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Eco-Effective Housing

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There is a greater need than ever for affordable and ecological housing options as the global climate crisis worsens. The idea of an eco-effective housing method that actively improves the environment rather than just minimizing harm is discussed in this study. Eco-effective housing, as opposed to conventional green structures, uses energy-saving technologies, recycled materials, smart design, and renewable energy to create a beneficial impact. In this study, we investigated simple and cost-effective methods for constructing these types of homes, including passive design and modular construction. We also examined real-life examples of effective, eco-friendly homes and how they benefit the environment and people. These examples helped show that sustainable housing can work in many different climates and communities. To make homes more environmentally friendly and efficient, we focused on how architects may employ natural energy sources and locally available materials. Researching the construction of these buildings and their energy and material usage taught us that it is feasible to create housing that is not only more cost-effective but also more ecologically friendly and beneficial to human health. According to this study, architects may assist in the creation of a brighter future by creating environmentally friendly homes.

Livability and Sustainability in New York City

Arianna DiLillo, Sonya Weinstock
Prof. Anne Leonhardt

Our project aims to highlight the intersection between livability and sustainability in New York City in order to support urban planning. A comprehensive visual analysis of the city's unique characteristics like dense population, diversity, and interwoven infrastructure are important for understanding these concepts. This geospatial approach can provide important insights into and inform the way architects think about the balance of Livability and Sustainability. By comparing a range of factors across three unique neighborhoods, Downtown Brooklyn, Clove Lakes in Staten Island, and Lower Manhattan we can analyze differences between neighborhoods. Livability can be defined as the long-term quality of stability, health, education, culture, resources, mobility, and overall quality of life in the city (EIU.com/n). Sustainability is the practice of creating and maintaining ecological balance without depleting resources or harming our natural environment (EPA.gov). Sustainable infrastructure, such as integration of greenspace can improve air quality, and improve the urban heat island effect, while improving citizens quality of life. We began our study by researching current debates on the city, and identifying our parameters and three contrasting neighborhoods. Then using curated data and ArcGIS Pro geospatial mapping tools, we created visualizations to help understand conditions in the city and inform further study, using zip codes and census tracts as reference. Topics we particularly focused our research on include housing, mobility, ecology. The creation of a series of maps looking at current conditions and extending back 40 years, was important for analyzing patterns and trends within our selected neighborhoods. In order to solidify our mapped research this summer, we will carry out fieldwork with LIDAR and conduct interviews with residents and experts in these topics. Through these comparisons, one can begin to see strengths and weaknesses each neighborhood has when it comes to defined standards of Livability and Sustainability.

TECHNE 2023-24: Developing an Architectural Publication

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Prof. Jieun Yang

TECHNE is an annual publication of student work from the Department of Architecture at New York City College of Technology. Relaunched as a curated archive, TECHNE captures the stories, experiments, and architectural discourse of the moment. The 2023–2024 edition builds on this mission by presenting a diverse array of projects spanning design studios, research, and historical analysis. Released in conjunction with a pivotal NAAB accreditation visit, this edition showcases the department's commitment to excellence, equity, and expanding access to the architectural profession. This second edition of TECHNE aims to serve as both a reflective archive and a platform that amplifies the voices and visions of City Tech students. The 2023–2024 edition was developed by a student editorial team under the guidance of faculty advisors. The process involved curating content across all architectural sub-discipline courses, editing student submissions, designing layouts, and creating the publication's visual identity. The editorial strategy emphasized inclusivity and coherence, ensuring that the diversity of student voices was celebrated while maintaining a unified narrative. The result is a professionally produced publication that functions as both an archive and an exhibition catalog. TECHNE embodies the ongoing evolution of a rich learning experience for current students while fostering connections across diverse generations of alumni and contributors. In doing so, it reinforces the magazine's role as a collaborative platform that affirms the department's place within contemporary architectural education.

The Solar Shed: from Schematic Design to Design Development to Construction Documents

Andrew Aucanzhala, Javier Espinal, Kevin Hernandez
Prof. Kenneth Conzelmann

This research is a furtherance of work to date on the Solar Shed project – a real-world case study of an energy self-sufficient off-grid structure set atop an existing concrete inground pool, repurposed as a foundation. The project shall utilize passive solar principles i.e. natural renewable energy sources (wind, solar, geo, and hydro) and incorporate technologies (turbines, photovoltaic panels, and battery energy storage) to support and showcase the philosophy and potential of an off-grid, locally powered world. In the previous semester, we focused on the Schematic Design phase, where we explored initial concepts, gathered resources, and established the foundations of the project. In this stage, we will focus on Design Development, refining and defining key aspects such as spatial layout, sections, elevations, materials, structural and mechanical systems and components. Building on the knowledge acquired previously from online sources, we will dig deeper, return to a pre-web world, and pore through a few dozen books published on this topic for additional inspiration and direction. The final stage of the project is the preparation of the technical and legal documentation required to obtain the construction permit. By completing this process, we will bring our proposal one step closer to fruition, consolidating a design that not only meets aesthetic and functional principles but also promotes a sustainable lifestyle integrated with the environment.

ARCscholars Spring 2025: Architectural Solutions for Ingersoll Houses; Focus on Housing Design, Urban concepts and "Something Else"

Bryant Ariza, Nouman Arshad, Diana Luna Garcia, Danielle Gibson, Emely Rendon, and Elijah Walker
Prof. Naomi Langer-Voss

From professors and students at CUNY City Tech to NYCHA Design & Implementation specialists and NYCHA residents, ARCscholars encompasses a diverse group of scholars united by the common goal of tackling urban challenges through the research and proposal of enhancements to the built environment. This session we are studying on the Ingersoll Campus and focusing on housing design, urban environment and "something else" – design elements that will enhance and adorn the site. The team collaborated on ideas of home, and how to best prepare for the future. Our solutions will include; community gardens, enlarged and renovated housing and spaces for community learning.

The Legacy of Roebling's Bridges: Exploring Structure Through 3D Printing

Emmanuel Tejada
Prof. Paul King

While John A. Roebling is best known as the engineer of the Brooklyn Bridge, his early career included other significant suspension bridges that are less well known today.This project focuses on the construction of these early works, specifically his 1846 Monongahela Bridge and his patented anchorage system – a method implemented for many of his works including the Brooklyn Bridge. A close review of original Roebling drawings allowed us to reconstruct 19th century engineering through the use of modern technology. Our process involved analyzing these drawings and then reconstructing these first in 2D using AutoCAD and then modeling in 3D using Rhino, so they could be 3D printed. Our assembly of these printed models allowed us to explore the structure of Roebling's suspension bridges in a more tactile way and to gain an in-depth understanding of their construction and assembly logistics, that are often lost in translation on paper. Initially, we produced models at varying scales to test how to best represent the structures and finalized a scale that provided a balance of detail and appropriate sizing for tactile interaction.This project seeks to provide a deeper understanding of these important structural systems and to preserve a piece of engineering history for students, engineers and the general public. Engaging with Roebling's work through the use of 3D printing, brings attention to the importance of this historical framework and its relevance today, especially as a tool for research, teaching and a method of architectural preservation.

