Book of Abstracts

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Radiographic Mapping of Nanoparticle Transport in Animal Tissues: Ionic Exchange and Restricted Diffusion Models

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Prof. Subhendra Sarkar
Prof. Chen Xu

This project is a combined experimental and simulation work involving results from several other projects within City Tech investigating biomedical and radiological questions. Nanoparticle induced diffusion and movement of various radio-opaque minerals are being studied within various layers of biological tissues for understanding of protein/nanoparticle interaction important in biomedicine. Physicochemical and mathematical modeling of changes in chemical bonding within tissue layers are performed.

Understanding of Aerosol Transmission of COVID 19 in Indoor Environment

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Our reason for discussing severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) or 2019 novel coronavirus (Covid-19), is to understand its aerosol transmission characteristics in indoor spaces, and to mitigate further spread of this disease by designing a new HVAC system. The problem that we are tackling is the spread of covid-19 droplets through aerosol transmission, by looking at potential engineering solutions to the existing HVAC systems. The purpose is to eradicate the spread of the COVID-19, by testing indoor spaces, in an effort to understand the effectiveness of ventilation controls. We believe that scientists and engineers have not created an environmental controls system to combat Covid-19 in the indoor environment. The goal is to answer this need and construct an innovative HVAC model with highly efficient filtration and ventilation. The methodology is to conduct an epidemiological investigation by researching case studies and scientific results of COVID-19 pathogen fluid dynamics in enclosed spaces, as well as its effect on pre-symptomatic, symptomatic, and asymptomatic individuals. This invention would be impactful because it would greatly improve commercial and residential air quality in buildings. The consequence of this HVAC ingenuity would prevent the concentration of coronavirus2 aerosol droplet dispersion. This study suggests that it is critical and very important to prevent over-crowding and provide ample ventilation and filtration of the circulating air in buildings. Our findings will help to identify solutions in improving aeration standards and integrate newer technology to upgrade HVAC-R systems.

Covid-19 Impact on Radiology Students' Distance Learning

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Prof. Zoya Vinokur

Distance learning (DL) is a teaching tool that offers education to students remotely in various locations (Ruiz, 2006). The increase in distance learning education is evident in all types of educational programs including those in Radiologic Sciences. DL education programs are expected to comply with all standards just as traditional programs are (Aaron, 2015). With traditional class settings, knowledge is taught at a given time and day and is structured in terms of course development and attendance. It does not factor in the domestic and familial responsibilities of the students outside the classroom walls or the effects of a worldwide pandemic. Radiological Technology education is active with DL for the current semester and looks to continue with DL into the Spring semester. What happens to Radiological Technology education when the COVID-19 pandemic continues with no visible end in sight. Laboratories and clinical rotations are still open and ongoing, respectively but based on the rising infections could stop at any moment. With the distribution of online surveys, we are continuing to evaluate the effects that distance learning has and to compare how both the first and second year students are coping with distance learning, modified laboratory schedules and increase positive COVID-19 cases at their clinical sites. We will look into the efficiency of course material distribution to prepare the junior students for clinical rotations and the current students for their licensing exam. We will also compare the emotional, mental, and physical well-being of the students over the course of the current school year.

References:

Aaron, Laura. (2015) Distance Education Standards. *Radiation Therapist,* 24 (2), 220-222.
Ruiz, J. G., Mintzer, M. J., & Leipzig, R. M. (2006). The impact of E-learning in medical education. *Academic medicine : journal of the Association of American Medical Colleges*, *81*(3), 207–212. https://doi.org/10.1097/00001888-200603000-00002

Face Detection with Machine Learning

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Prof. Marcos Pinto

With the evolution of Technology everywhere around the world we can come across many applications and programs that have to deal with Face Detection whether we are aware of it or not. In this project my main focus is to use OpenCV Library of python detect human faces in digital images to localize a particular region of the image using a particular dataset called WIDER face dataset that contains 393,703 faces. To showcase this dataset the data will be broken down into training, validation, and testing dataset.

