CUNY Research Scholars Program

List of CRSP students and their abstracts presented at the 2025 CRSP Symposium

Investigating the Role of Peroxide in Prolonged Antibacterial Activity of Singlet Oxygen

Patrick Gerges
Mentors: Professor Alan Lyons, Professor Chathuna Bodahandi

Many bacterial killing treatments use light to activate molecules that produce a special form of oxygen, called singlet oxygen, which can kill bacteria. However, singlet oxygen has a short lifetime, and cannot travel far in liquids, which limits its ability to provide long-lasting effects or kill thick biofilms. This study investigates if peroxides, which are formed as a byproduct of singlet oxygen reactions with proteins, are responsible for prolonged antibacterial activity. To test this, histidine, an amino acid, was reacted with singlet oxygen to produce organic peroxides. A light-absorbing dye, which is known as a photosensitizer, is used to cause the reaction to start under LED light. By measuring peroxide levels at different time intervals, the aim of this study is to determine how long these peroxides persist in water and how effective they are in killing bacteria over time. E. coli was the bacteria used to quantify the antibacterial properties of the formed peroxides and results were compared to standard hydrogen peroxide solutions. If the photo-generated peroxides play a major role in extending bacterial killing, this could improve light-based antibacterial treatments. These findings may provide better methods for fighting bacterial infections, especially those caused by antibiotic-resistant bacterial strains. By further collecting data and understanding how peroxides affect antibacterial activity, this study could help develop more effective treatments for infections, medical sterilization methods, and dental applications.

Extrapolation of Digital Holograms for Enhanced Reconstruction Using Deep Learning

Angelina Bittan
Mentor: Professor Shuqun Zhang

Digital holography is a technique that captures three-dimensional information as a two-dimensional interference pattern using a digital camera, and reconstructs it computationally. It has a wide range of applications, including security and authentication, 3D displays and augmented reality, biomedical imaging and microscopy, and deformation inspection and measurement. However, due to the limited size of image sensors, high-spatial-frequency components diffracted at large angles from the object cannot be recorded. This truncation of the optical field introduces artifacts and significant speckle noise, resulting in low-quality, low-resolution reconstructions. To address this limitation, a deep learning method is employed to extrapolate digital holograms and recover the wavefront beyond the actual detector size. A synthetic image dataset is generated for model training and testing, which can also serve future deep learning-based digital holography research.

Pathological Tau-Induced Changes in Protein and Receptor Expression in the Mouse Brain

Genesis Castro
Mentor: Professor Alegandra Alonso

Pathological human tau (PH-tau) commonly refers to a hyperphosphorylated version of the tau protein associated with neurodegenerative diseases. Tau stabilizes microtubules which support cell structure. A transgenic mouse model expressing PH-tau was used to investigate how abnormal tau impacts the subcellular localization of proteins such as Tom 20 (mitochondrial marker) and TDP-43 (transcription factor normally localized in the nucleus). The proteins were labeled with fluorescent tagged antibodies and visualized using confocal microscopy. In the PH-tau expressing mice, TDP-43 was mis-localized to the cytoplasm, and changes in TOM-20 expression were observed, indicating signs of neurodegeneration. To further assess how PHtau affects neuronal signaling, we examined the expression of GABA-A and Muscarinic (M2) receptors. GABA-A receptors regulate inhibitory neurotransmission, while M2 Muscarinic receptors are part of the excitatory system involved in cognitive functions such as memory. Compared to control tissue, both receptor types were upregulated in the transgenic mouse brain. However, the increase in M2 receptor expression was more present than GABA-A. This imbalance suggests a shift toward excitatory signaling.

Video-Based Heart Rate/Stress Estimation: A Non-Contact or Invasive Approach to Real-Time Pulse Analysis

Xia Jie Ou
Mentor: Professor Sos Agaian

Physical activities refer to any movement that activates muscles while consuming energy. Human physical and mental health requires steady exercise participation. Individuals exercise across different locations from their house to rehab centers and fitness facilities, but they require suitable methods to track their progress. The traditional body-worn sensor monitoring techniques restrict movement and develop skin irritations as they are connected through body sensors. These modern noncontact monitoring systems eliminate earlier technology problems to provide greater comfort and monitoring accessibility. This research examines video-based technology that tracks vital signs, such as heart rate, while people exercise in different lighting environments without using touch-based sensors. Video analysis allows for the detection of facial appearance, followed by processing changes in 5 facial color that correspond to blood flow patterns to determine heart rate measurements accurately. The objective is to build real-time monitoring systems that track stress indicators along with non-contact solutions for healthcare and fitness purposes to help tracking stress and heart rate become effective for all users. Future research will continue investigation of heart rate pattern analysis for stress level detection and optimizing this technology.