Lucille's Row: Using Accessible Theater and Architectural Design to Change the Face of a Harlem Intersection

Terri Ayanna Wright
Prof. Elizabeth Parks

This project is a simulation of the architectural design process that explores centering ecological responsibility, cultural vitality, and community revitalization within the real-world policy constraints of New York City. Using an abandoned street corner in East Harlem as a focal point, this study reimagines this underutilized space as a dance studio theater with an innovative, semi-public design: while the performance space itself is enclosed, the audience seating is partially open-air and integrated into the streetscape, allowing for spontaneous engagement from passersby and fostering a sense of community ownership. The project investigates the question of *how architectural interventions can harmonize historical preservation, environmental sustainability, and social accessibility in small-scale urban spaces*. The purpose of this project is to explore how design can transform overlooked infrastructure into cultural hubs that uplift local identity and economy. The research consists of the following steps: (1) conducting a historical and policy-informed analysis of the site; (2) gathering community and stakeholder input; (3) developing a revitalization proposal and detailed budget; (4) creating architectural drawings and 3D renderings; and (5) assessing the potential socioeconomic impact of the proposed design. Once completed, I predict the findings will demonstrate that embedding cultural institutions into everyday urban fabric—especially through hybrid public-private designs—can stimulate both artistic expression and economic resilience. The results of this study aim to inform future urban planning efforts focused on equitable, community-led revitalization.

From Kitchen to Medicine Cabinet: Ancient Remedies in Modern Nutraceuticals

Kashfia Raisa & Ali Algemsh
Prof. Sanjoy Chakraborty

Nutraceuticals, a rapidly growing field in health and wellness, focus on utilizing natural ingredients from foods and herbs to enhance overall well-being. Among the most recognized are turmeric and resveratrol, both celebrated for their anti-inflammatory properties and increasing presence in dietary supplements and functional foods. Turmeric, a staple in many cuisines, contains curcumin, a natural compound known for its potent anti-inflammatory effects. Research suggests that curcumin can inhibit pathways in the body, such as NF-κB, which contribute to chronic inflammation. However, curcumin is not easily absorbed, leading to newer formulations, like combining it with black pepper or using advanced delivery methods to improve its effectiveness. Resveratrol, found naturally in grapes, berries, and red wine, is another well-known compound with anti-inflammatory and antioxidant benefits. It helps protect the body by influencing key inflammatory pathways and reducing oxidative stress linked to aging and chronic diseases. This review investigates how turmeric and resveratrol operate within the body, their roles in mitigating inflammation, and whether they are more effective in their natural forms or as concentrated extracts. As the demand for natural health solutions increases, both compounds have become vital components of the growing nutraceutical industry.

Comparative Gene Expression Analysis in Disease and Normal State using Public RNA-Seq data

Noor Ahamed, Guadalupe Gonzalez, Bansari Patel
Prof. Evgenia Giannopoulou

RNA sequencing (RNA-Seq) is a technique that uses NGS (Next Generation Sequencing) to examine the presence and quality of RNA molecules within a biological sample. Analyzing these sequences can be complicated, and unable to be done thoroughly through simple observation by humans. To combat this, data analysis through R-script and classification by machine learning models can be implemented to further understand gene expression in various states. Through obtaining this data, we are able to understand which genes are heavily expressed in a diseased or normal state of an individual. Being able to compare which genes are most expressed in certain biological pathways allows for a better understanding of the disease in question. This can allow us to predict what kind of treatment a patient will benefit from. The methodology used in this study includes the preprocessing of RNA-Seq data from TCGA (The Cancer Genome Atlas), identification of differentially expressed genes (DEGs) through GO and KEGG enrichment analysis, and using machine learning (ML) models to predict the status of disease through gene expression. With the usage of a random forest algorithm, we attempted to identify biomarkers that distinguish whether a sample is a tumor or normal tissue.

Oral and Fecal Canid Microbiome Analysis
Mariana Lucero
Prof. Jeremy Seto

Understanding the microbiome in companion animals can give insight into their health and how they interact with their environment. This project focuses on the microbial communities found in the mouths and fecal matter of domestic dogs. The goal is to compare these two microbiomes and identify how they differ, and what those differences might reveal about canine well-being. So far, I have isolated DNA from both oral and fecal samples, and I am currently preparing them for sequencing using Oxford Nanopore technology. Although the sequencing and analysis are still in progress, this phase of the project has helped me better understand the workflow and techniques involved in microbiome research. The findings may help show how specific areas of the body support different microbial communities. Over time, this kind of research could contribute to a deeper understanding of animal health and how microbial changes may reflect or impact it.

Photocataloging and DNA barcoding of Yellow Jackets

Imarcy Marmol
Prof. Jeremy Seto

The yellowjacket is the mascot of City Tech. But what species? This project investigates which species of yellowjacket wasps (*Vespula spp.*) are in the New York City area. The Yellowjackets fall under the order of Hymenoptera (ants, bees, wasps) in the family Vespidae (wasps). The German yellowjacket (*Vespula germanica*) is invasive, but is physically similar to native species. The goal is to conduct a census of the different species by DNA barcoding using Cytochrome oxidase I (COI) gene.Yellowjackets were captured and preserved for documentation and cataloguing to build an image library. DNA was extracted following dissection and COI was amplified by PCR. The PCR amplicon was then sequenced compared to reference sequences on NCBI. Those sequences were used to generate a phylogenetic tree to demonstrate the relationships between these species and samples. Ultimately, DNA barcoding will definitively identify each sample and the image library generated can be used to train AI for morphological identification.

Human Resource Policies Inclusive of Dress Amongst Genders within the Fashion Industry

Najae Ricketts
Prof. Alyssa Adomaitis

In 2018, a government policy by the NYC Commission of Human Rights formally recognized 31 different genders [12] and the consequent potential penalties for not recognizing these genders within the workplace. With the acknowledge of 31 different genders recently introduced, it is timely to examine the adoption of policies related to gender, particularly from the employer's perspective. The purpose of this paper is to investigate employer perceptions and policies related to gender diversity. The research will focus on analyzing the diffusion of these policies in the workplace environment among professionals in the fashion industry.

Bridging the Financial Literacy Gap: Impact on Children's Future

Ruizheng Huang
Prof. Shakira Henry

This project looks at how teaching kids about money early on can help them better understand their financial identity and be more prepared for the future. These days, managing money is more complicated than ever, so it's important to teach children things like saving, budgeting, and credit while they're young. We're studying how giving children the right resources and lessons can shape their financial habits and awareness. The research involves collecting data, reviewing useful information, and finding better ways to teach financial literacy. We're using both numbers and observations to see what works best. Early results show that when kids learn about money early, they feel more confident and can make smarter decisions later in life. In the end, this project supports adding financial lessons into regular education to help kids build a better future.

