VIRGINIA TECH | WAKE FOREST UNIVERSITY

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

Funded Grad Student Opportunities

2023

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	3D Bioprinting and Regenerative Medicine
Position Need:	PhD/MS student(s), start anytime
Funding:	

Advisor:	**Your Name**
	Anthony Atala, MD Professor and Director, Wake Forest Institute for Regenerative Medicine Wake Forest University Medical Center Blvd. Winston-Salem, NC 27157 Phone: (336) 716-5701 Email: aatala@wakehealth.edu www.wfirm.org Wake Forest School of Medicine Institute for Regenerative Medicine

Specific Project Description:	3D bioprinting is being used in our laboratory to print cells, tissues, and organs. Various components are essential in allowing these technologies to move forward, including biomaterial specificity, bio-ink design and manufacturing, cell biology, hardware design and construction, and software development. The goal of this research is to manufacture tissue constructs that can be implanted in patients. We are working on many tissues with the bioprinting technology, including liver, heart, kidney, trachea, lung, muscle, cartilage, blood vessels and bone. This research involves using cells to engineer an implant, with the engineered bio-ink/biomaterials degrading as new tissue builds over time. We are currently building on our prior research where human tissues and organs have been engineered and implanted in patients, in an effort to expand the number of tissues available, and to scale up the technology through 3D printing. The various aspects of this project include: • To develop novel bio-inks and bio-materials • To develop novel hardware and software for bioprinting • To standardize cell culture and expansion conditions • To define the optimal bioprinting parameters • To bioprint tissues for in-vivo implantation

Other Notes:	

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Body-on-a-Chip
Position Need:	PhD/MS student(s), start anytime
Funding:	

Advisor:	**Your Name**
	Anthony Atala, MD Professor and Director, Wake Forest Institute for Regenerative Medicine Wake Forest University Medical Center Blvd. Winston-Salem, NC 27157 Phone: (336) 716-5701 Email: aatala@wakehealth.edu www.wfirm.org Wake Forest School of Medicine Institute for Regenerative Medicine

Specific Project Description:	The Body on a Chip project is a federally funded effort to build a miniaturized system of human organs to model the body's responses to harmful agents and to develop potential therapies. Biomaterial-derived bio-inks are being designed and formulated as an extracellular matrix, and are combined with tissue specific human cells to 3D bio-print the organ structures. Miniature lab-engineered organ-like hearts, lungs, livers and blood vessels are placed on microchips and linked together via a system of circulating artificial blood substitutes through channels and sensors to provide online monitoring of individual organs and the overall organ system. The goal of the research is to accelerate the development of therapeutic agents by having a technology that better represents the human biological system, as compared to current methods of 2D culture systems or in vivo animal testing that may not accurately replicate the human response. The system can also be used to develop diseased tissue and organ models that can be used to study specific pathology, and can be explored for the advancement of personalized medicine therapeutics. •

Other Notes:	The project involves various aspects of research, including the design and creation of new biomaterials, cell characterization and culture, 3D printing, microchip construction and optimization, and bio-sensing design and analyses.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Regenerative Medicine for the Wounded Warrior
Position Need:	PhD/MS student(s), start anytime
Funding:	

Advisor:	**Your Name**
	Anthony Atala, MD Professor and Director, Wake Forest Institute for Regenerative Medicine Wake Forest University Medical Center Blvd. Winston-Salem, NC 27157 Phone: (336) 716-5701 Email: aatala@wakehealth.edu www.wfirm.org Wake Forest School of Medicine Institute for Regenerative Medicine

Specific Project Description:	The Wake Forest Institute for Regenerative Medicine (WFIRM) has over A dozen projects in the development pipeline for our wounded warriors. Under a $75 Million federally funded program, the Armed Forces Institute of Regenerative Medicine, directed by Dr. Atala, aims to translate regenerative medicine technologies to our wounded warriors. Many technologies are under development affecting 5 major focus areas: Craniofacial, Extremities, Composite Tissue Allo-transplantation, Skin, and Genitourinary. These technologies include the development of biomaterials, cells, or both together, to achieve therapeutic targets in patients. A multi-disciplinary approach involving biomaterial sciences, nanotechnology, molecular and cell biology, physiology and pharmacology, is needed to create therapy constructs that could be developed or tissue engineered. This program has projects that cover the entire spectrum of technology development, including idea conception, experimental design, basic and applied sciences, in-vitro and in-vivo testing, proof-of-principle research, pre-clinical studies, process development, FDA regulatory filings, GMP manufacturing, quality assurance, and clinical trial design and execution.

Other Notes:	There is an opportunity to be involved in various areas, involving different tissue and organ targets, with a wide range of research projects.

2022 Faculty Advisor Request form for Graduate Student Position

Location:	**Virginia Tech**

Project Title:	Mechanoregulation in Patients with Metabolic Bone Disease
Position Need:	MS or PhD student(s), start Fall 2023
Funding:	VT Start-up Funds

Advisor:	**Caitlyn Collins, PhD**
	Assistant Professor Department of Biomedical Engineering and Mechanics (BEAM) Virginia Tech 323 Kelly Hall Blacksburg, VA 24060 Email: cjcollins@vt.edu https://beam.vt.edu/people/faculty/collins.html https://www.bone.ethz.ch/research/clin-mech.html

Specific Project Description:	Significant gaps remain in our understanding of the effects of aging and disease on bone mechanical and material properties, compromising the reliability of clinical techniques used in assessing bone integrity and individualized pre- and post-operative treatment planning. Our multi-disciplinary work merges advances in bone mechanobiology, micro-finite element simulations, and medical imaging to develop novel methods for monitoring changes in bone health over time.  We are currently recruiting graduate students with an interest in areas including bone biomechanics, mechanobiology, computational mechanics, biomedical imaging, and translational medicine. Desired technical skills include software programming and development (Python, GitHub) and mechanical testing experience.

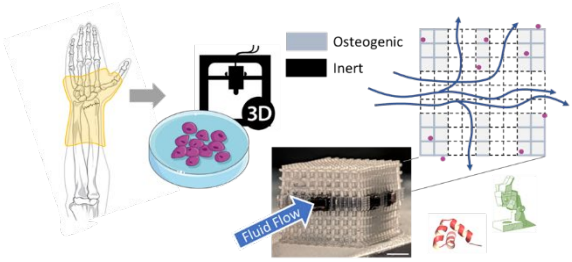
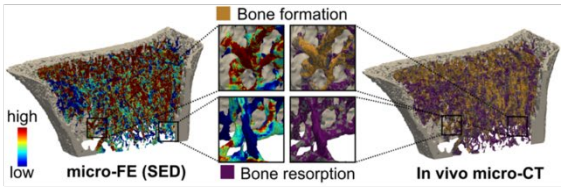
Other Notes:	Team members have a variety of backgrounds in engineering, biology, and computer science, and we routinely interface with collaborators in both pre-clinical and clinical settings. Willingness to work collaboratively with an academic community that is diverse with regard to gender, race, ethnicity, religion, nationality, sexual orientation or identity, disability status, and protected veteran status is essential.

2022 Faculty Advisor Request form for Graduate Student Position

Location: Virginia Tech

Project Title:	Development of Strain-associated Biomarkers for Precision Medicine in Delayed Fracture Healing
Position Need:	MS or PhD student(s), start Fall 2023
Funding:	VT Start-up Funds, ASBMR Project Funding

Advisor:	**Caitlyn Collins, PhD**
	Assistant Professor Department of Biomedical Engineering and Mechanics (BEAM) Virginia Tech 323 Kelly Hall Blacksburg, VA 24060 Email: cjcollins@vt.edu https://beam.vt.edu/people/faculty/collins.html https://www.bone.ethz.ch/research/clin-mech.html

Specific Project Description:	Prolonged fracture healing contributes to considerable patient disability and reduced quality of life. Biofabricated, patient-derived organoids, provide a means to study human cells for an extended period in a microenvironment that replicates conditions within the body. The proposed project will evaluate the capabilities of a 3D bioprinted (3DP) bone organoid for assessing bone healing capacity in patients and utilize *in silico* modeling to explore the role cell-mechanosensetivity on tissue formation and mineralization.   We are currently recruiting graduate students with an interest in areas including bone tissue engineering, mechanobiology, computational mechanics, biomedical imaging, and translational medicine. Desired technical skills include cell culture and tissue engineering experience.

Other Notes:	Team members have a variety of backgrounds in engineering, biology, and computer science, and we routinely interface with collaborators in both pre-clinical and clinical settings. Willingness to work collaboratively with an academic community that is diverse with regard to gender, race, ethnicity, religion, nationality, sexual orientation or identity, disability status, and protected veteran status is essential.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location: **Wake Forest University**

Project Title: Standardizing Repositioning Methods for Virtual Assessment in Human Body Models

Position Need: 1 MS/PhD (PhD preferred), start May or August 2023

Funding: Funded via a GRA, contract in place

Advisor:

Scott Gayzik, PhD
Associate Professor, Biomedical Engineering
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave, Suite 120
Winston-Salem, NC 27101
sgayzik@wakehealth.edu
www.CIB.vt.edu

Specific Project Description:

Human body models (HBMs) have gained prominence in biomechanics literature over the last two decades, but there is little information available regarding the standardization of model positioning. It is well understood that deviations in initial positioning of human models can lead to deviations in outcomes for otherwise identical crash simulations, yet this effect is not well quantified. This project focuses on developing best practices (BPs) for simulation-based repositioning, gravity-settling, belting, and pre-test posture reporting of human body models. As human modeling takes on a greater role in the regulatory sphere, it is important to establish published BPs on how best to prepare HBMs for in-vehicle simulations.

Other Notes: This research effort will be in the Center for Injury Biomechanics (CIB) and you will have the opportunity to work on a range of projects in the field of automobile safety, military restraints, and sports biomechanics. The CIB has two primary research facilities. The first is in the WFU School of Medicine in Winston-Salem, NC and the second is at Virginia Tech. The research at the CIB combines experimental testing, computational modeling, and case analysis to investigate human injury biomechanics.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location: **Wake Forest University**

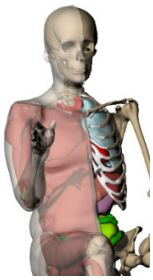
Project Title: Human Body Model Development for Trauma Research
Position Need: 1 MS/PhD (PhD preferred), start May or August 2023
Funding: Funded via a GRA, contract in place

Advisor:

Scott Gayzik, PhD
Associate Professor, Biomedical Engineering
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave, Suite 120
Winston-Salem, NC 27101
sgayzik@wakehealth.edu
www.CIB.vt.edu

Specific Project Description:

Computational modeling is a growing component of injury biomechanics and trauma research. This project is a multi-center effort developing a next generation set of human body finite element models for enhanced injury prediction and prevention systems. The student will be responsible for assisting in model development tasks including scaling, postural adjustment, meshing, and contact algorithm development. Responsibilities will also include reporting FEA model analysis and results, running analyses on distributed computing environments, simulating validation procedures, performing literature reviews, and reporting related research efforts through written and oral status updates. The student(s) will gain valuable experience in fields of trauma research, computer modeling, and injury biomechanics.



