# AHAD BEHBOODI, MSc, PhD

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***Assistant Professor at UNO Biomechanics, Founder of Elasthetics LLC***

## RESEARCH INTEREST

As a researcher and entrepreneur, my focus lies in translational research dedicated to advancing pediatric rehabilitation technologies that foster motor learning. My research comprises three fundamental components: 1) design and implementation of rehabilitation systems to improve gait; 2) investigation of the effects of such systems at the functional, biomechanical, and cortical levels; and 3) timely market translation of effective systems. My main research projects include:

- **BCI-mediated neurofeedback:** Employing deep learning to create EEG-based brain-computer interface (BCI) systems for motor rehabilitation.
- **Artificial muscle:** Designing and implementing comfortable exoskeletons based on soft actuators; this initiative led to the establishment of Elasthetics LLC, a spinoff stemming from this project.
- **Task-specific NMES:** Developing rehabilitation protocols based on neuromuscular electrical stimulation (NMES)-assisted gait training, BCI-driven NMES for improving motor coordination, and NMES-assisted cycling exercise.

## EDUCATION

**Ph.D.** University of Delaware (UDel), Newark, DE, USA; 2019

Biomechanics and Movement Science
Thesis: An Artificial Skeletal Muscle for Use in Pediatric Rehabilitation Robotics

**M.Sc.** Iran University of Science and Technology, Tehran, Iran; 2011

Biomedical Engineering-Bioelectronics
Thesis: Designing and Implementing Microcontroller Based FES Cycling System, with Simultaneous Control of System Power and Crank Velocity, Using TMS320f2812 Microcontroller.

**B.Sc.** Shahed University, Tehran, Iran; 2008

Biomedical Engineering-Clinical
Thesis: A Brain-Computer Interface for Classification of left vs. right-hand motor imagery.

## PROFESSIONAL EXPERIENCE

2023-present University of Nebraska Omaha (UNO), Omaha, NE
*Assistant Professor at the Department of Biomechanics*

2023-present National Institutes of Health (NIH), Bethesda, MD
*Special Volunteer at Neurorehabilitation and Biomechanics Research Section (NAB) Lab.*

2020-2023 National Institutes of Health (NIH), Bethesda, MD
*Post-doctoral Fellow at Neurorehabilitation and Biomechanics Research Section*

*(NAB) Lab.*
*Mentor: Diane Damiano PT, PhD.*

2019-Present Elasthetics LLC, Newark, DE
*Founder and CEO*

2019-2020 University of Delaware, Newark, DE
*Post-doctoral Fellow Venture Development Center,*
*Entrepreneurship Mentors: Christina Pelican, Daniel Freeman, Derek Lehane;*
*Technical Mentor: Samuel C.K. Lee, PT, PhD*

2016-2017 GoBabyGo, Newark, DE
*Lead Research Engineer at (GoBabyGlobal)*

2013-2019 University of Delaware, Newark, DE
*Full-Time Graduate Research Assistant in the Pediatric Mobility Lab*

2013-2019 Shriners Hospitals for Children, Philadelphia, PA
*Graduate Student Researcher*

2009-2012 Nad-Co (https://www.nadcosharif.com/ an educational company), Karaj, Iran
*CEO of the Karaj branch*

2009-2011 Iran Neural Technology Center, Tehran, Iran
*Graduate Research Assistant*

## MAJOR COMPLETED RESEARCH

- **A Soft Smart Ankle Foot Orthosis Powered by Artificial Muscle for Children with CP.**

  PI: Ahad Behboodi
  NSF I-Corps grant # 1906128

- **Design and Evaluation of a Neurofeedback System for Training the Lower Limb Motor Coordination in Children with Cerebral Palsy (CP).**

  Role: Lead Researcher PI: Diane Damiano
  NIH internal funding; protocol #13-CC-0110

- **Analyzing the Cycling Performance of Children with CP**

  PI: Samuel C.K. Lee
  NIH's Eunice Kennedy Shriver National Institute of Child Health and Human Development (grant # R01HD062588-01A1)

- **Artificial Muscles for Mechanizing a Unilateral Pediatric Shoulder/Elbow Orthosis**

  Role: Lead Researcher PI: Samuel C.K. Lee
  Funded by Shriners Hospitals for Children (Grant #87500-PHI17)
  NIH DE-CTR ACCEL (Grant # U54-GM104941)

- **FES Assisted Walking System to Improve Fitness and Strength in Children with CP**

  PI: Samuel C.K. Lee

Funded by Shriners Hospitals for Children (grant #71011).