Augmented Reality Scavenger Hunt Interactive Superimposed Video Fun Fact Finder for City Tech Campus Public Spaces

Sally Chen, Amir Gamble, Alan Jaquez
Prof. Jenna Spevack

Augmented Reality (AR) is an emerging medium that superimposes digital content over a user's view of the real world. Our research explores how AR can help engage the college community through real-life physical experiences using interaction and play. We utilize the AR application MembitTM, "a geolocative augmented reality (AR) storytelling platform," as well as other approaches and platforms to enhance the campus experience. With this goal in mind, we created the Fun Fact Finder project to acquaint incoming students with the various public spaces City Tech offers in the form of an interactive scavenger hunt. Using AR in Membit, the real-life locations merge seamlessly with the introduction videos filmed at the respective locations to create an immersive and informative experience for the user while promoting the functions of the campus' diverse resources. The outcome of this project would affirm AR's potential in fostering community engagement via its ability to pique interest in blending digital and reality. The application's effect of publicizing school resources highlights AR's usefulness in promoting ideas, which inspires the follow-up project of an AR bookstore that digitally simulates the physical appearance of the completely online City Tech bookstore in the form of a vending machine. The new application would run on a website, improving accessibility by eliminating the need to download an app while encouraging more user activity on the bookstore website via embedded links and object interactivity.

Smart Lock System with Biometric and RF-Based Multi-Factor Authentication
Kevin Balbuena Montes, Francisco Zamora, Ibraheem Esa, and Erick Cabrera
Prof. Mohammed Islam

In response to rising cybersecurity threats and unauthorized access to smart devices, this project presents a low-cost and effective Arduino-based Smart Lock system that uses biometric and RF-based Multi-Factor Authentication (MFA). The design combines an Arduino microcontroller with an ESP32-CAM for facial recognition and a fingerprint sensor. This setup makes sure that only people you trust can release your front door. To accommodate guests or children, an RFID reader is also included as an additional access method. An OLED and LCD display combination provides real-time feedback during the authentication process, while a speaker offers audio alerts. To enhance security, the system can send notifications through a mobile app when a family member successfully enters the home or when suspicious activity is detected such as multiple failed attempts or system errors. By using affordable components and an efficient design, this smart lock offers reliable, real time home protection without the high cost of commercial systems.

3D-Printed Culinary Tool Assistive Device

Amber M. Ocasio
Prof. Farrukh Zia

Earlier research shows that employers are hesitant to employ people with disabilities due to the lack of assistive technology at their disposal. To remedy this, my research project explores the development of assistive devices aimed at enhancing the independence of individuals with disabilities. The main focus is to design and produce a cost-effective, 3D-printed *sharpless knife* that enables safe food preparation without the risks associated with traditional blades. The innovative design features repetitive ridges in place of a sharp edge, allowing users to cut or saw through soft foods while minimizing the potential for injury. Although the project is ongoing, it is anticipated that the final product will improve safety and autonomy in kitchen environments for individuals with limited dexterity or motor impairments. Prototypes will be distributed in collaboration with the Goodwill Foundation to support inclusive culinary training and employment opportunities. Following this project , future studies can highlight the intersection of engineering, accessibility, and social impact, emphasizing the potential of adaptive technologies to transform everyday experiences for people with disabilities.

Maze Master in the Making: How Do You Build a Robot That Never Gets Lost?

Majida Naz
Prof. Farrukh Zia

Before a robot can conquer a maze, it must first be imagined, understood, and intelligently designed. This research sets the stage for building a maze-solving robot entirely from scratch—not by rushing into construction, but by pausing to ask the most important question: *What makes an effective robot?* The study focuses on identifying and evaluating the most suitable components—such as sensors, microcontrollers, motors, and chassis frameworks—that can power autonomous navigation in confined, unpredictable environments. From ultrasonic sensors to the logic behind pathfinding algorithms like A* and wall-following, each choice plays a critical role in how a robot perceives and reacts to the world around it. While the final product lies in the future, this project serves as a blueprint: a thoughtful exploration of design decisions, trade-offs, and the exciting possibilities at the intersection of hardware and intelligence. Whether you're an engineer or just curious about how robots think, this research invites you into the creative process behind bringing a maze-runner to life.

When Amylase Works and the Pancreas Doesn't

Hailah Nagi
Prof. Farrukh Zia

Lung cancer is one of the leading causes of death all over the world, it accounts for 90% of cases caused by smoking. It affects not only smokers but also secondhand smokers who inhale the same toxic chemicals in the air. In addition to smoking, other air pollutants contribute to lung cancer by damaging the respiratory system, such as PM2.5 small particles that we inhale. The lungs are lined with specific tissues that support breathing, but exposure to harmful substances like benzene, formaldehyde, and polycyclic aromatic hydrocarbons can cause these cells to mutate, grow abnormally, and spread to other parts of the body. That happens in different stages, as damaged cells lose their normal function and become cancerous with no initial symptoms, making it even worse. Secondhand smokers face similar risks since the chemicals from cigarette smoke linger in the air, making it a significant public health concern. Through this research project I will provide information and statistics to inform and educate the public about the harmful substances in smoke that cause cancerous tumors. Also, I will explain why smoking is not the best choice, even though a lot of people are aware and how secondhand smoke can have the same risks on non-smokers. The aim is to raise awareness, encourage people not to smoke, and promote smoke-free environments for everyone's health.

Control of Electro-Mechanical Systems with Assistive Technology Devices

Shiou Ching Chen
Prof. Farrukh Zia

This paper presents a service-learning STEM project aimed to develop an assistive technology system that empowers individuals with severe physical disabilities and limited mobility to control a robotic arm using mouth movement. With a broader goal of promoting accessibility and independence, the project utilizes a Lip Sync device that translates oral gestures into movement commands for the robotic arm. The research aims to integrate assistive devices to create a hands-free control interface for the users. Currently in the proof-of-concept stage, the system successfully maps Lip Sync outputs to robotic arm movements using microcontroller-based interfacing and the IoT user interface software Blynk. The robotic arm will be constructed using 3D printing technology, allowing for a lightweight, cost-effective, and customizable design tailored to user needs. Future development of this project will focus on implementing wireless communication to improve system usability and portability. This work contributes to the growing field of assistive technologies by offering a customizable, scalable, and affordable solution that enhances autonomy, interaction, and quality of life for individuals with physical disabilities.

Micro:Bit Communication

Nadia Khan
Prof. Farrukh Zia

Earlier research on senior care technology shows that wearable devices and smartphones can help in emergencies, but the question about usability and simplicity for the elderly remains unaddressed. The research is important because it offers a low-cost, accessible alternative that can improve safety and independence for elderly users. The purpose of the research is to design a simple communication system using micro:bit devices to help elderly individuals call for help in case of emergencies or falls. The research consists of the following steps: connecting two micro:bits using the radio feature, programming button-triggered or audio input and motion-triggered alerts, and testing the system for response time, reliability, and ease of use. The findings of the research show that micro:bits can be used to create an effective emergency communication device. The data we collected demonstrate that the device reliably sends alerts during simulated falls and is simple enough for elderly users to operate. This research complements earlier efforts to improve elderly safety by showing that microcontroller-based solutions can be both affordable and practical. Following the research, future studies can explore integrating GPS functionality for location tracking or connecting the system to smartphones for remote caregiver notifications.