Other Notes: This research effort will be in the Center for Injury Biomechanics (CIB) and you will have the opportunity to work on a range of projects in the field of automobile safety, military restraints, and sports biomechanics. The CIB has two primary research facilities. The first is in the WFU School of Medicine in Winston-Salem, NC and the second is at Virginia Tech. The research at the CIB combines experimental testing, computational modeling, and case analysis to investigate human injury biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Exploring physics-based finite element analysis for BABT injury criteria development using human surrogates
Position Need:	
Funding:	

Advisor:	
	Scott Gayzik, PhD Associate Professor, Biomedical Engineering VT-WFU Center for Injury Biomechanics School of Biomedical Engineering and Sciences 575 N. Patterson Ave, Suite 120 Winston-Salem, NC 27101 sgayzik@wakehealth.edu www.CIB.vt.edu

Specific Project Description:	The objective of this research is to develop and validate a physics-based finite element animal model(s) (ovine and caprine species) to study behind armor blunt trauma (BABT). These models will be an important tool for evaluating countermeasures and developing computational injury criteria to better protect service members. The models will be used to provide insight and guidance on the risk of skeletal and soft tissue injuries including the development of injury criteria for rib, pulmonary and limited vascular and peripheral organ injury from BABT. The proposed project is the first of its kind to develop ovine and caprine FEA models for use in the study of BABT. Specifically the models will be used to develop finite element based BABT injury criteria.

Other Notes:	This research effort will be in the Center for Injury Biomechanics (CIB) and you will have the opportunity to work on a range of projects in the field of automobile safety, military restraints, and sports biomechanics. The CIB has two primary research facilities. The first is in the WFU School of Medicine in Winston-Salem, NC and the second is at Virginia Tech. The research at the CIB combines experimental testing, computational modeling, and case analysis to investigate human injury biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

Location: Virginia Tech

Project Title: Somatosensory Deficits Post Stroke
Position Need: 1 PhD student
Funding: VT Start-up Funds

Advisor:

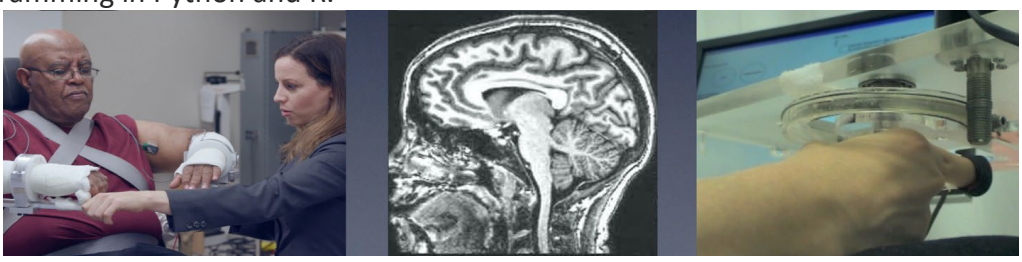
Netta Gurari, PhD
Director, Robotics and Sensorimotor Control Lab
Assistant Professor
Department of Biomedical Engineering and Mechanics
224 Norris Hall
Blacksburg, VA 24060
(540) 231-3073
gurari@vt.edu

Research Program Summary:

We are investigating how somatosensory perception occurs in humans, with a focus on the upper limb of individuals with stroke. We are a multi-disciplinary team with a vision to develop more effective treatments for humans with compromised somatosensation by, first, developing a richer understanding of human sensorimotor control and perception. Ongoing research we plan to advance includes:

- Exposing Tactile Deficits in Individuals with Stroke
- Identifying Location(s) of Tactile Deficits along the Nervous System of Individuals with Stroke
- Investigating how Somatosensation Develops in Young Children

We are recruiting up to one graduate student with an interest in areas including neuroscience, robotics, kinesiology, and physiology. Preferred technical skills include i) building of mechatronic systems with actuators, sensors, controllers, and ii) software programming in Python and R.



Other Notes: The Robotics and Sensorimotor Control Lab is highly interdisciplinary, with members and collaborators who are experts in areas including robotics, neurophysiology, neuroimaging, and clinical care. The ability to effectively communicate in a multi-disciplinary, collaborative team setting is highly desired.

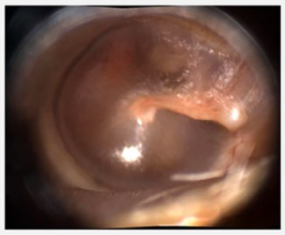
2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Developing Artificial Intelligence to Detect Ear Infections**
Position Need:	**1-2 students, starting Fall 2022**
Funding:	**NIH R01**

Advisor:	**Metin Gurcan, Ph.D.**
	Metin N. Gurcan, Ph.D. Director, Center for Biomedical Informatics Informatics Program Leader, The Wake Forest Clinical and Translational Science Institute (CTSI) Professor, Department of Internal Medicine, Pathology, BME Wake Forest School of Medicine Medical Center Boulevard, Winston-Salem, NC 27157 p: (336) 716-5422 | school.wakehealth.edu/wfbmi | mgurcan@wakehealth.edu https://school.wakehealth.edu/research/labs/clinical-image-analysis-lab/

Specific Project Description:	Diseases of the ear, particularly acute otitis media (AOM) and middle ear effusions, are the most commonly treated childhood pathologies. The financial burden of ear disease is estimated at more than $3.2 billion per year. Because ear diseases are common, a significant problem is over-diagnosis and over-treatment, due to two factors. First, the subjective nature of diagnosing ear disease - based on a brief glimpse of the eardrum with an otoscope - makes an accurate diagnosis difficult, even for experienced primary care, emergency medicine, or ear, nose, and throat (ENT) physicians. Second, with a growing shortage of primary care physicians in the US, more Advanced Practice Providers (Nurse Practitioners and Physician Assistants) serve as first-line clinicians in primary care and emergency settings but lack extensive training in otoscopy (i.e., clinical examination of the eardrum). Consequently, clinicians often err on the side of making a diagnosis of ear infection and prescribing oral antibiotics. Over 8 million unnecessary antibiotics are prescribed annually, contributing to the rise of antibiotic-resistant bacteria and creating the largest number of pediatric medication-related adverse events. Children with inaccurate ear diagnoses are often referred to ENTs for surgical placement of ear tubes for recurrent infections, and up to 70% of these cases are not indicated. Diagnosing ear pathologies still depends on clinician subjectivity, based on a brief glimpse of the eardrum. This diagnostic subjectivity creates a critical barrier to decreasing healthcare costs and reducing over-diagnosis and over-treatment of ear disease. Devices are needed to assist in a more accurate, consistent, and objective diagnosis of ear pathology. Our previous work laid the foundation to develop machine-learning approaches to provide an objective approach to ear diagnosis using digital otoscopy computer-assisted image analysis.

Other Notes:	 * Disease ❑ AOM ❑ Effusion ❑ Obstructing Cerumen ❑ Perforation ❑ Other (please specify) ❑ Retraction ❑ Tympanosclerosis ❑ Tube ❑ Normal * Confidence Level ○ (5) Extremely confident ○ (4) Very confident ○ (3) Somehow confident ○ (2) Not so confident ○ (1) Not at all confident	**Our group is a worldwide leader in this area. We have access to one of the largest databases in the world and several expert clinical collaborators.**

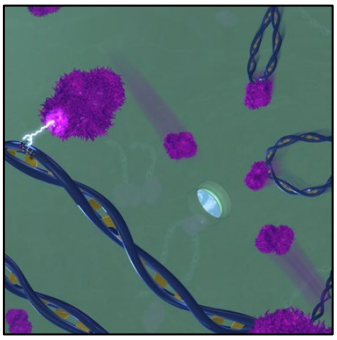
SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request Form for Graduate Student Position

Location: Wake Forest University

Project Title:	Analysis of nucleic acid biomarkers using solid-state nanopores
Position Need:	1 PhD, MS start August 2023
Funding:	funded through GRA, contract in place (NIH R33)

Advisor:	Adam Hall, PhD
	Assistant Professor, Biomedical Engineering, WFU Campus VT-WFU School of Biomedical Engineering and Sciences 575 N. Patterson Ave, Suite 120 Winston-Salem, NC 27101 arhall@wakehealth.edu **www.thehalllab.org**

Specific Project Description:	 The wide-ranging roles of nucleic acids make them valuable as molecular biomarkers for diverse diseases, from infection to cancer. While these molecules can be probed with some conventional techniques, current technologies have limitations in cost, speed, sensitivity, specificity, and/or versatility that challenge their integration into clinical care. Consequently, there is a need for new technologies for molecular analysis. In response, our laboratory is developing the emerging single molecule technology of solid-state nanopores: devices consisting of a single, nanometer-sized aperture fabricated in a synthetic membrane through which biomolecules can be threaded electrically and probed individually. In addition to conventional analysis with this platform, we have also demonstrated a novel assay that enables the selective detection and quantification of diverse features of nucleic acids, including sequence motifs and epigenetic modifications. The goal of this project will be to continue our development towards translation of SS-nanopores to clinically-relevant applications with a specific focus on cancer.

Other Notes:	This project is highly interdisciplinary, requiring the development of skills in biological and biochemical techniques, biophysics, device fabrication, chemistry, and programming. Past experience in one or more of these areas is preferred, but not required.

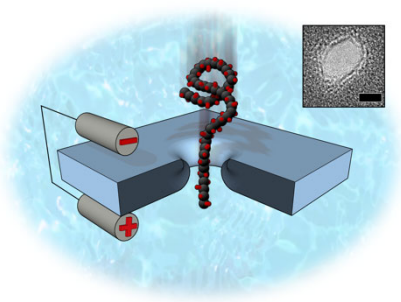
SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request Form for Graduate Student Position

Location: Wake Forest University

Project Title:	Solid-state nanopore analysis of biological sugars
Position Need:	1 PhD, MS start August 2023
Funding:	funded through GRA, contract in place (NIH R01)

Advisor:	Adam Hall, PhD
	Assistant Professor, Biomedical Engineering, WFU Campus VT-WFU School of Biomedical Engineering and Sciences 575 N. Patterson Ave, Suite 120 Winston-Salem, NC 27101 arhall@wakehealth.edu **www.thehalllab.org**

Specific Project Description:	 Hyaluronan (or hyaluronic acid, HA) is a key glycosaminoglycan (i.e. a linear anionic sugar polymer) that has diverse roles, including tissue structure definition and hydration, intrinsic immunity, and joint lubrication. HA can be found in all physiological fluids and tissues, where changes in its composition can either result from or be a direct cause of disease emergence, making it a potentially important bioindicator. However, current tools for analyzing HA have limitations in sensitivity and/or ability to discriminate critical size differences. To address this gap, we have developed solid-state (SS-) nanopore technology – electrical detection of single-molecules as they are driven through a nanoscopic pore – to achieve direct quantification and molecular weight determination of ultra-small amounts of HA (Rivas et al. *Nature Communications, 2018*). Using tools built entirely in our lab, we have demonstrated that a full size distribution can be obtained rapidly and with single-molecule precision from as little as *10 nanograms* of HA extracted from physiological samples. This project will apply our technology to examine the HA as a bioindicator of osteoarthritis and cancer.