Mobile Robot Inspector in A Wireless Sensor Network Framework
Leticia Donkor
Prof. Zhou Zhang

The gas monitor calibration is extremely critical because it determines if a gas sensor can accurately give useful feedback. Typically, the calibration frequencies for a sensor are between 3 and 6 months but can be required more often or less often based on the usage. The calibration is very laborious and costly. To reduce the calibration frequency as less as possible with the prerequisite of safety is becoming significant. In order to realize the optimization of the calibration frequency and furtherly to reduce the cost, a mobile robot inspector in a wireless sensor network framework is designed. The idea is to mount one calibrated gas sensor on the mobile robot, and the robot will make daily patrols around the workplace in which the sensors are installed. This robot inspector is developed based on a smart remote control(RC) car, and it is designed for automated mobile inspection of the workplace. The calibrated sensor measures the level of gas, and then, the measured value is used to compare with the local sensor's reading. Therefore, the calibration drift can be identified if the difference between the readings from both the calibrated sensor and the local sensors exceeds a threshold of error. In order to increase the efficiency of the inspector, a wireless sensor network framework is designed to pass and process the data acquired by the inspector. The proposed project includes two parts: the RC car design and the wireless sensor network framework design. This project also has the potential to be employed for the remote detection and localization of gas leaks since the sensor mounted on the inspector can detect the gas leaks to ensure the safety of human life and equipment investments at large industrial and public sites.

PEDGA Degradation Rate Studies
Marvin Espinoza
Prof. Ozlem Yasar

PDMS is a biodegradable and bio-compatible material that is commonly used in Tissue Engineering field. In this research, degradation rate of PDMS is investigated by dissolving the PDMS within the water and ethyl alcohol. Outcomes are compared to decide the degradation speed of engineered scaffolds. Our preliminary results indicates that PDMS can be dissolved within the ethyl alcohol faster.

Two and Three-Dimensional Radiographic Imaging of Contrast Agents in Heterogeneous Live Cell Media to Understand Contrast-induced Toxicity
Aldona Gjoni
Fahameda Hassan
Prof. Subhendra Sarkar

Radiographic imaging was done using low and high energy radiography equipment. The test hypothesis that macromolecular aggregation changes sample noise in imaging samples for optical imaging methods. Inorganic complexes scatter radiation at the molecular level and may increase the sample noise locally. At high and low photon energies in various x-ray machines, sample and background noise were gathered and compared with those from mammography systems from

mammography researchers. The samples with high macromolecular aggregates were prepared using various animal cell compositions and imaged under different conditions that produced different macromolecular dynamics within the samples and thus different image-based sample noise. Such investigations may offer insights into the protein/ion interaction in model animal tissues for biophysical implications.

Deep Lens Based American Sign Language Translation
Jakob Horowitz
Prof. Xiaohai Li

This project aims to utilize machine learning technology to enable real time translation of American Sign Language into written English text. This would not be feasible without cloud computing and AI technology as image classification is very difficult through standard programming techniques. We are using an Amazon cloud service called SageMaker to build, train and deploy machine learning models, as well as a fully programmable Amazon Web Service (AWS) DeepLens camera that is fully integrated with SageMaker and other AWS services. All of the code we develop for setting up, training, and running the machine learning model is done using Python. We have done research on other machine learning platforms, most notably Tensorflow which also uses Python, however because of the benefits of cloud computing, and the more comprehensive toolset, we decided to use AWS.

The DeepLens camera will be used to take images to generate the dataset needed to train the deep learning model. The code execution is handled through AWS Lambda functions, and all necessary files will be accessed via cloud storage. This project is intended to be a yearlong, and we are currently wrapping up the first semester. Because of this, we don't have a fully working model, but we are optimistic that we will be able to develop a working project.

Predicting Covid-19 Virus Spread with the use of Machine Learning
Brian Jerez
Prof. Marcos Pinto

This project applies a machine learning model to analyze and predict the growth of the Covid 19 virus epidemic. A data driven approach with higher accuracy can be very useful for a proactive response from the government and citizens. John Hopkins University dataset will be used to fine-tune the model.

Visual Communication Design for Assistive Technology
Gui Jing Jiang
Prof. Farrukh Zia

Communication Design utilizes creativity and technology to design rich multi-media for public and professional communication. Recent advances in Computer Technology have made it possible to use low cost computer hardware and open source software tools to create visual communication media such as pictures and videos. This research project will explore the use of low-cost computer hardware and open source computer software in creating multi-media visual communication for designing and creating assistive technology devices.

Polyethylene Glycol Diacrylate Degradation Rate Studies
Almami Kanazoe
Prof. Ozlem Yasar

PDMS is a biodegradable and bio-compatible material that is commonly used in Tissue Engineering field. In this research, degradation rate of PDMS is investigated by dissolving the PDMS within the water and ethyl alcohol. Outcomes are compared to decide the degradation speed of engineered scaffolds. Our preliminary results indicates that PDMS can be dissolved within the ethyl alcohol faster.