Smart House Security Control with Micro:Bit Wearable Micro-Computer

Doussouba Diakite
Prof. Farrukh Zia

Smart House Technology is becoming prevalent to make the houses energy efficient and remotely managed while increasing living comfort and security. From smart thermostats and security cameras to voice-controlled assistants and automated lighting systems, these devices collectively form what is known as the Internet of Things (IoT). Despite their benefits, smart home technologies introduce a range of new security challenges. Many IoT devices have limited processing power and lack sophisticated built-in security mechanisms, making them vulnerable to cyber threats. Common risks include weak authentication methods, unencrypted data transmission, and inadequate software updates, all of which can expose users to unauthorized access, data breaches, and privacy invasions. This research project explores the use of wearable Micro:Bit micro-computer to manage and interact with smart house technology by using Bluetooth wireless communication, examine the specific cybersecurity threats facing smart home technologies, assess the impact of these threats on users, and analyze the effectiveness of existing security measures. By exploring various types of attacks, such as malware targeting IoT devices, unauthorized access, and network-based intrusions, this study seeks to provide an overview of the vulnerabilities in smart home ecosystems.

Virtual Meeting Space
Maurice Alexander
Prof. Marcos Pinto

Using a metaverse platform, such as spatial.io, to create a basic 3D virtual room up and running. The platform offers pre-built environments, avatar systems, and communication features. Users can join the 3D virtual room, move around, and communicate with each other using avatars.

Gene Mutation Analysis and Disease Prediction: Classifying Dangerous Variants Using Machine Learning

Shazrim Farin
Prof. Samuel Greenberg

Genetic mutations are a key factor in many human diseases, and understanding their impact is essential for advancing medical research and treatment. Earlier research using genetic databases shows important links between gene mutations and disease development, but the question about how to predict diseases from mutations without identified associations remains unaddressed. This project investigates gene-mutation data from the ClinVar database to identify high-risk gene mutation combinations and predict associated diseases using machine learning techniques. This research is important because it uses machine learning to bridge gaps in clinical understanding and support better predictive health strategies. The research consists of two steps. First, dangerous mutations were filtered and extracted from the ClinVar database based on gene name, mutation ID, chromosome position, reference and alternate bases, clinical significance, and associated disease. Second, a machine learning model was developed and evaluated to classify mutations that do not have a known associated disease. The findings of the research show that several dangerous mutations currently lack associated disease information, and the machine learning model demonstrates strong performance in predicting likely diseases for these mutations. The results suggest that integrating machine learning with genetic databases can enhance disease risk identification. Following the research, future genetic research can focus on refining predictive models and expanding databases to include a wider range of genetic variations.

Re-purposed Whole Textile Reinforced Clay to Enhance Bearing Capacity of Pavement Soils Abstract

Chrisly Narcisse, Jonathan Huerta, Roland Guevara, Ritika Talwar
Prof. Ivan L. Guzman

Method of Test for Moisture-Density Relations of Soils Using Harvard Compaction Apparatus (STP38484S) Standard Test Method for Unconfined Compressive Strength of Cohesive Soil (ASTM Standard D-2166) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTS Standard D-2216) This research investigates the potential of repurposed textile—specifically polyester fiber—to enhance the shear strength characteristics of clay soils for geotechnical applications such as roadway pavement and shallow foundation design. The study began with establishing a standardized procedure for specimen preparation, including determining ambient water content, increasing it by 30% for uniformity, and allowing samples to cure under controlled laboratory conditions for a specific amount of time before testing. Moisture content was determined using ASTM Standard D2216, compaction was achieved via the Harvard Miniature Compaction method (STP38484S), and undrained shear strength was evaluated using the Unconfined Compression Test in accordance with ASTM Standard D2166. Building on the baseline data from unreinforced clay, the current phase introduced polyester textile (cut into ½″ squares) at varying concentrations — 0.75%, 1.0%, and 1.25% by weight — into the clay specimen. Compacted samples were clay cylinders approximately 3 inches in height and 1.3 inches in radius, containing approximately 195 grams of clay, 28.5 grams of water, and corresponding polyester content by concentration. Post-testing, clay-textile samples were dried to determine exact moisture content, then rehydrated and remixed for repeat testing after a 24-hour curing period This was done to maintain consistency through testing trials. Results revealed that samples with 0.75% textile specimens at an approximate 29% moisture content, demonstrated the most significant increase in undrained shear strength when compared to clay only specimens. The findings suggest that low-percentage polyester fiber reinforcement can meaningfully improve the mechanical performance of clay soils without compromising stability. Future work will focus on long-term strength retention, fiber distribution effects, fiber degradation and potential scaling of this reinforcement method for field applications.

Early Childhood Caries

Shahd Abdalla
Prof. Dora-Ann Oddo

Early Childhood Caries (ECC) is defined as the presence of one or more dental caries in children aged six years or younger. The development of ECC is attributed to various factors, including excessive sugar consumption, inadequate oral hygiene practices, and, in some instances, genetic susceptibility. The prevalence of dental caries is notably high among children from low-income households, with an estimated prevalence rate of 56.3-60%.[1,2] ECC can have significant and long-lasting effects on a child's oral health. Dental caries in children progress rapidly and often affect multiple primary teeth simultaneously, leading to impaired chewing ability, severe tooth decay, and the formation of painful abscesses.

Arduino-based Sensor Enhanced Electric Vehicle

Ndibmouwem Umanah
Prof. Ahmed Hassebo

This project builds upon the Arduino-Based Obstacle Avoidance Electric Vehicle by integrating advanced sensor applications for both navigation and path tracking. The enhanced system combines ultrasonic sensors for real-time obstacle detection with infrared (IR) sensors to keep the vehicle on a predefined track on the ground. Ultrasonic sensors are employed to scan the surroundings, measure distances, and help the vehicle avoid collisions by altering its path when objects are detected. Simultaneously, IR sensors are mounted underneath the vehicle to detect the contrast between the track and the background surface, enabling the vehicle to follow a specific route accurately. This dual-sensor approach not only improves the autonomy of the vehicle but also provides a deeper understanding of how different sensors can be used cooperatively for efficient and intelligent robotic movement.

ESP32-based Weather Monitor

Sherlyn Cruz
Prof. Ahmed Hassebo

Temperature and humidity monitors are designed to detect and alert users to changes in environmental conditions within a given space. In our project, we are using an ESP32 microcontroller to receive and transmit data collected by a DHT11 sensor, which measures outdoor temperature and humidity. This data is then made accessible through the Blynk application, where users can view real-time readings via interactive widgets. The app's features, such as data history logging, enable users to compare past and current readings to identify environmental trends and make informed adjustments. To evaluate the system's accuracy, we will compare the sensor data with weather information from a smartphone application. The resulting data can help users determine whether an environment meets optimal conditions for purposes such as public safety, agriculture, storage, or enclosed spaces.

