Department of Electrical and Computer Engineering

TEXAS TECH UNIVERSITY
Edward E. Whitacre Jr.
College *of* Engineering™

Spring 2024 Seminar Series

Seminar Title: ***Computational Methods in Brain Injury and Musculoskeletal Health Research***

Time: 2:00-2:50 PM, Friday, Apr 19, 2024
Location: Holden Hall 150

Speaker:
Suman Chowdhury
Department of Industrial, Manufacturing, and Systems Engineering, Texas Tech University

Abstract:
Traumatic brain injury (TBI) is often referred to as the "silent epidemic" and remains a growing public health concern, with an annual prevalence of about 1.7 million cases and a yearly cost of about $40.6 billion in the United States alone. People of all ages are vulnerable to TBI risk factors (e.g., fall incidences in the elderly and pediatric populations, motor vehicle accidents, ballistic and non-ballistic impacts, etc.). Despite years of research, there exists a core methodological problem that limits the progression of knowledge in the study of TBI – the lack of a computational framework that can mimic realistic brain and neck muscle activation dynamics. However, it is challenging to model this dynamic interaction between the brain and muscles because looking at this complex relationship in the realm of a single paradigm—biomechanics or neuroscience—does not offer a comprehensive understanding of how mechanical impacts impair the brain, and in turn, brain impairment affects musculoskeletal biomechanics. Modeling this complex interplay and then validating its' fidelity against sensor-based human health data requires knowledge and methods drawn from various domains, including biomechanics, neuro-engineering, control theory, and artificial intelligence (AI). Therefore, this talk will detail the development of a biofildilic, magnetic resonance imaging (MRI)-based head-neck finite element model (composed of scalp, skull, pia and dura mater, brain's grey and white matters, cervical vertebrae, discs, ligaments, and muscles) and demonstrate the roles played by neck muscles and its damping properties in mitigating the TBI severity during various head injury scenarios. Furthermore, the talk will provide an overview of our ongoing research activities on how we leverage AI algorithms in Alzheimer's disease research and the development of a brain-muscle interaction framework. Finally, the design of engineering (helmet) and therapeutic (implants) interventions to address major health issues (e.g., TBI, neck pain, and spine health) necessitates human-machine biomechanical simulations. This talk will also highlight how we identify a safe envelope of helmet inertial properties using the OpenSim musculoskeletal modeling platform, with the purpose of reducing the risk of cervical spinal injury.

Speaker Bio:

Dr. Suman Chowdhury joined as an Assistant Professor (tenure-track) in the Department of Industrial, Manufacturing, and Systems Engineering at Texas Tech University in 2019. His research areas include computational biomechanics, traumatic brain injury, neuroengineering, and helmet, exoskeleton, and prosthetic designs. He received his Ph.D. in Occupational Biomechanics and Human Factors Engineering from West Virginia University in 2016. He was a postdoctoral fellow in the Department of Mechanical Engineering and Materials Science at University of Pittsburgh from 2016 to 2017 and an Assistant Research Scientist in the Industrial & Systems Engineering Department at Texas A&M University from 2017 to 2019. He served as the Chair of the Occupational Ergonomics Technical Group of Human Factors and Ergonomics Society, USA, from 2020 to 2022. So far, he secured about $2.2 million grants as a lead principal investigator from various federal agencies, including the Department of Homeland Security, the CDC's National Institute of Occupational Safety and Health, and the National Science Foundation's prestigious CAREER award (2023).