- **FES Assisted Cycling to Improve Fitness and Strength in Adults with Spinal Cord Injury**

  PI: Abbas Erfanian-Omidvar

## LEADERSHIP

2023-Present Director of Neo-Therapeutic Lab at UNO

Lead a team of two graduate students, one master', one PhD to design novel orthotics and therapeutics for children with neuromotor disorders.

2020-2023 Neurofeedback Project at NIH

Led a team of two biomedical (one male, one female) and one mechanical engineer (male) at the **National Institutes of Health** (NIH) Rehabilitation Medicine Department. Implementing a real-time brain-computer interface (BCI) system for rehabilitation application based on neurofeedback motor learning paradigms.

2019-2022 DE-AFO project at UDel

Conceptualizing the idea of a comfortable and smart ankle-foot orthosis for children with cerebral palsy (DE-AFO) using dielectric elastomer actuators. Securing ~$350K of funding for the project. Established a startup called **Elasthetics LLC**. Led a team of two undergraduate mechanical engineers, one undergraduate electrical engineer, two scientific consultants (two females), a physical therapist, and two business advisors (one female).

2016-2019 Artificial Skeletal Muscle Project at UDel

Conceptualizing the idea of using a soft actuator (Dielectric Elastomer) for pediatric rehabilitation robotics. translating the knowledge to the lab by establishing collaboration with a pioneer research group in Europe led by Dr Federico Carpi. Securing ~$200K funding for the project. Led a team of two undergraduate mechanical engineering students.

2017-2018 GoBabyGo

Led a team of three undergraduate engineering students (one female) to design an electrical circuit for modifying ride-on cars for children with movement disabilities. The modification was used in multiple GobabyGo events, including an event sponsored by Philadelphia Eagles and Children's Hospital of Philadelphia at Lincoln Financial Field.

2011-2013 NadCo

CEO of a robotic education company in Karaj, Iran. Led a team of seven staff members and 20 teachers, providing the required hardware, software, curriculum, and instructors for teaching robotics to over 1500 students in 30 high, middle, and elementary schools.

## HONORS AND AWARDS

2025 Selected for 2025 Training in Grantsmanship for Rehabilitation Research (TIGRR).

2020 The Center for Translation of Rehabilitation Engineering Advances and Technology (TREAT) Commercialization Assistance Program. NIH P2CHD086841.

2019 American Congress of Rehabilitation Medicine's (ACRM's) LaunchPad Most Innovative award for "Soft Ankle Foot Orthosis Powered by Artificial Muscle, DE-AFO."

2019 The University of Delaware's Horn Entrepreneurship Program **Post-Doctoral Innovation Fellowship, $75k**.

2019 University Science Center's QED program Awardee. QED is a competitive $200K proof of concept funding between 20 institutes in Pennsylvania, Delaware, and New Jersey.

2015 Chosen student participant for the IEEE Signal Processing summer school in Pavia, Italy.

## PATENT

Behboodi A, Lee SC, Binder-Macleod SA, Wright H, inventors; University of Delaware, assignee. *"Modular Artificial Skeletal Muscle Actuators and Exoskeletons Powered Thereby."* U.S. Patent 12,083,067, issued September 10, 2024.

## GRANTS

### Primary Investigator:

2024 University of Nebraska Collaboration Initiative Grant. "Enhancing Upper Extremity Rehabilitation in Neurodiverse Children: BCI-Mediated Neurofeedback and Virtual Reality for Improved Engagement and Training Quality." PI: **Behboodi**. $100k.

2020 Pennsylvania Pediatric Device Consortium, funded by FDA, through Children's Hospital of Philadelphia (CHOP). "Soft Ankle Foot Orthosis Powered by Artificial Muscle, DE-AFO." PI: **Behboodi**. $50k.

