

CURRICULUM VITAE

Inseung Kang

inseung@mit.edu | inseungkang.github.io
43 Vassar St 2033A, Cambridge, MA, 02139

EDUCATION

Georgia Institute of Technology

Ph.D. in Mechanical Engineering Aug 2021

- Dissertation Title: Adaptive User State Estimation for Assisting Human Locomotion Using Powered Hip Exoskeletons
- Advisor: Aaron J. Young Ph.D.

M.S. in Mechanical Engineering May 2018

B.S. in Mechanical Engineering May 2016

ACADEMIC POSITION

Postdoctoral Associate

Motor Control Lab (PI: Dr. Nidhi Seethapathi) Jan 2022 - Current
Department of Brain and Cognitive Sciences
Massachusetts Institute of Technology

EMPLOYMENT AND EXPERIENCE

Graduate Research Assistant

School of Mechanical Engineering Aug 2018 – Aug 2021
Georgia Institute of Technology

Graduate Teaching Assistant

School of Mechanical Engineering Aug 2016 – Aug 2018
Georgia Institute of Technology

CAD/CAM Instructor

School of Biological Sciences Spring 2017, 2018
Georgia Institute of Technology

Research Assistant

Neuro-Robotic Rehabilitation Team | The Center for Bionics Summer 2017
Korea Institute of Science and Technology

PUBLICATIONS

Journal Articles (*indicates equal contribution)

- J11: **I. Kang**, R. Peterson, K. Herrin, A. Mazumdar, A. Young, Design and Validation of a Torque-Controllable Series Elastic Actuator-Based Hip Exoskeleton for Dynamic Locomotion, ASME Journal of Mechanisms and Robotics, June 2022

- J10: **I. Kang**, D. Molinaro, G. Choi, J. Camargo, A. Young, Subject-Independent Continuous Locomotion Mode Classification for Robotic Hip Exoskeleton Applications, IEEE Transactions on Biomedical Engineering, April 2022
- J9: D. Molinaro, **I. Kang**, J. Camargo, M. Gombolay, A. Young, Subject-Independent, Biological Hip Moment Estimation During Multimodal Overground Ambulation Using Deep Learning, IEEE Transactions on Medical Robotics and Bionics, January 2022
- J8: D. Lee, B. McLain, **I. Kang**, A. Young, Biomechanical Comparison of Assistance Strategies Using a Bilateral Robotic Knee Exoskeleton, IEEE Transactions on Biomedical Engineering, May 2021
- J7: **I. Kang**, D. Molinaro, S. Duggal, Y. Chen, P. Kunapuli, A. Young, Real-time gait phase estimation for robotic hip exoskeleton control during multimodal locomotion, IEEE Robotics and Automation Letters, February 2021
- J6: D. Lee, **I. Kang**, D. Molinaro, A. Yu, A. Young, Real-Time User-Independent Slope Prediction using Deep Learning for Modulation of Robotic Knee Exoskeleton Assistance, IEEE Robotics and Automation Letters, February 2021
- J5: SE. Lee, C. Kilpatrick, **I. Kang**, H. Hsu, W. Childers, A. Young, Investigating the Impact of the User Interface for a Powered Hip Orthosis on Metabolic Cost and User Comfort: A Preliminary Study, Journal of Prosthetics and Orthotics, June 2020
- J4: G. Sawicki, O. Beck, **I. Kang**, A. Young, The Exoskeleton Expansion: Improving Walking and Running Economy, Journal of NeuroEngineering and Rehabilitation, February 2020
- J3: D. Lee, EC. Kwak, B. McLain, **I. Kang**, A. Young, Biomechanical Effects of a Robotic Knee Exoskeleton during Incline and Decline Walking, IEEE Transactions on Neural Systems & Rehabilitation Engineering, February 2020
- J2: **I. Kang***, P. Kunapuli*, A. Young, Real-Time Neural Network-based Gait Phase Estimation using a Robotic Hip Exoskeleton, IEEE Transactions on Medical Robotics and Bionics, December 2019
- J1: **I. Kang**, H. Hsu, A. Young, The Effect of Hip Assistance Levels on Human Energetic Cost Using Robotic Hip Exoskeletons, IEEE Robotics and Automations Letters, April 2019

Refereed Conference Proceedings

- C10: H. Cho, **I. Kang**, D. Park, D. Molinaro, A. Young, Real-Time Walk Detection for Robotic Hip Exoskeleton Applications, IEEE International Symposium on Medical Robotics, April 2022
- C9: H. Jin, **I. Kang**, G. Choi, D. Molinaro, A. Young, Wearable Sensor-Based Step Length Estimation During Overground Locomotion Using a Deep Convolutional Neural Network, IEEE International Conference of the Engineering in Medicine and Biology Society (EMBC), October 2021
- C8: G. Choi, D. Lee, **I. Kang**, A. Young, Effect of Assistance Timing in Knee Extensor Muscle Activation During Sit-To-Stand Using a Bilateral Robotic Knee Exoskeleton, IEEE International Conference of the Engineering in Medicine and Biology Society (EMBC), October 2021

