*Devon Thompson, Julia Podsen, Yannis Halkiadakis, Prateek Rana, and Kyle-Gabriel Tan.*

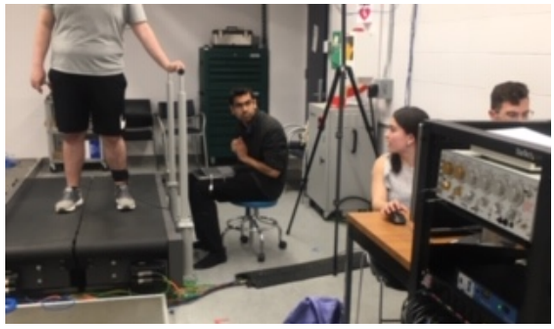
BIOMEDICAL ENGINEERING

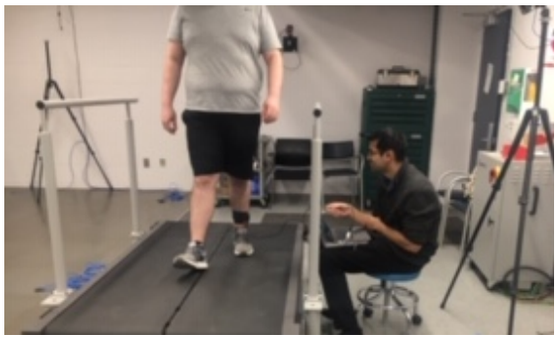
**TEAM:** 16
**SPONSOR:** General Dynamics Electric Boat
**ADVISOR:** Dr. Kristin Morgan

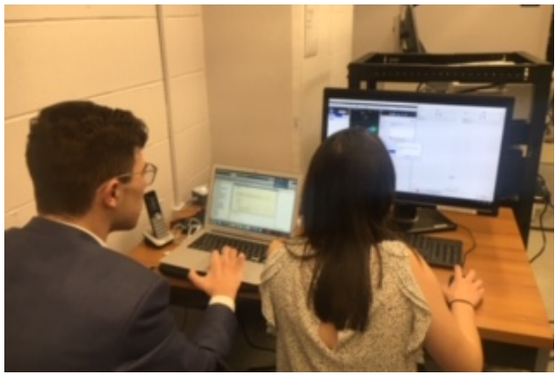
# Data visualization integrated with wearable technology to identify alternate motor control strategies

GENERAL DYNAMICS
Electric Boat

The objective of our project was to differentiate between normal and abnormal gait patterns using sound in real-time. This project, which was sponsored by General Dynamics Electric Boat, involved constructing an acoustic sensor and analyzing the acoustic signal to detect differences in movement dynamics. To delineate between healthy and pathological gait, we conducted an experimental study where healthy controls and individuals with lower extremity injuries performed an asymmetric walking protocol. To validate our sensor data, we simultaneously collected joint kinematic and ground reaction force data using a 12 camera VICON motion capture system and Bertec instrumented split-belt treadmill. We then extracted time and frequency domain metrics from our acoustic signal and created an injury classification algorithm to delineate between those with healthy and pathological gait. The significance of this project was to develop a low-cost, non-invasive wearable device to detect movement abnormalities in individuals. Future work will see this device evolve into an early diagnostic tool to detect the early onset of fatigue and lower extremity injuries.







Our project involves using sound to differentiate between healthy gait, pathological gait, and fatigued gait. We are using real time analysis to differentiate between normal (healthy) walking patterns and abnormal walking patterns. These abnormal walking patterns may consist of pathological disorders, patellofemoral pain, or ACL injuries. We are creating a wearable sensor that collects sound data through a microphone. This data will use audio frequencies to differentiate between normal and abnormal gait in real-time. The data will gather heel-on and toe-off sound frequencies that will characterize the participants gait pattern and parameters. With a wearable device, there is a need for low-cost solutions that can be utilized by the common person. Sound is a prime solution for a low-cost injury detection device since audio data yields frequency data that can be analyzed in real time in order to determine gait parameters. Additionally, it will allow for the monitoring of fatigue in individuals wearing the sensor, thus preventing a possible fatigue related injury. The goal of this project is to be able to discern between abnormal and normal gait patterns. We wish to take it a step further and be able to discern between different injuries and disorders using the parameters of gait.