2019 Philadelphia University City Science Center QED award. "Soft Ankle Foot Orthosis Using Artificial Muscle, DEAFO". PI: **Behboodi**. $185K

2018 NSF I-Corps Team, project # 1906128. "Soft Ankle Foot Orthosis Using Artificial Muscle, DEAFO". PI: **Behboodi**. $50K

2018 NSF I-Corps Site, Grant # 1347329. *"Soft Ankle Foot Orthosis Using Dielectric Elastomer, DEAFO"*. $3K

### Co-Investigator:

2017 NIH DE CTR ACCEL, Pilot Grant # U54-GM104941. "Artificial Muscles for Mechanizing a Unilateral Pediatric Shoulder/Elbow Orthosis" No-Cost Extension. PI: Lee. (Behboodi, %50 effort). $40K

***Role:*** Conceptualization. Lead on writing the research plan. Execution.

2016 NIH DE-CTR ACCEL, Pilot Grant # U54-GM104941. "Artificial Muscles for Mechanizing a Unilateral Pediatric Shoulder/Elbow Orthosis". PI: Lee. (Behboodi, %50 effort). $80K

***Role:*** Conceptualization. Lead on writing the research plan. Execution.

2016 Shriners Hospital for Children, Grant #87500-PHI17. "Artificial Muscle Actuators for Mechanizing an Upper Extremity Exoskeleton Orthosis". PI: Lee. (Behboodi, %50 effort) $120K

***Role***: Conceptualization. Lead on writing the research plan. Execution.

## MEDIA COVERAGE

2024 Orthopedici & Sanitari: *Motorized AFO for Children with Cerebral Palsy*

2021 *UD Research:* ***FRONT END OF DISCOVERY: HELPING CHILDREN MOVE***

2020 *CHOP:* ***SEED FUNDS AWARDED TO FOUR PROPOSALS TO DEVELOP MEDICAL DEVICES FOR CHILDREN***

The Venture Development Center and Physical Therapy Department at the University of Delaware are collaborating to develop the DE-AFO

2019 *UDaily:* ***ARTIFICIAL MUSCLE POWER***

UD research team funded to develop medical device for children with cerebral palsy

2019 *O&P EDGE:* ***UNIVERSITY RESEARCHER AWARDED FOR ORTHOSIS DEVELOPMENT***

2019 *EurekAlert (a service of the American Association for the Advancement of Science (AAAS)):****ARTIFICIAL MUSCLES' TO HELP CHILDREN WITH CEREBRAL PALSY***

## PUBLICATIONS

**Under Review**

- Bulea T, **Behboodi** A, Lee W, Damiano D. *"Online application of independent component analysis to isolate cortical sources for EEG-based brain-machine interfacing applications: toward real-time control and feedback"* IEEE Transactions on Neural Systems and Rehabilitation Engineering information.

**Peer-Reviewed Journal Papers:**

- Mohammadi V, Mohammadi Ghalehney S, Tajdani M, **Behboodi** A. (2024) *"Evaluating Stacked Dielectric Elastomer Actuators as Soft Motor Units for Forming Artificial Muscles in Biomimetic Rehabilitation Robots."* Actuators.
- Mohammadi V, Tajdani M, Masaei M, Mohammadi Ghalehney S, **Behboodi** A. (2024) *"DE-AFO: A Robotic Ankle Foot Orthosis for Children with Cerebral Palsy Powered by Dielectric Elastomer Artificial Muscle."* Sensors.
- Mohammadi V, Shahbad R, Hosseini M, Gholampour MH, Shiry Ghidary S, Najafi F, **Behboodi** A. (2024) *"Development of a Two-Finger Haptic Robotic Hand with Novel Stiffness Detection and Impedance Control."* Sensors.
- **Behboodi** A, Kline J, Gravunder A, Phillips C, Parker SM, Damiano D. (2024). *"Development and evaluation of a BCI-neurofeedback system with real-time EEG detection and electrical stimulation assistance during motor attempt for neurorehabilitation of children with cerebral palsy."* Frontiers in Human Neuroscience.
- Kahlon AS, Verma K, Sage A, Lee SCK, **Behboodi** A**.** (2024) *"Enhancing wearable gait monitoring systems: identifying optimal kinematic inputs in typical adolescents."* Sensors.
- **Behboodi** A, Hinchbereger T, Lee W, Damiano D. (2023) "*Determining Optimal Mobile Neurofeedback Methods for Motor Neurorehabilitation in Children and Adults with Non-progressive Neurological Disorders: a Scoping Review."* Journal of NeuroEngineering and Rehabilitation.
- **Behboodi** A, Sansare A, Zahradka N, Lee SCK. *"Case Report: The Gait Deviation Index may*