The Effects of Chronic Social Isolation on Oligodendrocyte Progenitor Cells in the Anterior Corpus Callosum

Gianna Albano
Mentor: Professor Leora Yetnikoff

The corpus callosum, the largest white matter tract of the brain, is composed of crossing cortical nerve fibers. This tract allows our brain's left and right hemispheres to communicate through signals that coordinate everyday activities, functioning as a bridge between both hemispheres. Axons within the corpus callosum are myelinated (giving the tract its "white" appearance) through oligodendrocytes, which produce a lipid-protein substance that wraps around the axons, enabling rapid transmission of action potentials. Oligodendrocytes are continuously produced throughout the lifespan by the proliferation of non-myelinating oligodendrocyte precursor cells (OPCs). It was recently discovered that myelination exhibits plasticity, changing in response to neural activity and behavioral stimuli such as social conditions. For instance, social isolation reduces the volume of the corpus callosum and causes hypomyelination in this region. However, the mechanisms underlying this effect are not clear. This study investigates whether prolonged social isolation during adulthood leads to hypomyelination by decreasing the number of OPCs. To investigate, male and female adult PDGFRa-GFP mice were either group-housed or socially isolated for two months. These mice 2 express a green fluorescent protein (GFP) in OPCs, enabling easy quantification. Cells are identified by immunofluorescence and quantified using IMARIS software. Preliminary analysis demonstrates no difference in OPC density between socially isolated and group housed mice. However, analyses are ongoing, and this result may change as the sample size increases. By understanding the relationship between myelination and social isolation, the data can contribute to understanding how environmental factors impact brain health and function.

Targeting Diabetes Inequities: The Role of Education and Neighborhood Deprivation Among Hispanic Adults in New York City

Selvia Rofail
Mentor: Professor Shiryn Sukhram

Hispanic adults in the United States face a disproportionate burden of type 2 diabetes, with more than half expected to be affected over their lifetime. In New York City (NYC), diabetes prevalence reflects not only biomedical risk factors but also broader social and economic inequities affecting Hispanic communities. This study analyzed data from the 2020 NYC Community Health Survey to assess the relationship between diabetes diagnosis and sociodemographic factors among Hispanic adults residing in socioeconomically deprived neighborhoods. Weighted logistic regression models were used to estimate the odds of diabetes diagnosis in relation to age, gender, obesity, high blood pressure, educational attainment, neighborhood poverty levels, and psychological distress. Lower levels of educational attainment and residence in areas with elevated poverty were significantly associated with higher odds of diabetes diagnosis. Obesity and high blood pressure demonstrated strong associations with diabetes, while psychological distress was also independently associated with higher risk. Females exhibited slightly lower odds of diagnosis compared to male participants. The findings emphasize the critical influence of social determinants of health on diabetes risk in Hispanic populations, extending beyond individual lifestyle factors. Structural inequities in education, healthcare access, and mental health resources contribute to the burden of chronic disease management. Community centered interventions that include accessible adult education programs, culturally tailored diabetes education, and integrated bilingual mental health services may help reduce these disparities and improve diabetes prevention and management among Hispanic adults in NYC.

Speaker Adjustments to English Voiceless Stop Consonants

Nora Nesimi, Ashley Wallace, Anna Bochneva
Mentor: Professor Jason Bishop

An important insight of modern approaches to phonetics is that speech production patterns are sensitive to perceptual considerations. We call this the listener-directed speech hypothesis (LDSH). According to this hypothesis, speakers make both conscious and unconscious adjustments to their speech to make it easier for listeners to hear and perceive words. In the present study, still in progress, we are investigating how speakers produce the consonant sounds /p/, /t/, and /k/ in different contexts. These sounds are referred to as "stop" consonants, due to their involving a brief but complete blocking of airflow in the vocal tract (mouth) and then a burst of high-pressure air upon release. According to the LDSH, if speakers do not release the stops (and therefore do not provide the salient information in the release that can distinguish these three sounds), they are predicted to compensate by producing other cues. To test this hypothesis, we are making acoustic measurements about (a) release burst duration; (b) stop closure duration; and (c) preceding vowel duration. Based on the LDSH, we predict unreleased stops will have longer preceding vowels and/or longer closure durations. We also explore differences between /p/, /t/, and /k/ in their rate of release.