A Low-cost SLAM RC Car with RPLIDAR
Najwan Kased
Prof. Zhou Zhang

Remote control(RC) car used to do simultaneous localization and mapping (SLAM), is becoming popular in the mission of rescue. One commercial product which has the similar functions is usually expensive. Therefore, how to make an affordable prototype of SLAM robot for research and learning is a challengeable topic. In order to create a low-cost SLAM RC car, the hardware and algorithms should be selected and optimized. For the hardware, the Arduino single-board microcontroller is employed to implement the control task. The sensor used to acquire the data of environment is 2D laser scanner RPLIDAR. RPLIDAR is a low-cost 'Light Detection and Ranging sensor' suitable for indoor robotic SLAM application. It provides 360 degree scan field, 5.5hz/10hz rotating frequency with ranging 16000 times per second and 25 meter ranger distance for A3. Certainly, such kind of configurations pose several problems: (1) It is crucial to balance the data acquire speed and the hardware processing speed since Arduino's baud rate is limited to 115200 baud; (2) The mapping work should keep a specific accuracy of 0.6 cm to make the generating map sense; (3) How to display the final results should be taken into account.

To solve the above problems, the discrete sample method is used. With this method, the sampling frequency is under control in order to balance the data acquire speed and the hardware processing speed. After that, maximum likelihood method is used to optimize the acquired data and to improve the accuracy of the mapping work. In addition, the acquired data will be sent out to a laptop through wireless communication, and the final results will be processed offline.

By implementing discrete sample method and maximum likelihood during SLAM; the low-cost SLAM RC car is expected to measure and perceive the surrounding environment through remote sensing. Then, provide 2D maps onto the graphic interface. The success of this project will enable the safe landing of robotic and manned vehicles with a high degree of precision with relative low investment.

Smart IoT Car Seat Alarm System for Preventing Hot Car Death
Fahmeda Khanom
Touheda Khanom
Prof. Xiaohai Li

It has been reported that on average, 39 children died from heat stroke after being left alone in a locked vehicle in hot summer every year, and since 1998 every state in the U.S. has experienced at least one such death among children under the age of 15. The objective of this research is to design and develop a compact and low-cost smart IoT device which can completely prevent such tragedies. In this project, we will design and develop a prototype system, which will be attached to existing car seats and detect if a child is left alone in a vehicle. When such an event is detected, the device will send alarms to the child's parents or caregiver through multiple means. If a prompt measure is not taken by the parents or caregiver after a short period, the device will alert the first responder for immediate action. In this project, we are using a compact physical computing platform that is connected to a Cloud which will not require active management of users and reach remote parents, caregiver or first responder. Also, we are going to use multiple channels of sensors to detect if a child is left alone in the car and will also measure the temperature of the car that will trigger the device to send alarms. By the research done by far, we have searched and studied existing works, in which Arduino and mobile apps are being used for similar systems. More research will be done on related projects and our own system design will be proposed. Then we will develop, implement and test our system.

Machine Learning and Physical Computing
Joan Beatrice Ladaban
Prof. Farrukh Zia

Machine learning and physical computing are important areas of research. This project involves the use of machine learning and physical computing to control an autonomous robot. Machine Learning refers to writing code that learns from data and improves its performance and is a topic related to Software Engineering. Physical computing refers to writing code to interact with the physical environment by using sensors and physical devices. This is a topic related to Hardware Engineering and where one can use open source hardware such as Arduino and Raspberry Pi. This research project combines the Software and Hardware aspects into one working system. In the current phase of the project a voice command recognition app is used on a mobile device to control an Arduino based smart car through Bluetooth wireless connection.

Developing Ionic Nanomaterials for Biomedical Applications: Surface Chemistry and Morphologic Imaging
Lin Mousa
Hayley Sanchez
Prof. Subhendra Sarkar
Prof. Zoya Vinokur

Microscopic properties of various radiologic contrast materials are studied for weak to strong surface interactions in model fruits. These interactions are imaged under various ionic environments as present in multiple, common fruit systems. Low and high X-ray energies may

show different imaging noise reflective of scattered radiation from iron, manganese, and other metal ions in fruits. This will be compared with MRI image noise on similar systems obtainable from collaborating MRI research students.