Other Notes:	This project is highly interdisciplinary, requiring the development of skills in biological and biochemical techniques, biophysics, device fabrication, chemistry, and programming. Past experience in one or more of these areas is preferred, but not required.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Image-Based Computational Modeling of Fluid Flow in the Brain for Early Diagnosis of Alzheimer's Disease**
Position Need:	**Ph.D. Student**
Funding:	**NIH**

Advisor:	**Jeongchul Kim**
	Radiology Informatic and Image Processing Lab MRI Building 2nd Floor 1 Medical Center Blvd, Winston Salem, NC 27157 336-716-0931 jeokim@wakehealth.edu

Specific Project Description:	Because the pathophysiology of Alzheimer's disease (AD) begins well before the onset of clinically detectable symptoms, early diagnosis and appropriate interventions are critical for prevention or delay of the progression. Aggregation of beta-Amyloid plaques in the brain parenchyma is the hallmark of AD. A plaque deposition is presumably caused by impaired clearance that involves blood and cerebrospinal fluid circulation. Cerebral blood flow modulates intracranial pressure and transmits the pulsation to cervical and ventricular cerebrospinal fluid (CSF) during the cardiac cycle. CSF driven by arterial flow allows exchange of water, small molecules and proteins between the brain parenchyma through interstitial fluid (ISF) bulk flow and meningeal lymphatic vessels. However, there is no direct scientific evidence relating flow dynamic properties of blood and CSF with AD pathophysiology in the human brain. In this project, we will investigate the effects of blood and CSF flow on heterogeneous plaque deposition and clearance in the aging brain. We will characterize the blood and CSF flow dynamics in the cranium using phase-contrast MRI and computational modeling approach. These flow dynamic imaging markers will be correlated with regional plaque deposition measured by positron emission tomography (PET). We hypothesize that increased regional plaque deposition is related to decreased intracranial vascular compliance and CSF maldistribution in the subarachnoid space. Wake Forest Alzheimer's Disease Clinical Core has collected longitudinal MRI/PET datasets for more than 800 participants, and we are developing high throughput MRI/PET processing pipelines and CSF flow dynamics assessment method by combining computational model and phase-contrast MRI.

	On completion of this project, we will provide a new imaging marker to quantify blood and CSF flow in the brain and explain the mechanisms of plaque deposition in the brain mediated by intracranial blood and CSF flow dynamics. Also, this approach can be applied to predict risk at an earlier stage of AD considering heterogeneous disease progression at the individual level.

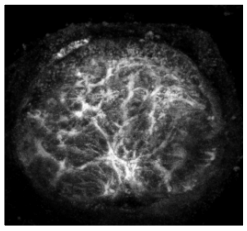
Other Notes:	

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Virginia Tech**

Project Title:	**Mechanical and biological factors in axon degeneration**
Position Need:	2 PhD students, start Summer/Fall 2023
Funding:	VT Start-up Funding

Advisor:	**Arina Korneva, PhD**
	Nerve Mechanics Laboratory Assistant Professor, Dept. Of Biomedical Engineering and Mechanics Norris Hall 228 (Office) / 200 (Lab) 495 Old Turner St, Blacksburg, VA Email: arina.korneva@vt.edu Website: https://beam.vt.edu/people/faculty/korneva.html

Specific Project Description:	One ambitious goal in medicine is to protect and repair nerve cells and their axons which are dying due to aging, disease, or trauma. The link between external loading of neural tissues and the eventual death of axons remains unknown. Axons of nerve cells are not isolated but are physically connected to each other, to other cells, or to the extracellular environment. When a mechanical load is applied to the tissue, it is transmitted to the axons across the surrounding tissue and biofluid. How axons deform under external loading and from mechano-biological stimuli are unknown. PhD students interested in experimental work will learn new skills, including: • animal models of optic neuropathy • second harmonic generation microscopy, confocal microscopy • image correlation methods • advanced methods for mechanical testing of microtissues PhD students interested in computational modeling will test hypotheses of how axons deform under external loading. Models of single axons embedded in a fiber network will be developed with the guidance of Dr. Korneva.  2-photon microscopy image of live fluorescent astrocytes, in an excised mouse eye specimen.

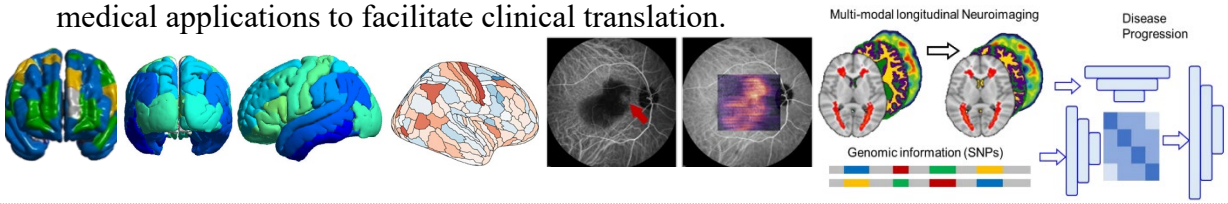
Other Notes:	Students with B.S. degrees in biomedical engineering, mechanical engineering, chemical and biological engineering, computer science, biology, or neuroscience are encouraged to apply. Projects will be adapted to fit PhD students interested in careers in industry or academia.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Multi-modal computational imaging genomics for Aging, Dementia, Alzheimer's Disease
Position Need:	PhD/MSc student, start Fall 2023
Funding:	Internal Funding

Advisor:	**Da Ma, PhD**
	Assistant Professor, Gerontology and Geriatric Medicine, Wake Forest School of Medicine Center for Biomedical Informatics, Alzheimer Disease Research Center dma@wakehealth.edu https://school.wakehealth.edu/faculty/m/da-ma https://da-ma-dm.github.io/

Specific Project Description:	Our group uses **machine learning (ML)** and **artificial intelligence (AI)** methods to develop computational biomarkers and **biomedical informatics** models to understand the **aging** process and identify early signs of age-related **neurodegenerative** diseases such as **Alzheimer's Disease** and other types of Dementia. We utilize high-dimensional longitudinal multi-modal data including **neuroimaging** (MRI, PET, OCT), **omics** data (genomics, transcriptomic, metabolomic), and **fluid biomarker** (CSF and plasma). The potential research project includes: - **Computational neuroanatomy** to study geometric patterns of disease using cortical-surface-based graph neural network (GNN) and spherical convolutional neural network. - Deep-learning-based **longitudinal volumetric and surface deformation mapping** and deep survival analysis to derive pathology **progression trajectory prediction**. - Identify **genomic risk factors** of aging and neurodegenerative disease using novel AI methods, including graph convolutional network to infer gene interaction, and adapted natural language processing (bio-NLP) on genomic sequence. - **Neuroimage genomics** using deep-learning-based multi-modal data fusion to reveal genotype-phenotype interaction underlying age-related biological process mechanism. - **Explainable AI** methods to validate, understand and visualize machine learning models in medical applications to facilitate clinical translation. 

Other Notes:	The research will be conducted with the joint collaboration program at Wake Forest Center for Biomedical Informatics (WFBMI) and Alzheimer's Disease Research Center (ADRC). The graduate students will have the opportunity to interact with the multi-disciplinary team and develop translational solutions to use state-of-the-art ML/AI to solve the emerging clinical need for age-related neurodegenerative diseases in the field of gerontology.

2022 Faculty Advisor Request form for Graduate Student Position

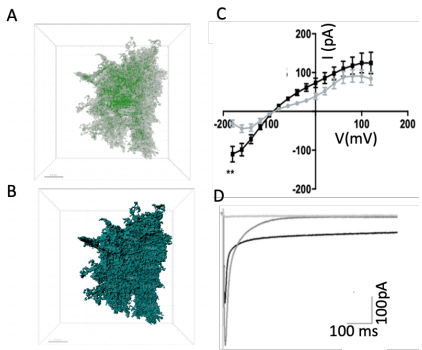
Location: Virginia Tech

Project Title:	***Astrocyte inflammation in the substantia nigra; a role in Parkinson disease***
Position Need:	**GRA**
Funding:	R01

Advisor:	**Michelle Olsen, PhD**
	Michelle Olsen, PhD Associate Professor Director of Neuroscience Graduate Studies School of Neuroscience 540-231-7394 | molsen1@vt.edu https://olsenlab.neuroscience.vt.edu

Specific Project Description:	The Olsen lab studies astrocyte function across the lifespan in health and disease. The current project aims at understanding a role for astrocyte inflammation in Parkinson's disease (1 million Americans are currently living with Parkinson's), a progressive neurodegenerative disease, resulting in the loss of neurons which release dopamine. The goals of this project aim to test an astrocyte enriched PD risk gene, which demonstrates marked alterations in expression in the context of inflammation and may ultimately serve to impact dopaminergic neuron function and viability. In addition to gaining broad understanding in neuroscience students involved in this project will gain a diverse skill set, including • Use of genetic models if human disease • Whole cell, voltage-clamp electrophysiology of astrocytes and neurons in brain tissue • Confocal Imaging and imaging analysis, including machine learning analysis tools • Molecular biology and biochemistry approaches to study gene and protein expression across individual cell types in brain • Stereotaxic surgeries to manipulate gene expression across different brain regions

Other Notes:



A. Confocal z-stack of an individual cortical astrocyte labeled with a membrane tethered fluorescent tag. **B.** Volume reconstruction and surface rendering of the same cell. **C.** Electrophysiological current recordings form single cortical astrocytes. **D.** Measurement of neurotransmitter uptake current uptake from single astrocytes in the cortex.

Astrocytes represent the 2nd most abundant cell type in the mammalian brain. Work over the last two decades demonstrates these are the most morphologically complex brain cell types- enwrapping neuronal cell bodies, with a single astrocyte contacting up to 1 million synapses in the human brain. At the synapse astrocytes regulate neurotransmitter homeostasis which is critical to neuronal cell function. Work in the Olsen lab aims to understand how astrocytes function at the synapse and how astrocyte dysfunction modulates neuronal health.

