DePaul University – Rosalind Franklin University of Medicine & Science
AI in Biomedical Discovery and Healthcare
2023 Grant Recipients

Title: Machine Learning Discovery of Novel Brainstem Nuclei Controlling Orofacial Behaviors

PI: DePaul: Jacob Furst (CDM), Thiru Ramiraj (CDM)

RFUMS: Kaiwen Kam

Award: $67,000

Neurons in the brainstem medullary reticular formation govern vital motor behaviors, such as breathing, vocalization, swallowing, and chewing. Disruption of these circuits in neurodevelopmental and neurodegenerative disorders lead to central apneas, Sudden Infant Death Syndrome, dysphagia, and speech disorders. Critical for understanding these neural circuits is identification and localization of reticular subpopulations controlling these myriad functions. A major obstacle to identifying these nuclei is the lack of clear cytoarchitectonic boundaries and molecular markers within the reticular formation delineating functional nuclei. Our central hypothesis is that functional subpopulations within the reticular formation that play distinct roles in orofacial motor behaviors can be identified using machine learning clustering of neurons based on three-dimensional proximity and similarities in their gene expression profile. The expected outcome of the project is determination and functional validation of precise boundaries for previously identified and novel subpopulations underlying control of behaviors critical for survival. The overall impact of this proposal will be the elucidation of fundamental principles governing the organization of the brainstem and a highly innovative application of machine learning to neuroscience discovery, akin to an unbiased neuroanatomical “screen,” that may be applied to tissues throughout the body.

Title: Improving Gait Activity Detection from GPS and IMUs with Machine Learning

PI: DePaul: Sungsoon (Julie) Hwang (LAS), Ilyas Ustun (CDM), and Umer Huzaifa (CDM)

RFUMS: Chris Connaboy

Award: $65,898

Detecting gait activities like abnormal walking can help detect injury risks, providing insights into the system health of an individual. Wearable sensors such as Inertial Measurement Units (IMUs) and GPS make it possible to monitor real-life gait activities beyond lab settings. The proposed research aims to determine the feasibility/efficacy of fusing GPS-derived features into IMU data, and using Machine Learning (ML) in gait activity classification. ML classifiers will be trained and validated using IMU/GPS data collected from participants (n=40). We will compare the performance of classification with vs without GPS features, and with vs. without ML.

Title: Development of AI Movement Diagnostic System for Neurological Disorder Models

PI: DePaul: Eric Landahl (CSH)

RFUMS: Eun Jung Hwang

Awarded: $67,000

Animal models play a pivotal role for discovering the biological mechanisms of neurological disorders and developing treatments. Neurological symptoms in animal models are typically assessed from body movements and postures such as locomotory speed, freezing, and orienting, and treatment efficacy is measured as the degree of reduction in those symptoms. Thus, robust and precise identifications of movement patterns are essential in animal model research. To enhance precision, efficiency, and reproducibility and reduce subjective bias and variability, we propose to develop an artificial intelligence (AI) movement symptom diagnosis system that automatically identifies and quantifies pathological movement patterns from the animal's kinematic data, focusing on Parkinson's disease (PD) mouse models. With this AI system, we aim to (1) accurately distinguish PD animals from control, (2) discover new characteristic movement features of PD that are subtle to human eyes but distinctly pathological, and (3) generate severity scores of PD symptoms to assess treatment efficacy in a fine-grained scale. The same AI system developed in this project will be readily adaptable to a broad spectrum of neurological animal models such as depression, anxiety, autism, aging, and Alzheimer's disease. So, our project would have a far-reaching impact on biomedical research.