Integrating Fibrotic Collagen and Immune Gene Signatures to Predict Patient Survival and Guide Therapeutic Strategies in Glioblastoma Multiforme (GBM), Breast Cancer (BC), and Lung Cancer (LC)

Melina Turco, Ambar Alvarenga
Mentor: Professor Nancy Liu-Sullivan

Collagen-rich desmoplasia in the glioblastoma multiforme (GBM) microenvironment creates a dense physical barrier that impedes penetration of chemotherapeutic drugs and ionizing radiation. In our previous work, we systematically analyzed key desmoplastic collagen genes (COL3A1, COL4A1, COL5A1) and showed low-grade gliomas (LGG) and melanoma, high levels of the genes COL3A1, COL4A1, and COL5A1 are linked to poorer survival outcomes. This means that when these genes are active in LGG and melanoma, patients tend to have a lower chance of long-term survival and is an indicator of tumor progression. In glioblastoma (GBM), the activity of these genes doesn't seem to impact survival as much, likely because the tumor genetic complexity and its microenvironment characterized by the bloodbrain barrier and intricate immune/stromal interactions diminish the effects of collagen. These findings imply that collagen expression could serve as a prognostic marker and therapeutic target in LGG and melanoma, while GBM may require more comprehensive treatment strategies that address multiple pathways. Building on those findings, our current study shifts focus to the immune compartment of desmoplastic stroma—recognizing that antigen presentation is decisive for anti-tumor immunity. We highlight HLA-DQA1, an MHC class II molecule that, in healthy tissue, presents extracellular peptides to T- lymphocytes. To assess its prognostic power more broadly, we compare HLA-DQA1 expression and survival side-by-side in GBM, breast cancer, and lung cancer, two malignancies prone to brain metastasis. Strikingly, high HLA-DQA1 levels are consistently linked with longer overall survival across all three cancers. These patterns suggest HLA-DQA1 as a strong immune prognostic marker connected to desmoplasia driven therapy resistance. In addition to positioning HLA-DQA1 as a promising prognostic biomarker, these results further underscore the critical role that immune mechanisms play in cancer progression and therapy response.

Visual Cryptography in Modern Healthcare

Daniel Voyevoda
Mentor: Professor Sos Agaian

As healthcare goes digital and data breaches become more common, protecting patient data has never been more critical. Medical images— X-rays, MRIs, and CT scans—carry sensitive information that needs secure transmission. This study examines how visual cryptography can secure medical image sharing, preserving both patient privacy and image integrity. Unlike traditional encryption, which relies on software and complex math, visual cryptography lets you decrypt images by overlaying shares and using your eyes—no specialized tools needed. We begin with binary visual cryptography: each image is split into two random-looking shares that reveal the original when aligned. Next, grayscale bit-plane decomposition breaks images into eight layers, one for each bit of pixel intensity, boosting security and letting you control access by choosing which layers to share. Finally, we extend this to color images by separating channels (RGB or CMY) and decomposing each channel into bit planes, producing layered color shares. A key advantage is distributing shares across multiple parties—doctors or medical centers— so that reconstructing the image requires collecting all shares. That way, no single entity 7 can access the data alone. And because decoding only needs human vision, it integrates smoothly into existing processes. We implemented these methods in Python and tested them on real medical images. To evaluate how well the encryption hides details, we use histogram analysis: simple graphs showing pixel intensity distributions for original and encrypted images in both grayscale and each color channel. Comparing these histograms lets us quantify how effectively the encryption disguises content. By using clear examples and straightforward explanations, this research bridges cryptographic theory and practical healthcare applications. Visual cryptography offers a lightweight, eye-powered solution for securing medical images and enabling safe, privacy preserving data sharing. Decoding requires no computational resources at the decryption stage. It also scales well for community-wide deployments and small clinics.