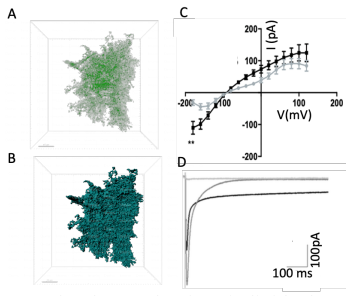
2022 Faculty Advisor Request form for Graduate Student Position

Location:	**Virginia Tech**

Project Title:	***Astrocyte dysfunction contributes to disordered breathing in Rett syndrome***
Position Need:	**GRA**
Funding:	R01

Advisor:	**Michelle Olsen, PhD**
	Michelle Olsen, PhD Associate Professor Director of Neuroscience Graduate Studies School of Neuroscience 540-231-7394 | molsen1@vt.edu https://olsenlab.neuroscience.vt.edu

Specific Project Description:	The current project aims at understanding astrocyte ion channel function in the neurodevelopmental disorder Rett Syndrome. Rett syndrome is a severe neurodevelopmental disorder, resulting in lack of speech, mobility and autonomic dysfunction in affected individuals. This project focuses on the phenotype of disordered breathing, which contributes to poor quality of life for Rett patients, a dysfunction that is readily phenocopied in animal models of the disease. Here we examine an astrocyte ion channel whose function regulates neuronal excitability, and its dysfunction in Rett animal models. In addition to gaining broad understanding in neuroscience students involved in this project will gain a diverse skill set, including • Use of genetic models if human disease • Whole cell, voltage-clamp electrophysiology of astrocytes and neurons in brain tissue • Confocal and Serial Block Face Scanning Microscopy and imaging analysis, including machine learning analysis tools • Molecular biology and biochemistry approaches to study gene and protein expression across individual cell types in brain • Stereotaxic surgeries to manipulate gene expression across different brain regions

Other Notes:	 **A**. Confocal z-stack of an individual cortical astrocyte labeled with a membrane tethered fluorescent tag. **B.** Volume reconstruction and surface rendering of the same cell. **C.** Electrophysiological current recordings form single cortical astrocytes. **D.** Measurement of neurotransmitter uptake current uptake from single astrocytes in the cortex.	Astrocytes represent the 2nd most abundant cell type in the mammalian brain. Work over the last two decades demonstrates these are the most morphologically complex brain cell types- enwrapping neuronal cell bodies, with a single astrocyte contacting up to 1 million synapses in the human brain. At the synapse astrocytes regulate neurotransmitter homeostasis which is critical to neuronal cell function. Work in the Olsen lab aims to understand how astrocytes function at the synapse and how astrocyte dysfunction modulates neuronal health.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Virginia Tech**

Project Title:	Analyses of Driving Data – Various Projects
Position Need:	1 PhD, 1 Masters, start May or August 2023
Funding:	**Funded via a GRA**

Advisor:	**Miguel Perez, PhD**
	*Associate Professor* Department of Biomedical Engineering and Mechanics School of Biomedical Engineering and Sciences Virginia Tech *Research Scientist* Virginia Tech Transportation Institute 3500 Transportation Research Plaza Blacksburg, VA 24061 Phone: (540) 231-1537 Fax: (540) 231-1555 Email: mperez@vt.edu Website: https://beam.vt.edu/people/faculty/perez.html

Specific Project Description:	The Virginia Tech Transportation Institute houses over petabytes of driving data encompassing vehicles ranging from skateboards to motorcoaches and novice to senior drivers. We work with a variety of customers, both public and private, that are interested in leveraging those data to understand driver behavior, decisions, and actions. In turn, this understanding yields insights that can improve the safety and efficiency of surface transportation. Projects range from detailed investigations of particular driver behaviors (e.g., texting), to analyses of causal factors for crashes, to understanding of occupant positioning pre-crash, to design of crash countermeasure systems, to examinations of crash pulses in particular crash scenarios, to (more recently) synthesizing data in ways that are useful for the design and operation of automated vehicles and understanding return-to-driving progression after medical procedures. We also study emergency vehicle response to crashes, with the goal of decreasing the time a victim has to wait in order to receive effective treatment.

Other Notes:	VTTI continues to collect data on an ongoing basis, generally on vehicles with newer technologies. Most recently, this includes vehicles with on-board Level 2 automation technologies and in-service ambulances.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Developing a multi-scale closed loop model of hemorrhagic shock and resuscitation**
Position Need:	**MS, PhD, or Postdoc. (Potentially up to 2 students, starting Fall 2023)**
Funding:	**NIH R01 - (NHLBI)**

Advisor:	**Elaheh Rahbar, PhD** **Associate Professor**
	575 N. Patterson Ave. Suite 530 Dept. of Biomedical Engineering Wake Forest Biotech Place Winston Salem, NC 27101 Email: erahbar@wakehealth.edu Lab website: https://school.wakehealth.edu/research/labs/rahbar-lab

Specific Project Description:	We aim to develop and validate a novel multi-scale computational model that will allow us to simulate the *in vivo* physiologic response to hemorrhagic shock. Using a 3D-0D closed loop approach of the cardiovascular system, we will be able to simulate the critical feedback loops and biologic response functions to render a physiologically relevant model. The *objective* is to use this computational framework to: 1) quantify the local and systemic hemodynamics (i.e., pressure, flow rate, shear stress, oxygen transport, etc.) during phases of active hemorrhage, aortic occlusion with REBOA, and resuscitation, 2) identify vascular regions that are vulnerable to shear- and ischemic damage as a result of the altered hemodynamics, 3) predict key physiologic responses related to vascular compliance, oxygen delivery and renal autoregulation during hemorrhage and aortic occlusion, and 4) determine optimal aortic occlusion size and duration of partial vs. full occlusion strategies to prevent ischemia-reperfusion injuries and renal failure. Candidates should have a background in applied math, biomedical or mechanical engineering, or quantitative physiology and have experience in modeling blood flow. Prior experience with SimVascular and/or CRIMSON is preferred. Programming experience in C, python and machine learning is also highly recommended.

Other Notes:	The Translational Trauma Research Lab led by Dr. Rahbar is highly interdisciplinary and works closely with the Heart & Vascular Research Lab led by Drs. Williams, Neff and Jordan at the Wake Forest School of Medicine. We also collaborate with Dr. Alberto Figueroa (founder of CRIMSON software) at the University of Michigan. The ability to effectively communicate in a multi-disciplinary collaborative team of engineers, physicians, veterinarians, and research scientists is highly desired.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Optimizing endovascular hemorrhage control devices for hemorrhagic shock**
Position Need:	**MS, PhD, or Postdoc. (Potentially up to 2 students, starting Fall 2023)**
Funding:	**DOD**

Advisor:	**Elaheh Rahbar, PhD** **Associate Professor**
	575 N. Patterson Ave. Suite 530 Dept. of Biomedical Engineering Wake Forest Biotech Place Winston Salem, NC 27101 Email: erahbar@wakehealth.edu Lab website: https://school.wakehealth.edu/research/labs/rahbar-lab

Specific Project Description:	Hemorrhagic shock is the leading cause of preventable death after a traumatic injury, and accounts for 91% of military and 35% of civilian fatalities after trauma. Injuries to non-compressible intracavity regions, such as the torso and abdomen, are a major clinical challenge due to a lack of appropriate interventions and represent 30-40% of early fatalities. To *address this problem*, endovascular hemorrhage control (EHC) devices and minimally invasive techniques such as Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) have been increasingly adopted, but there remain concerns over optimal implementation of REBOA. Major reductions in blood flow during REBOA result in ischemia-reperfusion injuries that increase the risk of subsequent renal failure. As such, there is a pressing need to identify optimal occlusion size, timing, and duration of REBOA deployment. In this project, we will use animal models of hemorrhagic shock and computational fluid dynamic models to optimize the design and implementation of REBOA-like devices, including size of occlusion, placement location and duration of occlusion. Candidates should have an interest in preclinical models of medical devices and good computational/programming skills. Experience in C, python and machine learning is also highly recommended.

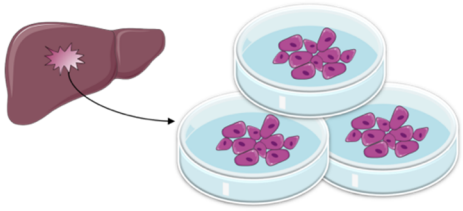
Other Notes:	The Translational Trauma Research Lab led by Dr. Rahbar is highly interdisciplinary and works closely with the Heart & Vascular Research Lab led by Drs. Williams, Neff and Jordan at the Wake Forest School of Medicine. We also collaborate with Dr. Alberto Figueroa (founder of CRIMSON software) at the University of Michigan. The ability to effectively communicate in a multi-disciplinary collaborative team of engineers, physicians, veterinarians, and research scientists is highly desired.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Exploiting 3D tissue engineered organ-like platforms for the study of immune-modulatory diets following trauma**
Position Need:	**MS, PhD, or Postdoc. (1 student starting Fall 2023)**
Funding:	**Start up funds**

Advisor:	**Elaheh Rahbar, PhD** **Associate Professor**
	575 N. Patterson Ave. Suite 530 Dept. of Biomedical Engineering Wake Forest Biotech Place Winston Salem, NC 27101 Email: erahbar@wakehealth.edu Lab website: https://school.wakehealth.edu/research/labs/rahbar-lab

Specific Project Description:	 Our lab has exploited 3D tissue engineered platforms (e.g., liver organoids, blood brain barrier and lung on a chip), to investigate gene-diet interactions. We are interested in knowing how omega-3 and omega-6 polyunsaturated fatty acids (PUFA)-rich diets influence inflammation, particularly post-trauma. Towards this goal, we culture primary cells and use various cell lines to generate organs of interest. Given that lipid and carbohydrate metabolism occur predominantly in the liver, we customize liver organ-like cultures to study the effect of PUFAs. However, future work could entail using multiple organs on a chip. Candidates should have an interest in biomaterials, tissue engineering, immunology, fatty acid metabolism, genetics, and/or metabolomics. Prior experience with cell culture and/or microfluidic techniques is also highly recommended.

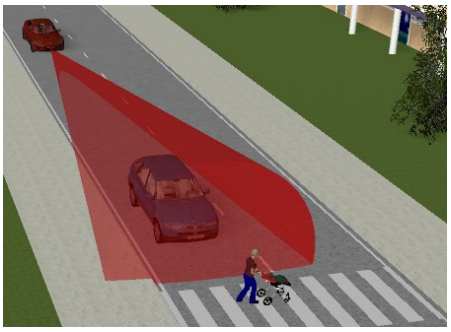
Other Notes:	The Translational Trauma Research Lab led by Dr. Rahbar is highly interdisciplinary and collaborates with faculty in the Molecular Medicine and Translational Sciences, as well as Integrative Physiology & Pharmacology. Dr. Rahbar is also an affiliate member of the Center for Precision Medicine. The ability to effectively communicate in a multi-disciplinary collaborative team of engineers, physiologists, immunologists, other research scientists is highly desired.