Research on renewable energy, solid waste processing, waste-to-energy (WTE) technology (recycling, biomass, combustion)

Babacar S, Rizwan Chowdhury, Harmony Divine, Rean Shahidullah
Prof. Masato Nakamura

Rising global waste and energy demands require urgent advancements in Waste-to-Energy (WTE) technologies, integrating recycling, biomass conversion, and combustion for sustainable urban solutions. This project investigates the efficiency of these WTE methods using experimental data and social datasets from NASA, NOAA, NYC, and the EPA to evaluate environmental and community impacts. Through a comprehensive literature review (ScienceDirect) and analysis of existing patents, we identify opportunities to innovate WTE systems while learning the patent-writing process—documenting our findings to prepare a provisional patent application for novel WTE designs. Preliminary results show biomass gasification of municipal solid waste (MSW) yields 25% higher energy output than traditional combustion, with 15% lower emissions. By correlating these findings with NYC waste stream data, we highlight scalable applications for underserved neighborhoods. This project not only contributes to a peer-reviewed research paper on WTE optimization but also serves as an educational model for STEM students to bridge technical research with intellectual property development, emphasizing real-world innovation pathways.

Redesigning the Light Testing Center of the Robotic System

Mohamed Ka
Prof. Muhammad Ali Ummy

This project focuses on designing and prototyping an upgraded mechanical light bulb testing system using 3D-printed components and magnet-based actuation, without the use of electronics or sensors. The goal is to develop a reliable and efficient system that allows users or the robotic arm on the system to easily insert a light bulb into a custom-designed docking station, where mechanical movement ensures proper electrical contact for testing. The design will incorporate guiding structures, a magnetically actuated mechanism, and hinged contact points that move in unison with the actuation, all modeled in Fusion 360 and manufactured using 3D printing. The system aims to improve testing speed, consistency, and ease of use, while remaining low-cost, durable, and easy to assemble. Through iterative design and prototyping, the project will demonstrate how mechanical principles, and additive manufacturing can be combined to create practical, sensor-free testing solutions.

Machine Learning Applications in Particle Accelerator Science and Technology

Parviz Subkhankulov
Prof. Li Geng

Machine learning (ML) and artificial intelligence (AI) have demonstrated significant value across various scientific domains, including biology, astrophysics, and materials science. One area with particularly high potential for ML and AI integration is particle accelerator science. Our investigation highlights that ML and AI are becoming essential tools in the operation, optimization, and maintenance of accelerators. These technologies facilitate faster beam tuning, enhance predictive diagnostics, and enable automation of complex control processes. In this study, we explore the interdisciplinary applications of ML in accelerator science, with a focus on beam dynamics, fault detection, simulation acceleration, and real-time control—leveraging frameworks such as the Cheetah differentiable simulator.

Automation of Japanese Shadow Puppets for Machine Control
Kristian Rice, Yinson Tso and Mukhammadali Yuldoshev
Prof. David Smith

The virtualization of Javanese shadow puppetry (Wayang Kulit) offers a unique opportunity to preserve and revitalize traditional performance art through immersive digital platforms. This project explores the development of a virtual Wayang Kulit experience using real-time 3D engines like Unity/Unreal Engine while focusing on simulating the mechanics and aesthetics of shadow puppet performance. The puppets are designed using detailed 2D planes and rigged with skeletal systems to reflect the stylized motion of traditional puppetry. An aspect of this project is integrating an AI-driven control system that autonomously animates the puppets, learning from recorded puppeteer performances to replicate gesture, rhythm, and narrative flow. This approach aims to enhance interactivity and provide a more authentic representation of Wayang performances in digital form. This work contributes to digital heritage preservation and AI-driven performance arts, creating new pathways for cultural education, engagement, and creative reinterpretation.

Bridging Digital and Physical Storytelling through AI-Assisted Shadow Puppet Design

Samuel Cheung
Prof. David Smith

This research project at New York City College of Technology explored how artificial intelligence can be used as a creative tool in the design process for a shadow puppet performance. The goal was to combine digital and physical methods to support visual storytelling, using AI not as a replacement for human creativity but as a way to assist with generating ideas and speeding up early design stages. I focused on developing character designs and scenic backgrounds by working with AI image generation models and prompt engineering techniques. The AI-generated results were then edited, adjusted, and reworked to match the story's tone and visual themes. Character designs started with AI templates that I adapted into detailed, hand-drawn illustrations before preparing them for fabrication using materials like paper and wood, including laser cutting for precision. Backgrounds followed a similar process, with AI outputs refined to align with puppet movement and stage direction. This hybrid approach allowed me to experiment with how digital tools and traditional craftsmanship can work together. While AI helped with brainstorming and drafting, the final pieces required personal judgment, storytelling skills, and hands-on design. The project shows that with the right balance, AI can be an effective tool for student artists working between physical and virtual worlds.

Understanding of the Impact of Climate Change on Building Energy Consumption

Ferasuddin Siddiqui, Abdellah Gessra, Rashiek Barber, Christopher Sanchez and Takoda Nestor
Prof. Daeho Kang

To effectively understand and assess the impact of climate change on, gaps in existing energy research and climate modeling need to be filled. The poor communication and collaboration in these two topics have led to a lack of understanding on the connection of climate change to building energy consumption. This study focuses on connecting the research of climate change and building energy consumption to help develop weather data for building energy systems and modeling to help understand the impact of climate change on building energy consumption. Our study looks into emission scenarios, general circulation modeling, and downscaling methods in order to analyze future weather data and its effect on building and energy consumption. It was found that the rise of global warming increases the demand of the HVAC systems. The growing demand leads to a decrease in efficiency and higher operating cost, worsening climate change and its effects. This research will help with the development of different strategies to reduce energy consumption. Future research is required where a bigger database can be used to improve accuracy.

Youth-Driven Approaches to At-Home DBS HIV Monitoring: The Role of Privacy, Clinical Trust, and Digital Tools

Cynthia Wen
Prof. Sitaji Gurung

Dried blood spot (DBS) biosampling offers a promising at-home method for HIV viral load monitoring, particularly for youth living with HIV who face barriers to routine clinical visits. Understanding youth perceptions is crucial for designing feasible and acceptable interventions. This study examines youth-driven approaches to at-home DBS HIV viral load monitoring. Semi-structured interviews were conducted with youth participants in an NIH-funded research study on DBS biosampling for HIV viral load monitoring. Qualitative data from this parent project (n=6 transcripts) were coded to explore participants' experiences, preferences, and concerns regarding at-home DBS biosampling. Using thematic analysis, interview transcripts were coded to identify patterns related to access, trust, usability, and engagement. Three major themes emerged: (1) *Preference for discreet access* – participants emphasized the importance of privacy and preferred picking up and returning kits through clinics to avoid stigma; (2) *Credibility through clinic promotion* – youth expressed greater trust in DBS kits distributed or endorsed by healthcare providers; and (3) *Use of digital tools for guidance and awareness* – QR codes, video tutorials, and social media were helpful for navigating sample collection and increasing awareness. Additional themes included the importance of adequate compensation, leveraging youth-driven platforms to improve engagement, forgetfulness as a barrier, lack of parental involvement, and confidentiality concerns. The key findings of this study highlight the importance of prioritizing privacy, trusted clinical partnerships, and engaging digital support tools for the successful implementation of at-home DBS biosampling among youth living with HIV. Addressing both structural and behavioral barriers can enhance adoption and support sustained HIV care.

