

BIOMEDICAL ENGINEERING
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: February 8, 2026

PROJECT TITLE: Smart Helmets for Detecting and Preventing Concussions

Physical Requirement :

Must be able to work in person

Project's Technical Skills Requirement :

Electrical circuit design, microcontroller programming, MATLAB, Python, C, C++

Project's Available Positions : 1

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Project Description

We are all familiar with the sight of an athlete experiencing a severe blow to the head and being unable to stand or walking shakily back to the sideline. In those instances, it is clear that the athlete has experienced a "concussion." A concussion, as defined by the Guideline Development Subcommittee of the American Academy of Neurology, is a syndrome of biomechanically induced alteration of brain function potentially affecting memory, orientation, and state of consciousness, and is the most common type of mild traumatic brain injury. Despite early work suggesting that concussion symptoms were directly correlated with the magnitudes of singular impacts, a more complete analysis of the data has made it clear that an impact threshold does not exist. In fact, the deleterious consequences of repetitive head impacts or sub-concussive blows can accumulate over time, causing tissue-level damage that both increases susceptibility to later head impacts and generally increases the volume of damaged brain tissue.

While numerous attempts have been made to design sensor systems to measure head impacts, including in-helmet systems, wearable accelerometers, and even mouthguards, they only quantify the risk of injury, and even so, with varying accuracy. Additionally, these sensors do little to encourage better technique. Recent work demonstrating that improved technique decreases an athlete's exposure to head impacts suggests that the best intervention is one that helps coaches better prepare their athletes for practices and games. The goal of this project is to develop a system that mitigates head injury by tracking the force of each hit and provides a video-based tool that will allow coaches to teach better technique.

The student will develop a miniaturized device that combines high-impact accelerometers, GPS, and Bluetooth capabilities into a single, discreet wearable. The wearable will track the force delivered by repetitive head impacts, map the location of these forces in real-time on a practice field, and relay this information back to a bay station that can be monitored by coaches and athletic training staff.