*predict the neurotherapeutic effects of FES-assisted gait training in children with cerebral palsy"* Frontiers in Rehabilitation Sciences.

- Kahlon A, Sansare A, **Behbood** A, (2022) *"Remote Gait Analysis as a Proxy for Traditional Gait Laboratories: Utilizing Smartphones for Subject-Driven Gait Assessment across Differing Terrains."* Biomechanics.
- Sansare A, **Behboodi** A, Johnston TE, Bodt B, Lee SCK. (2021) *"Characterizing Cycling Smoothness and Rhythm in Children with and without Cerebral Palsy"*. Frontiers in Rehabilitation Sciences.
- Zahradka N, **Behboodi** A, Sansare A, Lee SCK. (2021) *"Evaluation of Individualized Functional Electrical Stimulation-Induced Acute Changes during Walking: A Case Series in Children with Cerebral Palsy."* Sensors.
- Zahradka N, Verma K, **Behboodi** A, Bodt B, Wright H, Lee SCK. (2020) *"An Evaluation of Three Kinematic Methods for Gait Event Detection Compared to the Kinetic-Based 'Gold Standard."* Sensors.
- Zahradka N, **Behboodi** A, Wright, H., Bodt, B, Lee SCK. (2019) *"Evaluation of Gait Phase Detection Delay Compensation Strategies to Control a Gyroscope-Controlled Functional Electrical Stimulation System During Walking*." Sensors.
- **Behboodi** A, Zahradka N, Wright H, Alesi JF, and Lee SCK. (2019). *"Real-Time Detection of Seven Phases of Gait in Children with Cerebral Palsy Using Two Gyroscopes."* Sensors.
- **Behboodi** A, Zahradka N, Alesi JF, Wright H, Lee SCK. (2019) *"Use of a novel functional electrical stimulation gait training system in 2 adolescents with cerebral palsy: a case series exploring neurotherapeutic changes"* In Physical therapy.

**Peer-Reviewed Conference Papers**

- Baysa M, Muczynski B, Zuniga J, **Behboodi** A (2025) *"Exploring the Design of the DeCyborg; a Mechanized Version of E-NABLE's Cyborg Beast Powered by Artificial Muscles."* 47th Annual International Conference of the IEEE Engineering in Medicine and Biology.
- Masaei Koroyeh M, Mohammadi V, Tajdani M, **Behboodi** A (2025) *"Theoretical Evaluation of DE-AFO-1550: a Comfortable Robotic Ankle Exoskeleton for Children with Cerebral Palsy Powered by Advanced Stacked Dielectric Elastomer Actuators."* 19th International Conference On Rehabilitation Robotics (ICORR).
- Mohammadi Ghalehney S, Mohammadi V, Tajdani M, **Behboodi** A (2025) "*Advancing Soft Rehabilitation Robotics: Evaluating the Stress and Strain Generation Capabilities of Stacked Dielectric Elastomer Actuators (SDEAs)."* 19th International Conference On Rehabilitation Robotics (ICORR).
- **Behboodi** A, Lee W, Damiano D. (2022) *"Evaluation of Multi-Layer Perceptron Neural Networks in Predicting Ankle Dorsiflexion in Healthy Adults Using Movement-Related Cortical Potentials for BCI-Neurofeedback Applications."* In 18th IEEE International Conference on Rehabilitation Robotics (ICORR).
- **Behboodi** A, DeSantis C, Lubsen J, Lee SCK. (2020) "*A Mechanized Pediatric Elbow Joint Powered by a De-Based Artificial Skeletal Muscle."* In 42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC).