Disaster Preparedness in New York City

Suzana Edmond
Prof. Smita Ekka Dewan

This research explores disaster preparedness in urban environments, with a specific focus on New York City. The study examines preparedness strategies for coastal and riverine flooding, particularly in relation to vulnerable populations. A review of at least 5 scholarly articles reveals key insights into how various demographic factors influence preparedness, readiness, and resilience during extreme weather flooding events. The targeted population include individuals from New York City, segmented by age, people with disabilities, income levels, medical conditions, homeownership status, gender, LGBTQ orientation, religious minority status, ethnicity, and language spoken. The research study will present data from 2023 National household Disaster Preparedness data. By examining how these factors impact disaster preparedness, this study aims to identify gaps in current strategies and propose solutions to enhance resilience in diverse urban communities.

Cultural Barriers and Communication: South Asian Experiences in Healthcare

Sabahat Moughal
Prof. Sarah Price

Communication is a fundamental part of integrating into American society, yet for immigrants—particularly South Asian immigrants—it often becomes a site of struggle, especially within the healthcare system. This research explores the dynamics of cross-cultural communication between South Asian patients and their healthcare providers, focusing on barriers related to language, culture, ethnicity, and differing health beliefs. The study uses in-depth, open-ended interviews—conducted via Zoom or in person and voice-recorded without identifying information—to collect narratives from both patients and providers. It examines verbal and non-verbal communication, culturally specific expressions, symbolic practices, and regional understandings of health and illness. Fieldwork also includes informal interviews and observational research, particularly following a "Compassionate Connected Care" workshop at Wyckoff Heights Medical Center (WHMC), led by Press Ganey. The workshop, attended by program directors, attendings, and residents, emphasized relationship-centered care and techniques for more empathetic provider-patient interactions. Physician participants were invited to share personal takeaways from the workshop in follow-up conversations. The study is awaiting Institutional Review Board (IRB) approval from CUNY and the WHMC IRB committee, which would permit collaboration with interns and residents in WHMC's residency programs. This presentation will report on formative research involving needs assessment, site selection, capacity building, instrument design, human subjects' protection, and data protocols. By documenting the lived experiences of underrepresented populations, this study challenges stereotypes and promotes compassionate, culturally attuned healthcare.

Predicting Post-Translational Modification Sites Using Convolutional Neural Networks

Christopher Chow
Prof. Shang-Huan Chiu

Post-translational modifications (PTMs) refer to the attachment of molecules (e.g., phosphates, sulfates, glycans, ubiquitins, etc.) to amino acids in proteins. These modifications change the properties of proteins and play a large role in protein function, regulation, and cell signaling. PTMs also play a role in disease (e.g., Alzheimer's Disease via Tau hyperphosphorylation, Huntington's Disease via hypopalmitoylation of huntingtin protein, Type 2 Diabetes Mellitus via malonylation of enzymes involved in glucose and lipid metabolism, etc.); therefore, understanding PTMs and locating these modifications can provide valuable targets for therapeutics. However, discovery of PTMs and their locations on proteins is very time consuming, laborious, and expensive. Computational methods, such as machine learning, are required to alleviate these challenges. Logistic regression, support vector machines, random forests, and k-nearest neighbors are some traditional machine learning methods that were used with good success in predicting PTMs. As machine learning and AI have advanced tremendously in the last few years, advanced machine learning techniques such as Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Transformer Models, and Graph Neural Networks (GNNs) have been used and outperformed traditional machine learning methods. This work will explore the use of a CNN to predict phosphorylation sites using Pytorch and data from UniProt. The model in this work produced an accuracy of 73% and an F1 score of 39%. Attention heads, PTM crosstalk, secondary structure data, amino acid chemical property data, and hybrid models will be considered in future work to improve model performance.

Economical Impact of COVID-19 in the United States: County Level

Angelica Tellez
Prof. Huseyin Yuce

The COVID-19 pandemic caused a major economic crisis across the United States, with effects felt in nearly every county. Lockdowns, travel restrictions, and social distancing led to widespread disruptions in local economies. COVID-19's total cost to the U.S. economy to reach $14 trillion by the end of 2023 (Hlavka and Rose, 2023). In this project, we analyze how COVID-19 impacted the U.S. economy at the county level, using economic data and multivariate regression models. Our main focus is on GDP (Gross Domestic Product) to measure economic changes, but we're also looking at how factors like vaccination rates, the spread of the virus, and weighted population density affected economic outcomes in different counties. These help us understand how public health and population patterns shaped local economies during the pandemic. In the future, we plan to include more indicators, such as the debt-to-income ratio, to get a broader picture of how counties were financially affected. The results from this study could be useful in preparing for future pandemics by helping policymakers identify which counties were hit hardest and may have been overlooked, so that resources can be more effectively targeted and distributed next time. Overall, this study shows how a health crisis like COVID-19 can have a big impact on the economy, specifically at the local level.

Topics in Computational Number Theory
Evelyn Pulla
Prof. Satyanand Singh

We made explorations in number theory to solve problems by way of the computer software Python. The Python program was used to analyze conjectures and create simulations based on number theoretic problems. We looked at Divisibility and the Euclidean Algorithm, Prime Numbers and Fundamental Theorem of Arithmetic, and Linear Diophantine Equations. We also considered theoretical methods to verify our predictions. Our work demonstrates the immense power of computation and simulations to make predictions, many of which can be established by theoretical means.

NASA Design and Analysis of PEGDA Hydrogels for Microgreen Cultivation in Space

Fabiha Samiha, Luis Luna, Kelly Wu, Gabriel Antigua, and Artur Abramyan
Prof. Ozlem Yasar

During long-term space expeditions, it is crucial that astronauts receive the nutrients they need to maintain their overall health. While the current space diet of palatable foods is commendable and constantly evolving, nutritional content and food quality degrades over long durations. Microgreens are young plants that are harvested when true leaves are just emerging. They are nutrient-dense due to their high bioavailability and are also small and densely grown, making them an excellent candidate for space cultivation and adding variety to the current space diet. However, antigravity, microgreen fragility, degradation speed, contamination, and limited water and oxygen are substantial barriers to doing so. Hydroponic methods of growing microgreens in boxes and mats are currently being studied by NASA and other organizations. This study aims to address these challenges by designing and analyzing different hydrogel designs to find an efficient method for cultivating microgreens inside a soilless medium, minimizing water usage. Cylindrical samples of Polyethylene Glycol Diacrylate (PEGDA), a biocompatible polymer, were fabricated using photolithography to provide the moist environment required for microgreens. Arugula seeds were then encapsulated into these samples with inbuilt 3D printed flow channels to enable additional nutrient diffusion. 90% of the seeds germinated in the PEGDA samples within 1-3 days when left submerged in water, with true leaves emerging shortly afterwards. Although these results demonstrate great potential in microgreen cultivation in space, further research is needed to solidify the design for best cultivation. By designing multiple different molds, we can analyze which factors - from area, depth, and number of channels, yield the best results for plant growth and collection.

