



MECH 493 project: Do helmets prevent concussions? – Investigating the effect of helmets during head impacts

Research Project Overview

Concussions, or mild traumatic brain injuries, typically result from excessive accelerations of the head. Concussion incidence is high in sports, recreation, falling, and automobile accidents. It has been shown that current helmet designs may be effective in preventing severe brain injury involving skull fracture. However, the effectiveness of helmets for preventing concussions is still unclear. In the current project, we will design a controlled laboratory experiment to investigate the effects of helmets during mild head impacts in human participants. The Sensing in Biomechanical Processes lab (SimPL), led by Dr. Lyndia Wu, has a pendulum impactor that was designed to simulate controlled soccer ball impacts to the head. For the current project, we will modify the impactor design to enable helmeted head impacts and investigate the biomechanics of helmeted head impacts. We will conduct human participant experiments to simulate mild helmet impacts commonly seen in sports. During these experiments, we will measure the impact force, head impact accelerations, and use high-speed video tracking to compute head and neck kinematics. Then, we will apply dynamic models of the head and neck response to impact to understand the effects of helmet padding during varying levels of mild head impacts. The findings of this study may help inform the effect of helmets during sports head impacts and provide insights for more effective helmet designs to prevent from dangerous head accelerations that could lead to concussions.

Research to be performed by the student

- Modification of pendulum impactor to enable helmet impacts
- Setup and testing of instrumentation including force sensors, inertial measurement units (IMUs), and high speed cameras
- Assistance in human participant experiments
- Signal processing and data analysis
- Developing a biomechanical model and fitting model parameters using experimental data

Skills to be gained by the student

- Impactor design
- Multiple types of sensors including force sensors, IMUs
- Motion tracking using high speed cameras
- Signal processing and data analysis
- Biomechanical modeling
- Human participant experiments

Facilities and team:

Main lab location: ICICS Building, Room X015

Team: the undergraduate student will work with a PhD student on this project, with direct guidance from Prof. Wu