- **Behboodi** A, Lee SCK, (2019) *"Benchmarking of a Commercially Available Stacked Dielectric Elastomer as an Alternative Actuator for Rehabilitation Robotic Exoskeletons."* In 16th IEEE International Conference on Rehabilitation Robotics (ICORR).
- **Behboodi** A, and Salehi S. (2017) *"SDRE controller for motion design of cable-suspended robot with uncertainties and moving obstacles."* In IOP Conference Series: Materials Science and Engineering.
- **Behboodi** A, Wright H, Zahradka N, and Lee SCK. (2015) *"Seven phases of gait detected in real-time using shank attached gyroscopes."* In 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC).

**Book Chapters**

- **Behboodi** A, Alesi J, Lee SCK. (2021*) "An Artificial Skeletal Muscle for Use in Pediatric Rehabilitation Robots"* In Amir Jafari and Nafiseh Ebrahimi (Eds), Soft Robotics in Rehabilitation. Amsterdam, Netherland: Elsevier.
- Lee SCK, **Behboodi** A, Alesi J, Wright H. (2020) *"Functional Electrical Stimulation Interventions for Children and Youth with Cerebral Palsy"* In: Miller F., Bachrach S., Lennon N., O'Neil M. (Eds) Cerebral Palsy. Berlin, Germany: Springer.

## PRESENTATIONS

**Podium Presentations (Abstract)**

- *International Functional Electrical Stimulation Society (IFESS), 2024 "Custom Stimulation Protocols for Fes-Assisted Gait Training in Children with Cerebral Palsy: Moving Be-Yond a One-Size-Fits-All Approach."* Masaie M, Zahradka N, Verma K , Lee SCK , **Behboodi** A.
- SPIE Biophotonics in Exercise Science, Sports Medicine, Health Monitoring, 2024 "*Gait Assessment with Inertial Measurement Units: Similarity Score Of Walking Gait on Treadmill and Outdoor Overground Reflected in Lower Limb Angular Velocity and Acceleration in Typically Developing Children.*" Kahlon AS, Verma K, Sage A, Lee SCK, **Behboodi** A**.**
- SPIE Photonics West: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring, Section 2022 *"Smartphone Sensor Application for Gait Analysis."* Kahlon A, Khaksari S, **Behboodi** A, Sansare A.
- RehabWeek-IEEE International Conference on Rehabilitation Robotics (ICORR), 2022 "*Evaluation of Multi-Layer Perceptron Neural Networks in Predicting Ankle Dorsiflexion in Healthy Adults Using Movement-Related Cortical Potentials for BCI-Neurofeedback Applications.*" **Behboodi** A, Lee W, Bulea T, Damiano D.
- Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2020 "*A Mechanized Pediatric Elbow Joint Powered by a De-Based Artificial Skeletal Muscle."* **Behboodi** A, DeSantis C, Lubsen J, Lee SCK.
- IEEE Engineering in Medicine and Biology Society (EMBC), 2015 "*Seven Phases of Gait Detected in Real-Time Using Shank Attached Gyroscopes*." **Behboodi** A, Wright H, Zahradka N, Lee SCK.
- Iranian Conference on Electrical Engineering, 2012. "*Implementation of DSP Based FES-Cycling System with Control of Crank velocity*." **Behboodi** A, Erfanian A.