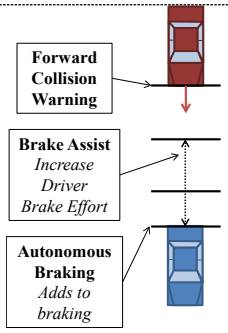
2023 Faculty Advisor Request form for Graduate Student Position

Location:	Virginia Tech
Project Title:	Crash and Injury Risk in Vehicles with Active Safety Systems
Position Need:	2 MS/PhDs (PhD Preferred), start May or August 2022
Funding:	Funded via a GRA, contract in place

Advisor:	**Luke E. Riexinger, PhD**
	Research Assistant Professor Virginia Tech Department of Biomedical Engineering and Mechanics 445 Kelly Hall, 325 Stanger Street (MC 0194) Blacksburg, VA 24061 Phone: (540) 231-7190 Email: riexinger@vt.edu www.beam.vt.edu/people/faculty/riexinger www.safetyimpact.beam.vt.edu

Specific Project Description:





Up to 90% of car crashes are caused by driver error. US auto companies are introducing a radically new generation of cars onto US highways with advanced crash avoidance sensors/actuators – frequently referred to as Active Safety Systems. These systems can automatically brake and steer a car to avoid an impending crash. These are the first steps toward full automated, driverless cars. Current systems use forward looking cameras, millimeter-wavelength radar, and LIDAR to alert the driver of a crash and in some cases take over control of the car. Automated collision avoidance features on new production cars include automated radar braking, forward collision warning, lane departure prevention, blind spot detection, and adaptive cruise control.

Active safety systems promise potential reduction in crash injuries, however, as evidenced by recent crashes of Tesla vehicles, these technologies may carry their own unique risks. In this project, we will couple laboratory vehicle test data with computational modeling to determine the crash risk and potential benefit of (1) the newest automated crash avoidance technologies, currently available only on luxury cars, (2) emerging technologies such as vehicle-to-vehicle communication, and (3) fully automated driverless cars.

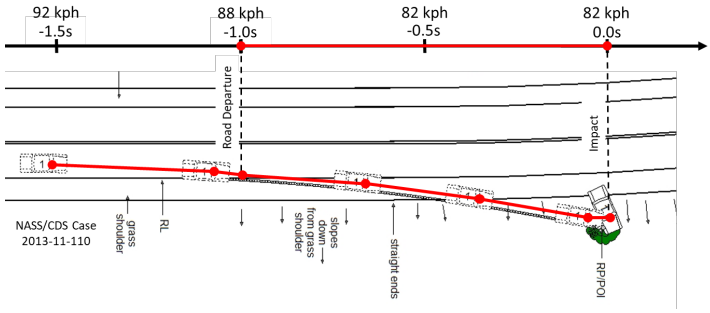
Other Notes:	The research will be conducted in the Center for Injury Biomechanics (CIB).

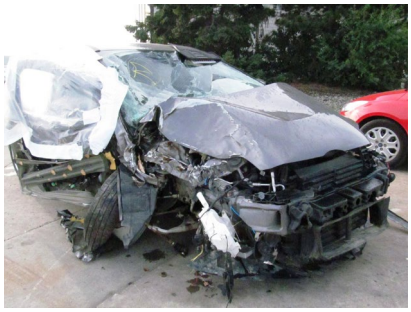
2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Virginia Tech**
Project Title:	Roadside Encroachment Database Development and Analysis
Position Need:	1 MS/PhDs (PhD Preferred), start May or August 2022
Funding:	Funded via a GRA, contract in place

Advisor:	**Luke E. Riexinger, PhD**
	Research Assistant Professor Virginia Tech Department of Biomedical Engineering and Mechanics 445 Kelly Hall, 325 Stanger Street (MC 0194) Blacksburg, VA 24061 Phone: (540) 231-7190 Email: riexinger@vt.edu www.beam.vt.edu/people/faculty/riexinger www.safetyimpact.beam.vt.edu

Specific Project Description:





Over one-third of all traffic fatalities are single-vehicle run-off-road crashes. The design of roadside safety hardware depends on detailed data about all roadside encroachments even those that do not result in a crash. This project aims to develop a detailed dataset of these encroachments for passenger vehicles, motorcycles, large trucks. The encroachment data will be extracted from national crash databases, state crash databases, and naturalistic driving studies.

The road geometry, roadside slope, roadside obstacles, vehicle attributes, encroachment shape will be analyzed to understand their effect on barrier performance and occupant injury. Applications of this research could improve barrier testing procedures, understand differences between crash and non-crash encroachments, understand the difference between tracking and non-tracking encroachments, and determine encroachment differences between passenger vehicles, trucks, and buses.

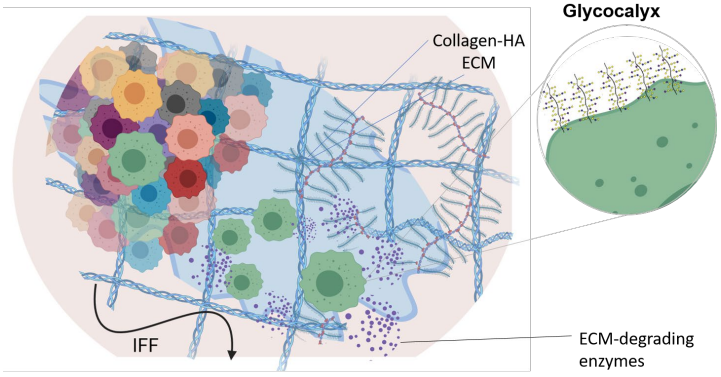
Other Notes:	The research will be conducted in the Center for Injury Biomechanics (CIB).

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Virginia Tech**

Project Title:	**Fluid flow-glycocalyx interactions in brain cancer**
Position Need:	**1-2 PhD student(s), start late Summer/Fall 2023**
Funding:	**VT Start-up Funds**

Advisor:	**Monét Roberts, PhD** Director, Glyco-Diversity Lab Assistant Professor
	Biomedical Engineering and Mechanics Kelly Hall Blacksburg, VA 24060 monetr@vt.edu

Specific Project Description:	The Roberts Glyco-Diversity Lab is aiming to investigate the sugar outer coating on all eukaryotic cells known as the glycocalyx. The glycocalyx is in important in cell-matrix and cell-cell interactions physiologically. Glycocalyx biopolymers (glycopolymers) are ubiquitous in the body and dysregulated in pathological states, such as cancer. We are particularly interested in its role in cancer and other pathologies within the central nervous system. This particular project will focus on glycopolymers on the cell surface of brain tumor cells that will be probed through RNAseq. Cells engineered to overexpress glycopolymers will be incorporated into 3D in vitro glioma models. Using this tool, we will be able to probe how mechanical stimuli in the extracellular matrix influence the glycocalyx as the cell's natural mechanosensor. Interestingly, malignant glycocalyx signatures have been suggested to be 

	neuroprotective. Therefore, we will also explore the role of the glycocalyx in cognitive outcomes and other tissues within the CNS, such as the meningeal lymphatics, in mice to understand underlying mechanisms in glycocalyx interactions in the brain. Students will gain a diverse skill set including: ● Scanning electron microscopy ● Animal models ● Behavioral testing ● Immunohistochemistry ● Cell culture ● Tissue dissection and harvesting ● Molecular biology ● RNA sequencing ● Cryosectioning

Other Notes:	**The Roberts Glyco-Diversity Lab's mission is to generate creative approaches in understanding mechanisms in cancer and neurological disorders, particularly to mitigate their impact through the lens of the glycocalyx with rigorous and meaningful science, collaborations, and integrity as well as being respectful of those who are doing the science, those who we impact, and the diverse identities in between and beyond.**

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title: **Nanothechology-based gene therapy to promote resolution of inflammation and pain after injury**

Position Need: **1 MS/PhD student**

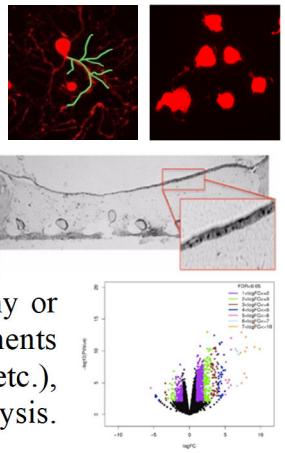
Funding: **NIH R01 and internal grant**

Advisor:

E. Alfonso Romero-Sandoval, MD, PhD
Associate Professor of Anesthesiology
Pain Mechanisms Laboratory
Wake Forest School of Medicine
1 Medical Center Blvd, Winston-Salem, NC 27157
Phone: 336-716-2725. Email: **eromeros@wakehealth.edu**

Specific Project Description:

My lab focuses on pain and inflammation after tissue damage, either by physical trauma (surgeries), pharmacologic treatments (chemotherapy) or metabolic conditions (diabetes). This project focuses on surgical trauma and inflammation. During large-scale surgeries, cells of monocytic lineage play a pivotal role in the initial inflammatory response and subsequent wound healing processes. Asynchronous transitions between the pro- and anti-inflammatory phenotypes of macrophages lead to prolonged inflammation, delayed wound healing, and the development of chronic pain. Our team has previously demonstrated that the induction of ED2/CD163 promotes polarization of macrophages towards an anti-inflammatory phenotype. In this project, we investigate whether the induction of ED2/CD163 at the wound-site produces faster recovery in a model of postoperative pain without causing pathological changes in non-injured tissues, namely cardiovascular organs. We induce ED2/CD163 at the injury site of rats that undergo skin/muscle incision and retraction (SMIR) surgery or inflammatory arthritis. Using mannosylated polyethylenimine (mPEI) nanoparticles that preferentially target macrophages, we deliver a plasmid to upregulate the expression of ED2/CD163 in the local microenvironment. We utilize a wide range of techniques including behavioral assessments in small rodents, tissue collection from animals or human subjects (healthy or patients) for pathological or molecular biology assessments (immunohistochemistry, Western blot, ELISA, qPCR, etc.), cellular cultures, genetic manipulation, or clinical data analysis.



