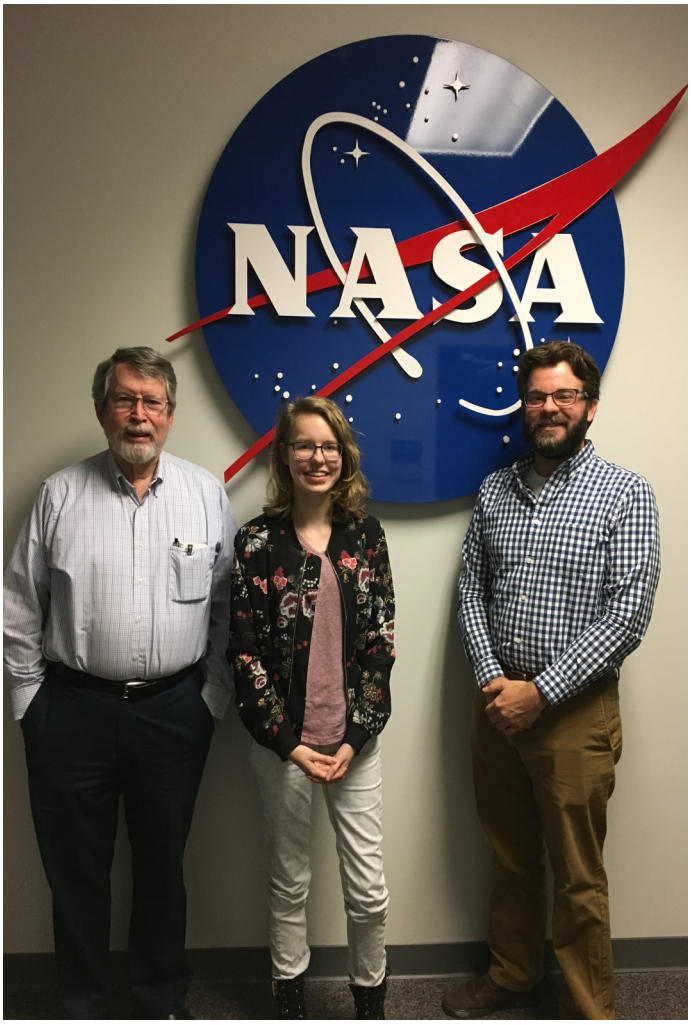
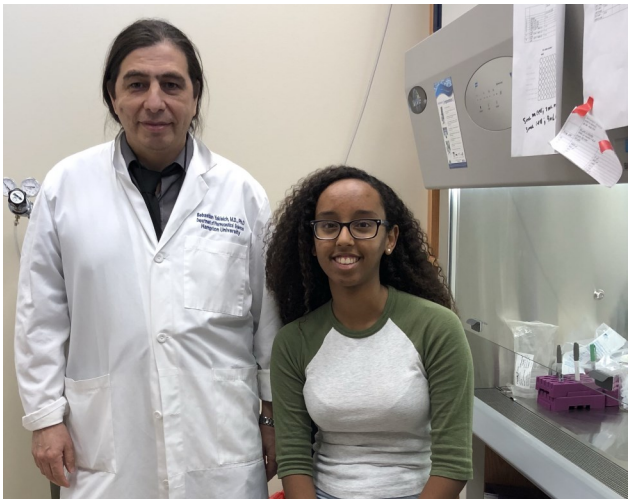

NASA
KATHERINE G. JOHNSON
COMPUTATIONAL RESEARCH FACILITY
Group Achievement Award

Experiences







Conferences and Presentations

VA Junior Science & Humanities Symposium
James Madison University

Interservice/Industry
Training, Simulation
& Education Conference
Orlando, FL

National Academic Quiz

Conrad Innovation Challenge

PACE National Scholastic Championship

Tidewater Science Fair – GSST Recognitions

Grand Prize Awards

Overall Grand Prize Winner – Anjali Patel

1st Award of Excellence – Katelynne Berland

2nd Award of Excellence – Gavin McCabe & Kai Vylet

Category Recognitions

Animal Science **2nd Place - Kelvin Burgos**

Biochemistry **1st Place – Katelynne Berland**
2nd Place - Carolyn Boothe
HM – Lillian Way

Cellular & Molecular Biology **1st Place - Anjali Patel**
2nd Place – Annie Cao

Computer Science **1st Place – Gavin McCabe & Kai Vylet**
3rd Place – Elizabeth Seguin

Engineering: Electrical & Mechanical **1st Place – Elizabeth Hinton**
2nd Place – Yifan Wang

Engineering: Materials & Bioengineering **3rd Place Sarah Lee**

Environmental Management **2nd Place - Steven Petit**

Plant Sciences **3rd Place – Katya Mikhailova**

Special Awards

Air Force Research Laboratory STEM Initiative **Yifan Wang**

American Institute of Aeronautics and Astronautics, Hampton Roads Section
1st Place – Katya Mikhailov
2nd Place - Elizabeth Hinton

Armed Forces Communications-Electronics Association, Hampton Roads Chapter
2nd Place - Gavin McCabe & Kai Vylet

Armed Forces Communications-Electronics Association, Tidewater Chapter
1st Place – Elizabeth Hinton
2nd Place – Yifan Wang
1st Place Team - Gavin McCabe & Kai Vylet

Naval Science Award **2nd Place - Yifan Wang**

HRSD: Environmental Improvement Award **1st Place – Steven Petit**

Information Systems Security Association **1st Place – Elizabeth Seguin**

Intel Excellence in Computer Science **Gavin McCabe & Kai Vylet**

Virginia Dental Association **1st Place -Sarah Lee**

State Science Fair in Roanoke, VA

Elizabeth Hinton-York HS: *The Effect of Package Shape on Drone Drag and Efficiency*
US Air Force Excellence in Engineering Award

Anjali Patel –Windsor HS: *Interplay of Tau and alpha -Synuclein on TPPP/p25*
3rd Place Award – Cellular and Molecular Biology

THE GOVERNOR'S SCHOOL for SCIENCE AND TECHNOLOGY

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Website: www.nhrec.org/gsst
Website: www.nhrec.org/governorsschool

Research: Key Component of the GSST Student Experience

A primary goal of the GSST is to provide students with an opportunity to conduct serious scientific research, engineering design, or computer programming projects.

All students take a junior-year course in Research Methods and Ethics, which introduces them to research methodology, statistics, critical thinking skills, and the skills of scientific writing and presentation. In the junior year, all students prepare a science fair project for submission to the Tidewater Science Fair. Students are encouraged to take their work to additional state and national competitions.

In their senior year, students design and conduct a year-long research or engineering design project under the direction of a professional in their field of interest. The field component is supported by an in-school course which guides students through the entire process, from the selection of a problem to the final presentation. Major aspects of the mentorship experience include: preparation of a formal written proposal for their project, oral presentation of the proposal and a status report at mid year to GSST faculty, a final research document, and presentation of final results to a panel of professionals in appropriate fields at the GSST Spring Symposium. In addition, many students present their findings at local, regional, and national science competitions and symposia. Exceptional work has been published in professional journals.

Research sites that have participated in the GSST Honors Research/Mentorship program included NASA Langley Research Center, Thomas Jefferson National Accelerator Facility, Virginia Institute of Marine Science, College of William & Mary, Hampton University, Christopher Newport University, local engineering firms, hospitals, and numerous medical and professional specialists.

New Horizons
REGIONAL EDUCATION CENTERS