**Poster Presentations (Abstract)**

- International Conference on Mobile Brain/Body Imaging (MoBI), 2022. "*Motor Attempt or Motor Imagery? The Effect of Brain-State on Functional Outcomes of Brain Computer Interface (BCI)-Mediated Neurofeedback Training for Stroke: A Scoping Review."* **Behboodi** A, Lee W, Hinchberger T, Damiano D.
- International Conference on Mobile Brain/Body Imaging (MoBI), 2022. *"BCI-Neurofeedback Training for Neurorehabilitation: a scoping review to identify optimal strategies for promotion or recovery of motor function."* **Behboodi** A, Lee W, Hinchberger T, Damiano DL.
- IEEE International Conference on Rehabilitation Robotics (ICORR), 2019. *"Benchmarking of a Commercially Available Stacked Dielectric Elastomer as an Alternative Actuator for Rehabilitation Robotic Exoskeletons."* **Behboodi** A, Lee SCK.
- International Cerebral Palsy Conference, 2016. *"Real-time Detection of 7 Phases of Gait in Children with CP Using Minimized Sensor Setup."* **Behboodi** A, Wright H, Zahradka N, Lee SCK.
- Gait and Clinical Movement Analysis Society Annual Conference (GCMAS), 2014. *"A Combined IMU and FSR System for Detecting 7 Phases of Gait in Real-Time."* **Behboodi** A, Zahradka N, Lenoir K, Marion MS, Wright H, Zarkou A, Torres M, Sazonov E, Lee SCK.

**Other Abstracts**

- The European Academy of Childhood Disability (EACD), 2024. *"EEG-based BCI-Neurofeedback Training to Improve Selective Motor Control in Cerebral Palsy."* Damiano D, **Behboodi** A, Kline J, Gravunder A, Parker S.
- International Mobile Brain/Body Interaction Conference (MoBI), 2024. *"Motor Attempt Neurofeedback Training Induces Spectral Power Alterations in the Motor Areas of Children with Cerebral Palsy."* Kline J, **Behboodi** A, Parker S, Damiano D.
- International Mobile Brain/Body Interaction Conference (MoBI), 2022. *"Investigation of Independent Component Analysis for use in Brain-Computer Interface Neurofeedback Paradigms for Motor Rehabilitation."* Lee W, **Behboodi** A, Bulea T, Damiano D.
- European Academy if Childhood Disabilty (EACD), 2022. *"Scoping review on neurofeedback training strategies most strongly associated with improved motor function for pediatric neurorehabilitation applications"* **Behboodi** A, Lee W, Hinchberger T, Damiano D.
- American Physical Therapy Association's Combined Sections Meeting (CSM), 2022. *"Absent Acute Kinematic Improvements of FES-Assisted Walking Are Not Indicative of Training Effects with FES."* Sansare A, **Behboodi** A, Zahradka N, Lee SCK.
- Combined Sections Meeting (CSM), 2021. *"Aerobic Response to FES-Assisted and Volitional Cycling in Children with Cerebral Palsy"*. Sansare A, **Behboodi** A, Jain A, Harrington AT, Lee SCK.
- American Academy of Cerebral Palsy and Developmental Medicine (AACPDM), 2020. "A Comparison of Cycling Smoothness, Rhythm And Cadence In Children With And Without Cerebral Palsy" Sansare A, **Behboodi** A, Alesi JF, Lee SCK.
- American Academy of Cerebral Palsy and Developmental Medicine (AACPDM), 2020. "Stochastic Resonance Stimulation Improves Control Of Balance During Walking In Children With Cerebral Palsy: A Pilot Study." Sansare A, Reimann H, **Behboodi** A, Lee SCK.
- Gait and Clinical Movement Analysis Society (GCAMS) Annual Conference, 2020. "A Comparison Of Kinematic-Based Foot Velocity, Shank Angular Velocity, Coordinate-Based

Treadmill Algorithms In Detecting Heel-Strike And Toe-Off Kinetic Force Plate Data Of Children With And Without Cerebral Palsy, And Unimpaired Adults" Verma K, **Behboodi** A, Zahradka N, Bodt B, Lee SCK.

- A Gait and Clinical Movement Analysis Society (GCMAS) Annual Conference, 2019. "Effects of FES-assisted Recumbent Cycling on Children with Cerebral Palsy." Sansare A, **Behboodi** A, Alesi JF, Wright H, Lee SCK.
- Center for Biomechanical Engineering Research Day, 2019. "Effects of FES-assisted Recumbent Cycling on Children with Cerebral Palsy." Sansare A, **Behboodi** A, Alesi JF, Wright H, Lee SCK.
- International Functional Electrical Stimulation Society Workshop, 2015. "A Gyroscope-Based Closed-Loop Feedback System for Delivery of Functional Electrical Stimulation During Walking." Zahradka N, **Behboodi** A, Wright H, Lee SCK.
- World Conference of Biomechanics, 2014. "A First Look at A Closed Loop IMU and FSR Based Feedback System for Delivery of Functional Electrical Stimulation During Walking." Zahradka N, **Behboodi** A, Lenoir K, Marion MS, Wright H, Zarkou A, Torres M, Sazonov E, Lee SCK.