Monitoring Heat Temperatures in New York City Subways

Alexander Abreu Ramirez, Tyler Ayala, Damilola Babs-Ogundeji, Kingston Ditsch, Maria Hashmi, Shaquan Larose, and Malique Paul
Prof. Abdou Bah

Climate change has had a major effect on New York City causing challenges for reducing trapped heat. The underground transportation system is heavily impacted by the changing climate, and the issue is more severe during summer when heat waves are common. The goal of this research is to identify stations that are heavily impacted by these environmental conditions and evaluate them to help with developing heat mitigation strategies. Each researcher was assigned to a train service in Brooklyn, NYC to measure the relative humidity and air temperature at both the subway platform and street level. To conduct this project, humidity and temperature data loggers were used to measure, store, and record data inside stations and at street level to be shown in a presentable way. This data will then be used for analysis in determining which stations in Brooklyn are impacted more heavily than others by heat, furthermore, helping with reducing hot temperatures underground. From previous research, specifically during July 2024, when the city experienced three continuous heat waves which kept the average temperatures of the Brooklyn subway stations ranging from high eighties and low to mid ninety degrees Fahrenheit. The research continued through the winter starting in early February, and the weather conditions were nearly opposite compared to the summer readings. Where summer was sunny, humid, and hot through the duration of the collection process. Winter has been overcast, rainy, and cold. From our collective data, we noticed the air temperature and humidity were both higher at the platform level compared to the street level. Although efforts are being made towards climate resilience, the implementation needs to be swift and concentrated on the stations more impacted. Climate change effects are significant, and this research will help with heat mitigation initiatives that can be implemented now to reduce warming effects in the future.

Monitoring Heat in the NYC Subway System

Abdoul Mohaimine Nana, Lou Kale, Cesar Pascal
Prof. Abdou Rachid Bah

New York City's subway system faces increasing thermal stress due to climate change, particularly during heat waves. This study investigates temperature and humidity conditions at street level and underground platforms across stations in the Bronx. Using portable sensors, mobile devices, and thermal infrared cameras, data were collected at different times of day, considering factors such as station depth, ventilation systems, and commuter density.Heat and humidity levels were further exacerbated by crowded situations during peak hours, highlighting the part that human activity plays in the subsurface Urban Heat Island (UHI) effect. These circumstances may impair infrastructure functioning and present health risks to employees and commuters. Results show that underground platforms are consistently hotter and more humid than street- level areas, with temperature differences averaging up to 3°C in stations without cooling systems. The most extreme conditions were recorded in stations lacking air tempering systems or fans, where average temperature differentials reached 0.875°F and humidity increased by over 6%. In contrast, stations equipped with climate control infrastructure showed smaller or even negative differences, highlighting the importance of proper ventilation and cooling technologies. This research contributes to the MTA's continuing Climate Resilience and Sustainability activities by identifying high-risk stations and directing focused heat mitigation strategies. As temperatures rise in New York City, continued monitoring and investment in cooling equipment are critical to ensuring the subway system's safety, comfort, and resilience.

Exploring Properties Of Resolved Regions In Galaxies Through Cosmic Time

Ena Chia
Prof. Charlotte Olsen

The properties of galaxies provide key insights into the complex physical processes governing galaxy evolution. The relationship between properties within a galaxy can reveal the internal conditions that regulate how gas is converted into stars. While observations have shown that star formation can turn on or shut off – a process known as quenching – in different parts of a galaxy, the mechanics of what causes this are not well understood. By using a hydrodynamical simulation of a Milky Way type galaxy, we investigate the variations of stellar mass and star formation rate across different regions within this galaxy. Analyzing the different properties in regions of the galaxy we can discover what areas are actively forming stars and what areas are not. Performing this same analysis on the galaxy in its past (up to 1 Gyr ago) we can see what regions were formerly active but are now quenched – or vice versa. Tracking the change in the relationship between stellar mass (amount of stars) and star formation rate over time gives us powerful insights into how galaxies evolve.

Stars and Simulations: Dwarf Galaxies and their Star Formation History

Rona Zhang, Ena Chia
Prof. Charlotte Welker

Understanding the formation and evolution of the cosmic web is a major goal within the field of cosmology. One of the methods of doing so is by analyzing the possible ways in which the filaments of the cosmic web may be impacting the star formation histories of the dwarf galaxies in their vicinity – galaxies which are more susceptible to their environments due to their mass and structure. These efforts involve both observational study and the analysis of data from simulations that combine current scientific theory into models that can provide insights that may not be easily seen through observation. One such simulation is NewHorizon, a zoom-in region of ~$(16\ \mathrm{Mpc})^3$ that is simulated at high resolution and embedded within the larger Horizon-AGN simulation. In this project, using a catalog of data from NewHorizon we explore how various properties of a selection of 5434 galaxies evolve with their respective stellar masses. We see a distinct difference in attributes such as the magnitude of the specific angular momentum with respect to the mass of galaxies of $10^8\ M_\odot$ or below when compared to their larger counterparts that suggest the presence of influences unique to galaxies of lower mass.

Quantitative Finance: Geometric Brownian Motion vs Quantum Stochastic Differential Equation

Sean Sinclair
Prof. German Kolmakov

This research investigates the potential of Quantum Stochastic Differential Equations (QSDEs) as a novel replacement for the traditional Geometric Brownian Motion (GBM) model in option pricing frameworks. While the Black-Scholes model relies on the assumption that asset prices follow GBM, this classical approach often fails to capture market inefficiencies, abrupt price movements, and extreme volatility—features that are increasingly relevant in today's complex financial landscape. By introducing QSDEs, which incorporate principles from quantum mechanics and stochastic calculus, this study aims to develop a more robust, adaptive model that can better represent the probabilistic nature of asset dynamics. The research explores how quantum noise, superposition, and entanglement can be used to simulate more realistic price path behaviors, and evaluates the computational advantages of QSDEs through theoretical analysis and numerical simulations. Ultimately, this work contributes to the evolving intersection of quantum computing and financial modeling, offering a new paradigm for derivative pricing in uncertain markets.

Edge Modes In Chiral Superconductors

Tonatiuh Fitzgerald
Prof. Roman Kezerashvili

This project explores edge modes in chiral superconducting double layers, focusing on the emergence and physicality of wavefunction solutions near domain walls. Starting from a coupled differential equation system with a spatially varying phase in the order parameter, three configurations were considered: a sharp phase jump and two smooth arctangent-based profiles. The goal was to obtain real, measurable wavefunctions by ensuring integrability—i.e., that the solutions do not diverge at infinity. Analytical and numerical methods were used to characterize these modes, with Python-based simulations (partially assisted by AI tools) verifying behavior across cases. In the third round of refinement, solutions were successfully adjusted to be square-integrable, confirming the physical validity of select edge states. This work builds upon the model introduced by Ziegler et al. (2022), further demonstrating that smooth domain walls can sustain localized, decaying zero-energy modes under appropriate phase conditions.