Graphene Coated Laminated Composite for Light Striking Prevention
Aaryan Nair
Prof. Akm S Rahman

Lightning strike protection (LSP) have recently been a newly developing field particularly with the emergence of graphene thin film integration into carbon fiber composite structures. This technology has a widespread application in airplanes, wind turbines, and other instruments susceptible to frequent lightning strikes. Electrical discharge of the instrument in a safe manner is vital for the safety of the passengers (in the case of flights) as well as the integrity of the aircraft structures because of their specific mechanical and structural properties. The purpose of the study is to design and fabricate graphene thin film coated carbon fiber composite structures for lightning strike protection. This study will look at different methods for incorporating GTF (graphene thin film) into Carbon Fiber Reinforced Plastic and assess the electrical conductivity. through methods such as fabrication of a highly conductive functionalized nanosized GTFs, and combined use of carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs). The method developed must reduce the resistivity of the CFRP and provide a safe discharge outlet for the lightning strikes.
In the current study we will develop GTF using GNP impregnated polymer. Electrospinning processes will be performed to develop this GTF. The study will include the investigation of large area shear crack and warpage on the graphene film. Also, the light striking study shall be conducted in Oak Ridge National Laboratory. As an extension of the current methods developed, the plan is to gain an understanding on how resistivity varies between blends of pristine graphene, against blends comprising of CNTs and GNPs. Successful development of highly conductive blends could result in increased safety standards of aircrafts, reduced maintenance costs for wind turbines, and increased usage of wind energy.

Low-Cost 3D Printed Rapid Deployment Arm (RDA)
Erik Peregrina
Prof. Andy Zhang

The current Covid-19 pandemic has put a massive strain on our health care system and our health care workers. During the New York shut down, health care workers ran out of Personal Protection Equipment (PPE) and began to ration them. Using robotics, we can help reduce healthcare workers direct interaction with highly infectious diseases and patients, through the use of robotic arms. For a rapid developing situation, the robotic arms can be assembled and installed quickly to cope with a sudden influx of patients or lack of PPE supplies.

Recovered Energy Solutions for Controlled Environment Agriculture (CEA)
Itay Rubin
Prof. Masato Nakamura

Controlled Environment Agriculture (CEA) has evolved to provide effective solutions addressing climate change and population growth in terms of water reduction, alternatives to arable land, and

efficient supply chains. However, CEA has not resolved the issue of the high-energy inputs required. This research will attempt to identify new ways to harvest sustainable energy resources derived from recovered waste outputs. These recovered energy resources can transform CEA into an energy efficient and truly sustainable alternative agricultural system.

Imaging Nanomaterials During Active Biochemical Transport in Model Plants and Chicken Eggs: Diffusion and Near Infra-Red Measurements

Amina Shahbaz
Tetiana Soloviova
Prof. Subhendra Sarkar
Prof. Chen Xu

Microscopic diffusion and transport of ionic nanomaterial complexes may disturb normal biochemical properties of live tissue. Biophysical studies of nanoparticles using radiology tools are gaining importance in nanomedicine due to therapeutic potential. This project involves interruption of nutrient transport in plants and animal tissues with small amount of radiopaque compounds and subsequent imaging of diffusion and molecular interaction using x-ray, CT and near infra-red spectroscopy (NIRS). Time series analysis of affected protein layers due to "toxic" interaction with Gadolinium and Iodine moieties in naturally occurring proteins in Aloe Vera plants and in chicken egg yolk are observed at various X ray conditions. Both of these groups of nanomaterials may offer new insights in nanomedicine where tissue transport is gaining importance.

Metric Dimension and Strong Metric Dimension of Graphs

Luc Telemaque
Prof. Nadia Benakli

Given a graph G, a pair of vertices u and v of G is said to be resolved (strongly resolved) by a vertex w of G if the distance from u to w is not equal to the distance from v to w (respectively, v is on a shortest path connecting u and w or u is on a shortest path connecting v and w). A set of vertices W is called a resolving set (strong resolving set) for G if every pair of vertices u and v of G is resolved (respectively, strongly resolved) by a vertex w of W. The metric dimension (strong metric dimension) is the cardinality of the smallest resolving set (respectively, strong resolving set). The concept of the metric dimension of a graph is closely related to what has been used by the Global Positioning System (GPS). Both the metric dimension and the strong metric dimension of graphs have many applications in several disciplines including navigation of robots in networks, pharmaceutical chemistry, coin weighting, network discovery, pattern recognition and optimization. In this project, we will show how to find the metric dimension and the strong metric dimension for examples of graphs, and we will discuss one of the applications of these parameters.