**Invited Presentations**

- International Functional Electrical Stimulation Society (IFESS), 2024, "Brain-Computer Interface (BCI)-mediated Neurofeedback for Neurodiverse Children."
- National Institutes of Health (NIH) Rehabilitation Medicine Department Grand Rounds, 2021. "Neuroprosthetic and Neurotherapeutic effects of Neuromuscular Electrical Stimulation (NMES) on Children with Cerebral Palsy (CP)."
- University of Delaware Biomechanics and Movement Science Seminar Series, 2021. "The effects of Neuromuscular Electrical Stimulation (NMES) on Children with Cerebral Palsy (CP)."
- University Science Center Annual Investor Meeting, 2019. "Soft Ankle Foot Orthosis Powered by Artificial Muscle; DE-AFO."
- American Congress of Rehabilitation Medicine (ACRM) Annual Conference, 2019. "Soft Ankle Foot Orthosis Powered by Artificial Muscle; DE-AFO."
- American Academy of Cerebral Palsy and Developmental Medicine (AACPDM) Annual Meeting, 2019. "Real-Time Gait Phase Detection and Electrical Stimulation Delivery in Children with CP."
- ACCEL Annual Meeting, Spring, 2018. "Artificial Muscles for Mechanizing a Unilateral Pediatric Shoulder/Elbow Orthosis."
- ACCEL annual; meeting, Spring 2017. "Artificial Muscles for Mechanizing a Unilateral Pediatric Shoulder/Elbow Orthosis.

## PROFESSIONAL SERVICE

**Grant Reviews**

National Science Foundation (NSF), Panel:221605 - Phase I SBIR/STTR: Rehabilitation & General Medical Devices

**Review Editor**

- Frontiers in Computational Neuroscience

- Frontiers in Computational Neuroimaging

**Journal Reviews**

- Neurorehabilitation and Neural Repair, SAGE
- IEEE Transactions on Neural Systems and Rehabilitation Engineering
- International Journal of Environmental Research and Public Health (ISSN 1660-4601)
- Sensors, MDPI (ISSN 1424-8220)
- Machines, MDPI (ISSN 2075-1702)
- Symmetry, MDPI (ISSN 2073-8994)
- Frontiers in Human Neuroscience

## MENTORSHIP

**Graduate Students**

- **Sahlel Mohammadi (PhD),** 2023-present
  Project: Design and Evaluate a biomimetic ankle exoskeleton powered by artificial muscles, DE-AFO, with smart mediolateral support.
  GRACA award recipient.
- **Mobina Masaei Koroyeh (Master's),** 2024-present
  Project: Design of the 2nd generation DE-AFO with an improved range of motion
  GRACA award recipient.
- **Matthew Baysa (Master's),** 2024-present
  Project: Design and evaluation of a hand exoskeleton powered by artificial muscles
  GRACA award recipient.

**Undergraduates Students**

- **Jacob Lubsen,** 2018-2020, Mechanical Engineering
- **Cody DeSantis,** 2018-2019, Mechanical Engineering
- **Matthew Hardie,** 2018-2020, Mechanical Engineering
- **Calvin Duong,** 2018-2019, Electrical Engineering

**Trainees**

**Amanrai Kahlon,** 2021-2023: Rai collected and analyzed adolescent gait to find the optimal kinematic signals for machine learning algorithms under my mentorship during his senior year in high school. As the results of this project:

- He published a journal article as the first author in Sensors (see the publication section).
- His research was also presented at 2024 SPIE Photonics West conference in San Francisco.
- Honored as a Regeneron Top 40 Scholar nationally in their Science Talent Search.
- Won the regional BioGENEius Excellence in Medical BioTech Research award.
- Won 1st place in the Medicine & Health category at the Delaware Valley Regional Science Fair

**Arjan Kahlon,** 2019-2023: Arjan designed a remote gait monitoring cell phone application under my mentorship during his senior year in high school. As the results of this project:

- He published a journal article as the first author in Sensors (see the publication section).
- His research was also presented at 2022 SPIE Photonics West conference in San Francisco.