Other Notes: The research will be conducted in the Pain Mechanisms Lab, Hanes building, WF Baptist Medical Center

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

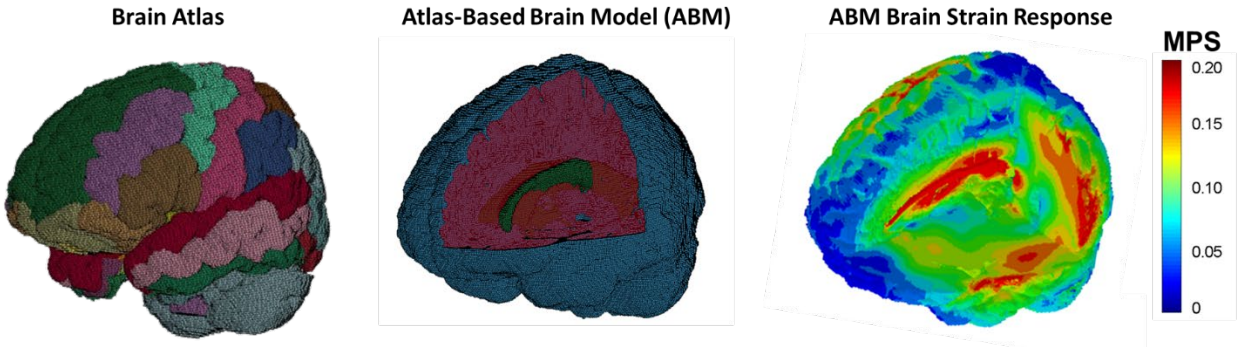
Location: **Wake Forest University**

Project Title: Quantifying Brain Response with the Atlas-Based Brain Model
Position Need: MS or PhD, May or August 2023
Support: Graduate Research Fellowship, NIH, Graduate School Support

Advisor:

Joel D. Stitzel, PhD, pubmed, linkedin

Professor, Biomedical Engineering, WFU Campus
Center for Injury Biomechanics at WFU
575 N. Patterson Ave, Suite 530, Winston-Salem, NC 27101
jstitzel@wakehealth.edu, CIB at WFU



Specific Project Description:

- Further validation of the atlas-based brain model (ABM)
- Improving the biofidelity of the brain-skull interface of the ABM and updating the brain material model
- Incorporating diffusion tensor imaging (DTI) tracts into model
- Simulating real-world head impacts collected from sports including football, hockey, soccer, gymnastics, and rugby
- The long term benefit of the research will be to allow equipment designers, researchers, and clinicians to better prevent, mitigate, identify and treat injuries to help improve sport safety.
- ABM development: Reference
- ABM application: Reference

Other Notes: This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

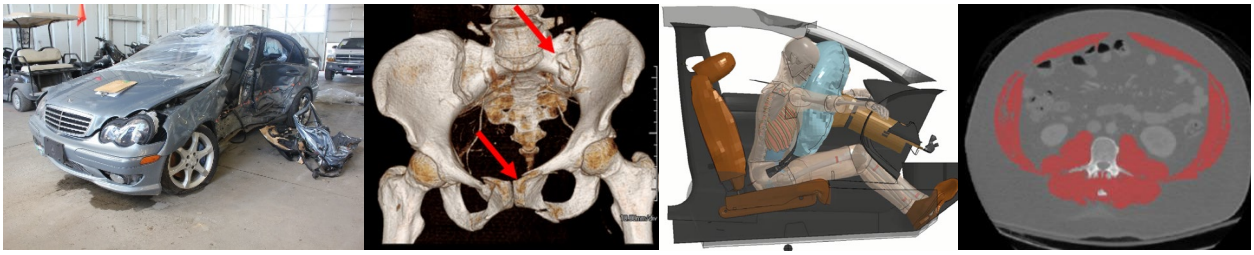
Location:	**Wake Forest University**

Project Title: Crash Injury Research and Engineering Network (CIREN)
Position Need: MS or PhD, May or August 2023
Support: Graduate Research Fellowship, National Highway Traffic Safety Administration (NHTSA), Graduate School Support

Advisor(s):

Joel D. Stitzel, PhD, pubmed, linkedin

Professor, Biomedical Engineering, WFU Campus
Center for Injury Biomechanics at WFU
575 N. Patterson Ave, Suite 530, Winston-Salem, NC 27101
jstitzel@wakehealth.edu, CIB at WFU



Specific Project Description:

- CIREN has been an ongoing project at WFUBMC since 2005. You'll work closely with faculty and team of expert staff investigators.
- Conducts detailed investigations of real-world motor vehicle crashes and determines mechanism and causation of occupant injuries to improve prevention, mitigation, and treatment of motor vehicle crash injuries.
- Involves collaboration and working closely with a broad range of medical specialties, including biomedical engineers, crash investigators, radiologists, orthopedic surgeons, and trauma surgeons.
- We also conduct finite element (FE) modeling reconstructions of CIREN crashes using the simplified GHBMC human body model and a simplified vehicle model. These reconstructions provide kinematic visualizations and injury analyses to supplement our investigations.
- CIREN is a research catalyst that can be used to conduct a wide range of motor vehicle trauma studies. A list of publications before 2016, many from our CIREN center, as well as general information about CIREN, can be found here.

Other Notes: This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location: Wake Forest University

Project Title: Youth Gymnastics Head Impact Exposure and Environmental Kinematic Quantification with Instrumented Mouthpiece

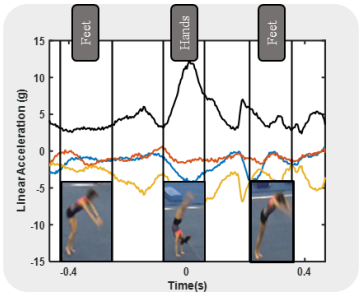
Position Need: MS or PhD, May or August 2023

Support: Graduate Research Fellowship, NIH, Graduate School Support

Advisor:

Joel D. Stitzel, PhD, pubmed, linkedin

Professor, Biomedical Engineering, WFU Campus
Center for Injury Biomechanics at WFU
575 N. Patterson Ave, Suite 530, Winston-Salem, NC 27101
jstitzel@wakehealth.edu, CIB at WFU



Specific Project Description:

- Development, testing, and field deployment of an instrumented mouthguard in youth gymnastics.
- Head impact data and video will be analyzed to assess skills and activities associated with measurements collected from the instrumented mouthpiece.
- We also collect measures of neurological function to assess changes that may result from performance of high-speed gymnastics skills. The long term benefit of the research will be to allow equipment designers, researchers, and clinicians to better prevent, mitigate, identify and treat injuries to help improve sport safety.
- Head Impact Exposure in Women's Artistic Gymnastics. Pritchard N.S., Urban J. Miller L. Stitzel J. *Presented at the 2020 Summer Biomechanics, Bioengineering, and Biotransport Conference.*

Other Notes: This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location: **Wake Forest University**

Project Title: Youth Hockey Head Impact Exposure Quantification with Instrumented Mouthguard

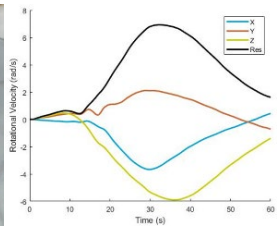
Position Need: MS or PhD, May or August 2023

Support: Graduate Research Fellowship, NIH, Graduate School Support

Advisor:

Joel D. Stitzel, PhD, pubmed, linkedin

Professor, Biomedical Engineering, WFU Campus
Center for Injury Biomechanics at WFU
575 N. Patterson Ave, Suite 530, Winston-Salem, NC 27101
jstitzel@wakehealth.edu, CIB at WFU



Specific Project Description:

- Development, testing, and field deployment of an instrumented mouthguard in competitive youth ice hockey.
- On-ice head impact data and video will be analyzed to assess on-field activity associated with measurements collected from the instrumented mouthpiece.
- We also conduct finite element (FE) modeling of the data with a head FE model. The long-term benefit of the research will be to allow equipment designers, researchers, and clinicians to better prevent, mitigate, identify and treat injuries to help improve sport safety.
- American Academy of Neurology Sports Concussion Reference

Other Notes: This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location: **Wake Forest University**

Project Title: Head Impact Exposure Quantification and Mitigation in Motorsports
Position Need: MS or PhD, May or August 2023
Support: Graduate Research Fellowship, NIH, Graduate School Support

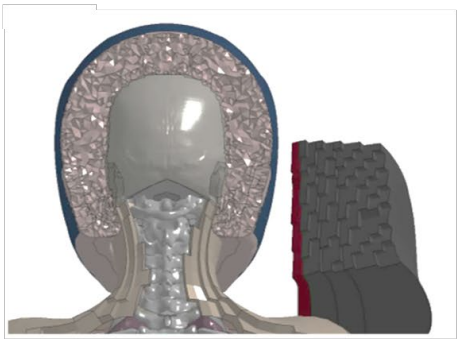
Advisor:

Joel D. Stitzel, PhD, pubmed, linkedin

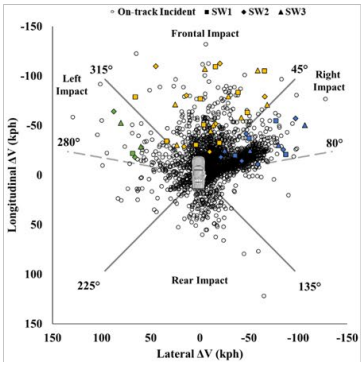
Professor, Biomedical Engineering, WFU Campus
Center for Injury Biomechanics at WFU
575 N. Patterson Ave, Suite 530, Winston-Salem, NC 27101
jstitzel@wakehealth.edu, CIB at WFU

Driver FE Model

FE Simulation for Driver Safety Optimization



Example On-Track Impacts



Specific Project Description:

- Pilot testing of individualized mouthpiece deployment in motorsports
- Analysis to quantify environmental and crash head kinematics
- Finite element (FE) modeling for injury risk assessment for drivers in crash scenarios
- FE simulation to optimize safety measures and driver comfort
- Injury risk assessment: Reference
- Optimization of safety measures: Reference

Other Notes: This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

SCHOOL OF BIOMEDICAL ENGINEERING AND SCIENCES

2023 Faculty Advisor Request form for Graduate Student Position

Location: **Wake Forest University**

Project Title: Quantifying Head Impact Exposure in Youth and Collegiate / Adult Soccer with Instrumented Mouthpiece

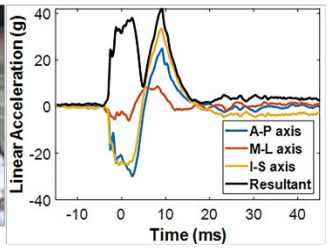
Position Need: MS or PhD, May or August 2023

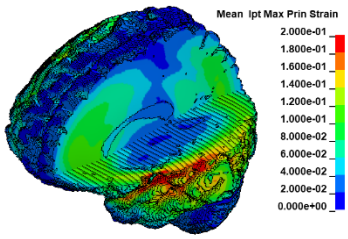
Support: Graduate Research Fellowship, NIH, Graduate School Support

Advisor:

Joel D. Stitzel, PhD, pubmed, linkedin

Professor, Biomedical Engineering, WFU Campus
Center for Injury Biomechanics at WFU
575 N. Patterson Ave, Suite 530, Winston-Salem, NC 27101
jstitzel@wakehealth.edu, CIB at WFU





Specific Project Description:

- Development, testing, and field deployment of an instrumented mouthguard in youth and collegiate soccer
- Analysis of on-field head impact data and time-synchronized video to assess on-field activity associated with measurements collected from the instrumented mouthpiece
- Finite element (FE) modeling of head impact data with a FE brain model to evaluate tissue-level stresses and strains
- Investigating potential modifiers of head impact exposure and concussion risk (e.g., drill types, athlete fatigue, header technique)
- The long term benefit of the research will be to assist equipment designers, researchers, and clinicians to better prevent, mitigate, identify, and treat injuries to help improve sport safety.
- Reference: Development, Validation, and Pilot Field Deployment of a Custom Mouthpiece for Head Impact Measurement

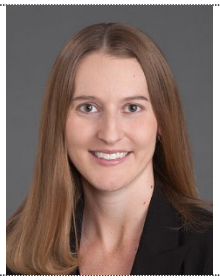
Other Notes: This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Osteoprotective Interventions for Older Adults Losing Weight
Position Need:	PhD or MS, start August 2023
Funding:	NIH