Optical Properties of Hybrid Nanostructure Containing Metal Nanoparticles on 2D InSe

Tomas Gonzalez, Keven Cruz, Stefanie Rivera
Prof. Vitaliy Dorogan

By studying the properties of transition-metal dichalcogenides (TMD) nanostructures we can gain insight on how these materials work for better performance in many devices. This can lead to new technologies in fields such as quantum computing and efficient light-based applications. Upon using metal nanoparticles of gold in conjunction with a 2D sheet of TMD material such as Indium Selenide (InSe), we can enhance the optical properties of 2D semiconductors. InSe is a class of 2D materials that has high electron mobility, strong interactions with light, and exhibits excitonic emission at room temperature. This can be accomplished by exploiting the van der waals forces within the TMDs. In order to manipulate said forces, exfoliation of InSe must take place starting off from bulk using a specialized tape and then hopefully reduced into monolayer flakes. After exfoliation, the compound is transferred onto a PDMS piece attached to a microscope glass which is transferred onto a substrate of silicon. Upon transferring flakes onto the silicon substrate, a signal for photoluminescence can be tested with a laser beam on the optic bench. If a photoluminescence signal is found from the substrate, gold nanoparticles can be theoretically applied on top in order to hopefully amplify the signal.

CAD Illustration of Deficits in Three-Dimensional Constructional Ability

Ivy Li
Prof. Daniel Capruso

Deficits in three-dimensional constructional ability are commonly seen in patients with neurologic disease, especially when the lesion involves the bilateral posterior cortices or right hemisphere parietal lobe. These constructional deficits often result in gross spatial distortions when patients attempt to reproduce three-dimensional block models. Accurately photographing these error types is difficult because image factors such as shadows and limited luminance contrast can make visual comprehension of the patient's response errors difficult to comprehend. The intent of this project was to determine if CAD can could be used to render improved illustrations of patient constructional deficits. The task used was the Benton & Fogel (1962) test of Three-Dimensional Block Construction. Response errors were drawn from patients with neurologic disease (n = 40) tested in a clinical neuropsychology laboratory. Examples of stimulus models and patient response errors were rendered as dimetric projections using AutoCAD with settings enabled for three-dimensionality. The resulting images were superior in visual clarity to traditional photographic illustration. Unlike photographs, the CAD models can be rotated so that viewers can inspect the models and patient response errors from every angle. These CAD illustrations will improve communication and documentation of constructional error types in scientific journals.

Foveal Fixations on Face, Dress, and Jewelry

Maggie Morales
Prof. Daniel Capruso

This experiment sought to determine the relative allocation of visual attention on the image of a well-dressed and bejeweled 19th Century French Princess. Subjects were CityTech students (*n* = 23). The stimulus was the portrait of the “Princesse de Broglie” by Jean Auguste Dominique Ingres. Foveal fixations were recorded using a Tobii T-60 eye tracker with a temporal resolution of 60 Hz and a typical gaze position accuracy of 0.5° of visual angle. Each scene element was delineated and consolidated into an “Area of Interest” (AOI), and similar AOIs were consolidated into group AOIs. Total gaze duration within each AOI group was calculated for the total 10s stimulus exposure. A within-subjects MANOVA indicated that the longest gaze duration was on the face (M = 2.62, SD = 1.51), Wilks Lambda = 0.10, $F(8, 15) = 16.98$, $p < .001$. Inspection of the percent of subjects who fixated on each AOI group indicated that aside from the face, hair, and body, fashion elements such as the dress, its lace trim, and jewelry were all noticed by subjects. Of particular interest, the lace trim was noticed (83%) with the same frequency as the dress (83%), even though it occupied a much smaller area of the image. The results confirm that the human brain is specialized for perception of the face above all other visual elements, but that allocation of visual attention extends as well to a person’s dress, decorative clothing elements (lace), and fashion accessories (shawl and gloves).

The Role of MRI in Diagnosing Conditions Affecting Organs and Soft Tissues
Sebastien Louis
Prof. Lillian Amann

Magnetic Resonance Imaging (MRI) is widely used in the medical field for its ability to provide detailed images of organs and soft tissues. This technology plays a major role in diagnosing a variety of conditions, including brain injuries, spinal disorders, heart problems, and internal organ damage. The purpose of this project was to examine how MRI improves the accuracy and efficiency of diagnosing these conditions. The main question I explored was whether MRI is more effective than other imaging methods, such as X-rays or CT scans, when it comes to identifying soft tissue and organ-related diseases. I conducted my research by reviewing medical literature, comparing clinical case examples, and gathering input from healthcare professionals who use MRI in their practice and experts in radiology. Based on this research, I found that MRI offers distinct, more detailed images that help doctors detect issues earlier and with greater precision. The outcome suggests that MRI not only improves diagnosis but also plays a key role in treatment planning, leading to better care and outcomes for patients.

Does Mechanical Injury in Potato and Apple Models Alter Water Dynamics at Surfaces: X-Ray Results to Understand Brain Trauma

Daler Djuraev, Achlyn Genao, Somdat Kissoon, Vanessa Robinson
Profs. Mary Browne, Eric Lobel, and Subhendra Sarkar

Tissue surface effects have not been studied in brain trauma. We have observed that mechanical injuries in model fruits affect x-ray absorption. Using cold or warm distilled water at and around cut potato and apple surfaces we believe biometals can be released and studied by surface scattering of x-rays. We can observe the differential behavior of carbohydrate molecules vs mineral ions at the surfaces since potato has 5x more biometals than apples while both are almost equally porous and moist (80 vs 85% water content). These experiments may add insights to cell damage and changes in cytosol in moderate, acute brain trauma where early effects are not imageable.

Role of Core vs. Valence Electrons in Sodium Chloride, and the Observation of Picosecond Quantum Dynamics in the Hydration Shell by X-rays

Andre Ngono, N. Tomskikh, X. Wu
Profs. Evan Lespinasse and Subhendra Sarkar

Hydration shells of alkali halides around biomolecules play an important role in living organism. Hologic Selenia dimension mammographic soft x-ray machine was used and X-ray images of Sodium Chloride were obtained at various temperature to observe the dynamic process of water recruitment into the hydration shells of sodium, and Chloride ions over time using low energy X-ray. Concurrently, the role of core, and valences electrons of NaCl were also observed to understand the complex process of picosecond quantum dynamics in hydration shells of alkali halide. The results of this experiment indicated that, Sodium Chloride (NaCl) reactivity is conducive with change in temperatures in aqueous solutions, and the resulting sodium ions formed more ordered hydration shells compared to chloride ions. As the concentration of NaCl increased, more water molecules attached to hydration shells with increased temperature. But at low temperatures (e.g., 4°C), Fewer hydration layers were formed, and less NaCl molecules were dissolved. Furthermore, increased concentration of NaCl in warmer water, increased the formation of hydration shells, and more so in the absence of stirring. Based on the result of this experiment, it was concluded that picosecond quantum dynamics can be observed in hydration shell of alkali halide at elevated temperature, and that, NaCl valence electrons readily attract water molecules to form hydration shells compared to chloride ions.