- Won 3rd place at Delaware Valley Science Fair (DVSF), and Leon Reznik Memorial Award.
- Won 1st place at BioGENEius statewide competition.
- Become BioGENEius International Finalist (1 of 14 worldwide).
- Honored as a Regeneron Top 300 Scholar in their Science Talent Search.

Arjan is currently a pre-med freshman at the University of Pennsylvania.

**University of Delaware Senior Design 2021:** Mentored a team of four senior Biomedical Engineering students (three females)**.** Project title: *Detection and Visualization of Gait Events*.

**University of Delaware Senior Design 2020:** Mentored a team of five Biomedical Engineers, senior Biomedical Engineering students with diverse ethnic backgrounds. Project title: *DE-AFO Enhancements*.

## OTHER ACCOMPLISHED PROJECTS and TECHNICAL SKILLS

2022 Investigated the classification accuracy of **Recurrent Neural Network** in prediction of ankle dorsiflexion attempt using **MATLAB Deep Learning toolbox**.

2021 Investigated the classification accuracy of Multi-Layer Perceptron **Neural Network** in predicting ankle dorsiflexion attempt classification and the effect of spatial filtering (e.g., Laplacian and Independent Component Analysis) using **PyTorch** framework.

2021 Investigated the effect of spatial filtering, including independent component analysis (**ICA**), Laplacian and common average referencing (CAR), event related potentials in EEG activation, using **EEGLab** toolbox in **MATLAB**.

2020 Investigated the feasibility and benefits of real-time independent component analysis (ICA) for EEG-based brain computer interface (BCI) applications, in **MATLAB**.

2021 Nonlinear analysis of gait in children with CP using Sample Entropy, Approximate Entropy and Lyapunov Exponent algorithms, in **MATLAB**.

2019 Proposed and evaluated a measure, based on cross correlation, to quantify cycling smoothness in children with CP, in **MATLAB**

2019 Quantified lower extremity muscles' co-contraction in children with, CP, using **EMG**, in **MATLAB**.

2018 Designed a **LabVIEW**-based test-rig, with ability to stream in laser displacement sensor, load cells, and control high voltage amplifiers. I used the test-rig for benchmark testing the mechanical properties of the CTsystems' stacked **dielectric elastomer actuator**, including strain, stress, strain-rate, reliability, electromechanical delay, hysteresis.

2017 Implemented **PID** algorithms in National Instruments (NI) **CompactRIO**-based testing setup, using **LabVIEW** real-time, for a civil engineering project with the capability to control velocity and torque of two stepper motors, simultaneously, while reading pressure, load, and torque sensors in real-time.

2015 Designed and implemented a rule-based real-time gait phase detection system for children with CP using a shank attached inertial measurement unit (**IMU**), in **LabVIEW**.

## WORKSHOP

2024 Training in Grantsmanship for Rehabilitation Research (TIGRR)

2021 UC San Diego 2021 virtual EEGLAB workshop

2021 NIH Office of Intramural Training and Education (OITE) Management Boot Camp

2020 Center for Translation of Rehabilitation Engineering Advances and Technology (TREAT) Commercialization Advancement Cohort.

2019 NSF I-Corps Spring Cohort, Boston. “I-Corps enables the transformation of invention to impact. The curriculum integrates scientific inquiry and industrial discovery in an inclusive, data-driven culture driven by rigor, relevance, and evidence. Through I-Corps training, researchers can reduce the time to translate a promising idea from the laboratory to the marketplace.”

2015 IEEE Engineering in Medicine and Biology Society (EMBC) Summer School on Advanced Biomedical Signal Processing, University of Pavia, Italy.