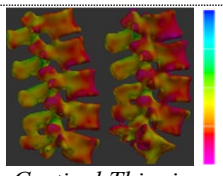
Advisor:	**Ashley Weaver, PhD**	PubMed		AshleyAWeaver



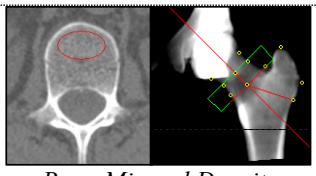
Associate Professor, Biomedical Engineering, WFU Campus
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave
Winston-Salem, NC 27101
asweaver@wakehealth.edu

Specific Project Description:

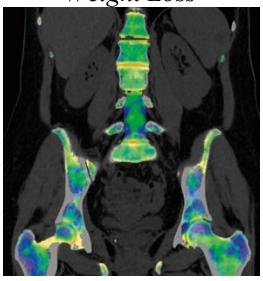
Weight loss is controversial in older adults due to its association with bone loss and increased fracture risk. We are conducting several randomized controlled trials (RCTs) to test the effects of dietary (e.g. higher protein), exercise (e.g. resistance training), loading (e.g. weighted vest), and medication (e.g. bisphosphonates) interventions in preserving bone health in older adults as they lose weight. Our team analyzes computed tomography (CT) scans and creates subject-specific finite element (FE) models to assess changes in bone mineral density, bone thickness, bone marrow adiposity, and bone strength and fracture risk over the course of various interventions. These computational analyses produce data on the effectiveness of these interventions in protecting against bone loss and fracture in an aging population at high risk for fracture.



Cortical Thinning with Weight Loss

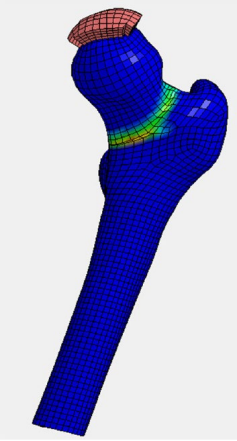


Bone Mineral Density Measurement



Bone Marrow Adiposity Measurement

FE Modeling for Bone Strength >> & Fracture Prediction



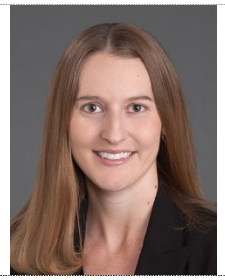
Other Notes:	This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of musculoskeletal, automobile, military, aerospace, and sports biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	High-Resolution Peripheral Quantitative Computed Tomography (HR-pQCT) Scanning in Clinical Trial Interventions
Position Need:	MS or PhD, start August 2023
Funding:	NIH

Advisor:	**Ashley Weaver, PhD**	PubMed		AshleyAWeaver



Associate Professor, Biomedical Engineering, WFU Campus
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave
Winston-Salem, NC 27101
asweaver@wakehealth.edu

Specific Project Description:	The XtremeCT II HR-pQCT scanner provides highly specialized CT scans at the distal radius and tibia. These images can be used to quantify changes in volumetric bone mineral density (vBMD) as well as structural changes by providing detailed resolution of the bone microarchitecture. These data are being used by our group in the clinical setting as part of interventional trials designed to evaluate the outcome of varying weight loss modalities (dietary, exercise, surgical) on metrics of bone health. The ability to see microarchitecture remodeling may lead to an increased understanding of how bones are affected by weight loss, particularly among older adults.

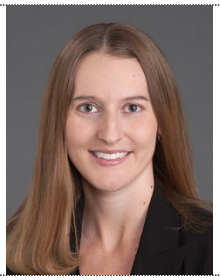
Other Notes:	This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Injury Risk Prediction in Lunar Terrain Vehicle EVAs
Position Need:	MS, start August 2023
Funding:	NASA

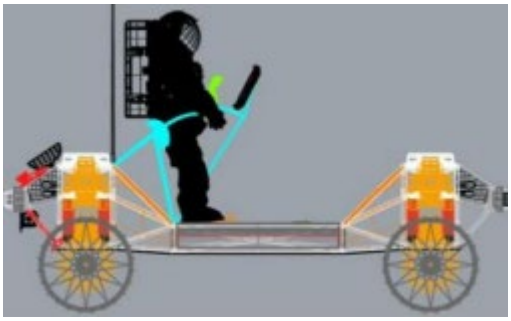
Advisor:	**Ashley Weaver, PhD**	PubMed		AshleyAWeaver



Associate Professor, Biomedical Engineering, WFU Campus
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave
Winston-Salem, NC 27101
asweaver@wakehealth.edu

Specific Project Description:

When humans return to the Moon on upcoming Artemis missions, extravehicular activities (EVAs) are expected to be performed shortly after landing. A Lunar Terrain Vehicle (LTV) will likely be used for transporting astronauts across the lunar terrain. NASA is considering a standing posture on the LTV to maximize vehicle egress and ingress time efficiency.



Driving an unpressurized vehicle in a standing posture on an uneven planetary surface could compromise crewmember safety if subjected to transient accelerations caused by lunar surface irregularities. This study uses an active muscle human body finite element model in the standing posture to simulate LTV scenarios. Head, neck, spine, and extremity kinematics and injury metrics will be analyzed from the simulations to predict astronaut injury risks. Currently, we are working on the mid-size male modeling, and we hope to expand to females and other occupant sizes to encompass a broader range of the astronaut corps. The simulation approach is a rapid and cost-effective means to study crew safety for Artemis missions and inform the design of astronaut suits, restraints, and vehicle interiors to protect against injury in transfers to and from the lunar surface.

Other Notes:	This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	Vulnerable Road User In-Depth Crash Investigation Study Injury and Causation Assessment (VICIS)
Position Need:	MS or PhD, start May or August 2023
Funding:	National Highway Traffic Safety Administration (NHTSA)

Advisor:	**Ashley Weaver, PhD**	PubMed		AshleyAWeaver

Associate Professor, Biomedical Engineering, WFU Campus
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave
Winston-Salem, NC 27101
asweaver@wakehealth.edu

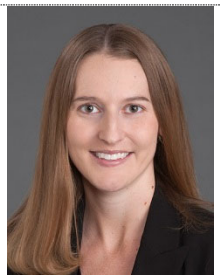
Specific Project Description:

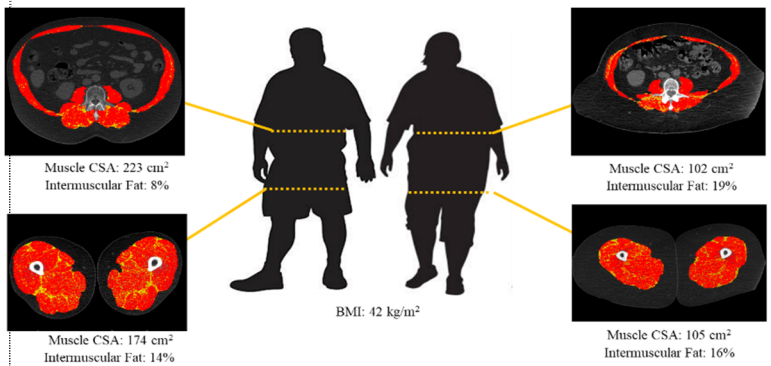
- VICIS is a study focused on reviewing and analyzing vulnerable pedestrian crash data for injury causation and crash causation factors.
- Conducts detailed investigations of real-world pedestrian crashes and determines mechanism and causation of occupant injuries to improve prevention, mitigation, and treatment of motor vehicle crash injuries.
- Involves collaboration and working closely with a broad range of medical specialties, including biomedical engineers, crash investigators, radiologists, orthopedic surgeons, and trauma surgeons.
- We also conduct finite element (FE) modeling reconstructions of pedestrian crashes using the simplified GHBMC human body model and a simplified vehicle model. These reconstructions provide kinematic visualizations and injury analyses to supplement our investigations.

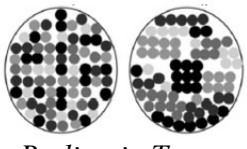
Other Notes:	This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

2023 Faculty Advisor Request form for Graduate Student Position

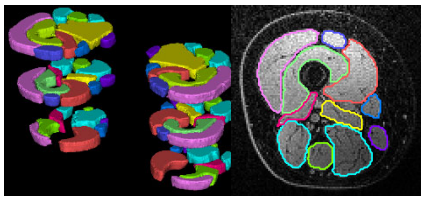
Location:	**Wake Forest School of Medicine**

Project Title:	Muscle Quality/Radiomics Features, and Muscle-Bone Crosstalk
Position Need:	PhD or MS, start August 2023
Funding:	NIH
Advisor:	**Ashley Weaver, PhD** PubMed AshleyAWeaver
	Associate Professor, Biomedical Engineering, WFU Campus VT-WFU Center for Injury Biomechanics School of Biomedical Engineering and Sciences 575 N. Patterson Ave. Winston-Salem, NC 27101 asweaver@wakehealth.edu
Specific Project Description:	Loss of muscle mass and strength can lead to mobility disability and increase risk of osteoporosis and fracture as muscle acts both mechanically and biochemically on bone. We are conducting studies utilizing computed tomography (CT) and magnetic resonance (MR) imaging to assess muscle changes with weight loss (diet/exercise-based or bariatric surgery), disease (e.g. myotonic dystrophy; heart failure), or normal aging. We apply automated machine-learning and semi-automated methods to assess changes in muscle area, volume, quality, and intermuscular fat in CT and MR scans. We also use automated radiomics analysis to extract high-dimensional muscle quality measures, such as uniformity, heterogeneity, randomness, and repetitive patterns from CT. These muscle properties can be correlated to bone mineral density and bone strength, which we derive from imaging. These analyses assess effectiveness of interventions, characterize mechanisms of disease, identify therapeutic targets, and will help establish imaging biomarkers to predict musculoskeletal decline.
Other Notes:	This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in automobile safety, aging, aerospace, military, and neurology.





Radiomic Textures



Myotonic Dystrophy

2023 Faculty Advisor Request form for Graduate Student Position

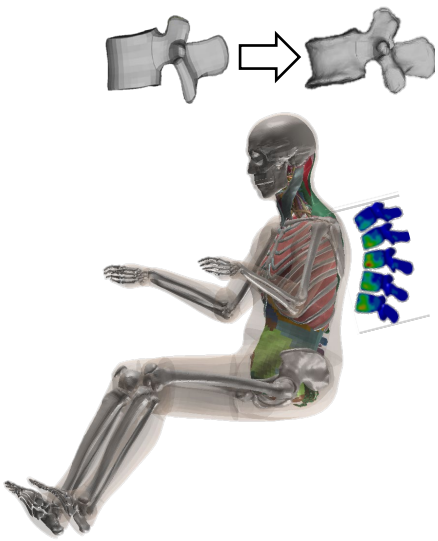
Location:	**Wake Forest School of Medicine**

Project Title:	CT and MRI Modeling Assessment of Spine Anatomy and Injury Risk Following Long-Duration Spaceflight
Position Need:	MS or PhD, start August 2023
Funding:	NASA

Advisor:	**Ashley Weaver, PhD**	PubMed		AshleyAWeaver

Associate Professor, Biomedical Engineering, WFU Campus
VT-WFU Center for Injury Biomechanics
School of Biomedical Engineering and Sciences
575 N. Patterson Ave
Winston-Salem, NC 27101
asweaver@wakehealth.edu

Specific Project Description:	Prolonged exposure of astronauts to microgravity during long-duration spaceflight can degrade the musculoskeletal system, increasing the risk of structural failure of these tissues when they experience dynamic loads. This study will measure the degradation of astronauts' vertebrae and spinal muscles during missions aboard the International Space Station (ISS). Changes in pre- and post-flight spine anatomy (vertebral morphology, spinal curvature, cortex thickness, bone mineral density, muscle volume, and disc morphology) will be measured from astronaut quantitative computed tomography (qCT) and magnetic resonance imaging (MRI) scans. Vertebral strength and injury risk will be quantified from simulations with a human body model altered to represent each astronaut's anthropometry and pre- and post-flight vertebrae and spinal musculature. Each astronaut-specific model will be developed by using morphing techniques.



Other Notes:	This research effort is on the Wake Forest Campus of the Center for Injury Biomechanics (CIB) with opportunities to work on a range of projects in the field of automobile, military, aerospace, and sports biomechanics.

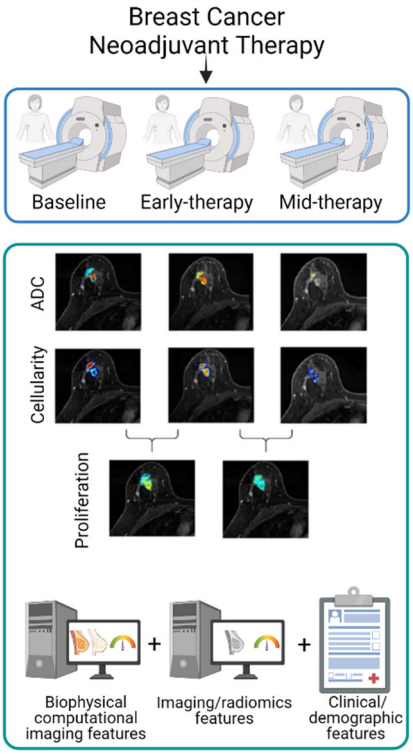
2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Biophysical computational imaging to monitor/predict the response to neoadjuvant therapy for breast cancer**
Position Need:	PhD or MS, start August 2023
Funding:	Internal

Advisor:	**Jared Weis, PhD**
	Assistant Professor, Biomedical Engineering, WFU Campus School of Biomedical Engineering and Sciences 575 N. Patterson Ave, Suite 530 Winston-Salem, NC 27101 jweis@wakehealth.edu https://school.wakehealth.edu/faculty/w/jared-a-weis weislab.org

Specific Project Description:	Breast cancer patients are routinely prescribed a pre-determined therapeutic regimen with pre-selected doses and cycles of anticancer neoadjuvant therapy. Some patients may need only a portion of this treatment for complete tumor eradication while others would significantly benefit from an alternative therapy. Accurate individualized assessment of real-time neoadjuvant therapy response is critical to allow for personalized intervention with dynamic strategies to tailor the given therapy to the observed response, while minimizing risks of subsequent toxicities. We have recently developed a computational imaging framework for characterizing breast cancer neoadjuvant therapy response using mechanistic biomathematical models to interpret patient-specific serial quantitative MRI data. This project seeks to harness the power of biophysical computational imaging methods to develop innovative technologies for non-invasive imaging "virtual biopsies" that reveal critical information regarding the underlying biophysics of therapy response to allow for monitoring of treatment response. By developing technologies that characterize dynamic biophysical phenotypic signatures of therapeutic response, our overall goal is to enable personalized therapeutic decision-support capable of early assessment of therapy response in individual breast cancer patients undergoing neoadjuvant therapy based on early imaging data.



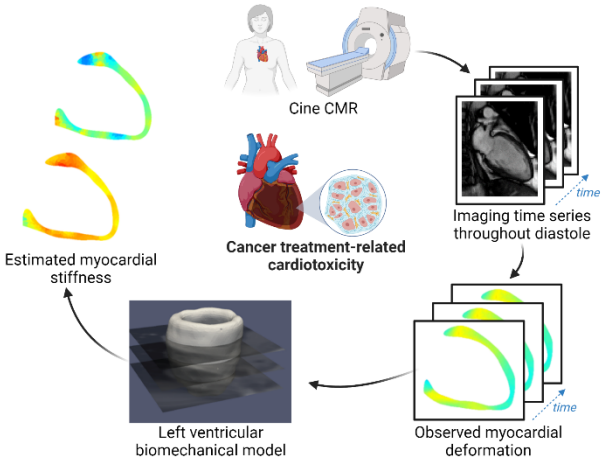
2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Cardiac elasticity imaging to identify sub-clinical cancer treatment-related dysfunction in breast cancer patients**
Position Need:	PhD or MS, start August 2023
Funding:	Internal

Advisor:	**Jared Weis, PhD**
	Assistant Professor, Biomedical Engineering, WFU Campus School of Biomedical Engineering and Sciences 575 N. Patterson Ave, Suite 530 Winston-Salem, NC 27101 jweis@wakehealth.edu https://school.wakehealth.edu/faculty/w/jared-a-weis weislab.org

Specific Project Description:	Cancer treatment-related cardiotoxicity is a significant concern for breast cancer patients. Increased survival rates along with a younger demographic shift makes patient survivorship issues, particularly cardiovascular disease, a forefront of clinical concern in an important patient group of women with decades of life to protect. Cardiotoxicity concerns limit therapeutic options and offset expected therapeutic benefits. Current clinical detection paradigms are based on semi-quantitative and subjective assessments that are only able to detect late-stage irreversible cardiac decline. There is a compelling need for new methods to assess early cardiac dysfunction to allow for interventional opportunities to minimize cancer therapy-induced cardiotoxicity while maximizing cancer treatment effect. We have recently shown the development of a novel myocardial mechanical stiffness phenotyping tool. This project seeks to further develop and optimize biomechanical model-embedded cardiovascular magnetic resonance imaging (CMR) assessment of myocardial mechanical elasticity to accurately and non-invasively detect cancer treatment-related changes in left ventricular stiffness as an early indicator of cardiac dysfunction to inform therapeutic management strategies for breast cancer patients prior to irreversible cardiovascular damage.

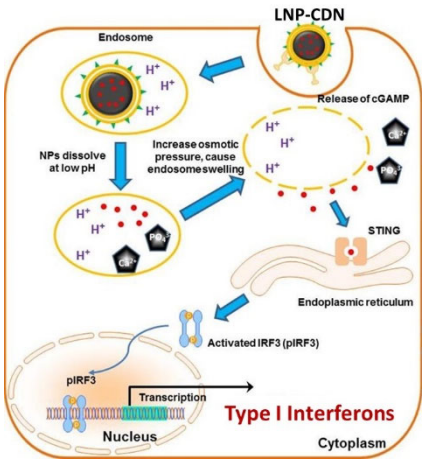


2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	**Development of immunotherapeutic nanoparticle for cancer treatment**
Position Need:	1 MS/PhD, start August 2023
Funding:	Funded via NIH R01

Advisor:	**Your Name**
	Dawen Zhao, MD, PhD Professor Biomedical Engineering Wells Fargo Faculty Scholar WFU Campus Medical Center Boulevard Winston-Salem, NC 27157 Phone: 336-713-5783 Fax: 336-716-54921 Email: dawzhao@wakehealth.edu

Specific Project Description:	The emergence of immunotherapy with immune checkpoint blockade (ICB) is providing promise in cancer treatment. However, only a fraction of cancer patients benefit from ICB. Significant clinical evidence has suggested that the tumor microenvironment (TME) is extremely immunosuppressive, which hampers the ICB immunotherapy. To mitigate the 'cold' TME, our lab has recently developed nanoparticle immune-therapeutic (LNP-CDN) that enables delivery of immunostimulants to one type of immune cells called 'antigen presenting cells' (APCs). Activation of APCs promotes the antitumor immunity of NK cells and cytotoxic T cells (*Liu, et al. Nature Nanotech. 2022; Liu, et al. Nature Commun, 2019*). In this project, we will optimize the nanoparticle immunotherapy system and explore its immunological and therapeutic effects as well as its ability to enhance anti-PD-1/PD-L1 ICB against metastatic lung cancers. 

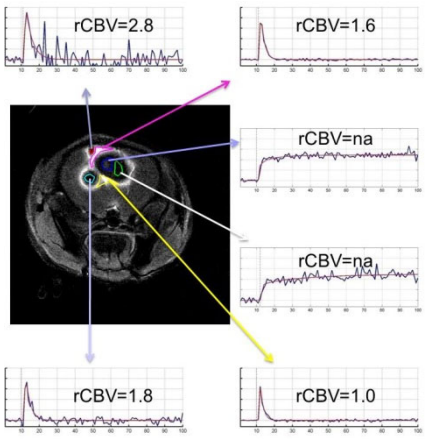
Other Notes:	The graduate student will have the opportunity to work within a highly interactive team to conduct basic and translational research through collaborations between BME, Immunology, Cancer Biology and Clinical Medicine Departments at Wake Forest University School of Medicine.

2023 Faculty Advisor Request form for Graduate Student Position

Location:	**Wake Forest School of Medicine**

Project Title:	***In vivo* MRI of the brain tumor microenvironment**
Position Need:	1 MS/PhD, start August 2023
Funding:	Funded via WFUHS Faculty Scholar

Advisor:	**Your Name**
	Dawen Zhao, MD, PhD Professor Biomedical Engineering Wells Fargo Faculty Scholar WFU Campus Medical Center Boulevard Winston-Salem, NC 27157 Phone: 336-713-5783 Fax: 336-716-54921 Email: dawzhao@wakehealth.edu

Specific Project Description:	Malignant brain tumors are characterized by profound angiogenesis and intratumoral hypoxia and necrosis, which have been shown to correlate negatively with clinical outcome. The major goal of this project is to integrate multiple imaging parameters to interrogate tumor vascular perfusion and permeability and their dynamic changes in response to irradiation and/or chemotherapy. The imaging findings will be correlated with histological and biological studies of tumor cell aggressiveness and hypoxia. Mouse models of glioma and brain metastasis established at the lab are available for the project.	

Other Notes:	The graduate student will have the opportunity to work within a highly interactive team to conduct basic and translational research through collaborations between BME, Immunology, Cancer Biology, Radiology and Radiation Oncology at Wake Forest University School of Medicine.