- C7: **I. Kang**, D. Molinaro, G. Choi, A. Young, Continuous locomotion mode classification using a powered bilateral hip exoskeleton, IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob), June 2020
- C6: D. Molinaro, **I. Kang**, J. Camargo, A. Young, Biological Hip Torque Estimation using a Robotic Hip Exoskeleton, IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob), June 2020
- C5: **I. Kang**, P. Kunapuli, H. Hsu, A. Young, Electromyography (EMG) Signal Contributions in Speed and Slope Estimation Using Robotic Exoskeletons, IEEE International Conference on Rehabilitation Robotics (ICORR), June 2019
- C4: H. Zheng, T. Shen, R. Afsar, **I. Kang**, A. Young, X. Shen A Semi-Wearable Robotic Device for Sit-to-Stand Assistance, IEEE International Conference on Rehabilitation Robotics (ICORR), June 2019
- C3: **I. Kang**, H. Hsu, A. Young, Design and Validation of a Torque Controllable Hip Exoskeleton for Walking Assistance, ASME Dynamic Systems and Control Conference, October 2018
- C2: H. Hsu, **I. Kang**, A. Young, Design and Evaluation of a Proportional Myoelectric Controller for Hip Exoskeleton During Normal Walking, ASME Dynamic Systems and Control Conference, October 2018
- C1: S. Kim, X. Chen, G. Dreifus, J. Lindahl, **I. Kang**, A. Kim, M. Selim, D. Nuttal, A. Messing, A. Nycz, R. Minneci, J. Bowers, B. Braswell, A. Hassan, B. Pipes, V. Kunc, An Integrated Design Approach for Infill Patterning of Fused Deposition Modeling and its Application to an Airfoil, SAMPE Conference, February 2017

Conference Abstracts

- A5: **I. Kang**, N. Seethapathi, Mapping step-to-step exploration and energetic cost to comprehend human locomotor adaptation, Annual Meeting of the Neural Control of Movement, July 2022
- A4: **I. Kang**, D. Molinaro, G. Choi, A. Young, A biomechanical analysis of adaptive assistance strategy for uphill walking using a powered hip exoskeleton, American Society of Biomechanics Annual Conference, August 2020
- A3: D. Molinaro, **I. Kang**, J. Camargo, A. Young, Estimating biological hip torque during overground ambulation: A machine learning approach, American Society of Biomechanics Annual Conference, August 2020
- A2: Y. Pan, **I. Kang**, K. Herrin, A. Young, The Biomechanical Effect of Bilateral Assistance for Hemiparetic Gait Poststroke Using a Powered Hip Exoskeleton, American Society of Biomechanics Annual Conference, August 2020
- A1: C. Kilpatrick, SE. Lee, **I. Kang**, H. Hsu, L. Childers, A. Young, The Impact of Hip Exoskeleton User Interface on User Comfort and Metabolic Cost: A Pilot Study, American Academy of Orthotists & Prosthetists Conference, March 2019

Under Review

- J1: **I. Kang***, Y. Pan*, J. Joh, P. Kim, K. Herrin, A. Young, Effects of Bilateral Assistance for Hemiparetic Gait Post-Stroke Using a Powered Hip Exoskeleton, Annals of Biomedical Engineering

PRESENTATION
Invited Seminar Talk

- T6: AI-driven robotic exoskeletons to augment humans for improved mobility during community ambulation, Drexel University Department of Mechanical Engineering and Mechanics, May 2022
- T5: Improving human locomotion using machine learning-based control of robotic hip exoskeletons, The Ohio State University Bioengineering Seminar, February 2022
- T4: Improving Human Locomotion Using a User State Adaptive Control of a Robotic Hip Exoskeleton, Yonsei University College of Medicine, January 2021
- T3: Robotic Exoskeleton for Improving Human Locomotion, NAVER LABS, December 2020
- T2: User State Adaptive Control of a Robotic Hip Exoskeleton to Improve Human Locomotion During Community Ambulation, Samsung Electronics, December 2020
- T1: User State Adaptive Assistance Strategy to Enhance Human Locomotion Using a Robotic Hip Exoskeleton, Georgia Tech IRIM RoboGrads Student Virtual Seminar Session, August 2020

Conference Talk

- T6: Inverting locomotor learning algorithms from data, Dynamic Walking Conference, June 2022
- T5: Real-time gait phase estimation for robotic hip exoskeleton control during multimodal locomotion, IEEE International Conference on Robotics and Automation, May 2021
- T4: Continuous locomotion mode classification using a powered bilateral hip exoskeleton, IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob), December 2020
- T3: Electromyography (EMG) Signal Contributions in Speed and Slope Estimation Using Robotic Exoskeletons, IEEE International Conference on Rehabilitation Robotics (ICORR), June 2019
- T2: Design and Validation of a Torque Controllable Hip Exoskeleton for Walking Assistance, ASME Dynamic Systems and Control Conference, October 2018
- T1: Effects of Assistance Levels on Energetic Savings Using a Robotic Hip Exoskeleton, Dynamic Walking Conference, May 2018

Poster Presentation

- P9: **I. Kang**, N. Seethapathi, Mapping step-to-step exploration and energetic cost to comprehend human locomotor adaptation, Society for the Neural Control of Movement, July 2022
- P8: D. Molinaro, **I. Kang**, A. Young, CNN-Based Hip Moment Estimates for Hip Exoskeleton Control, IEEE International Conference on Robotics and Automation, May 2022
- P7: B. McLain, D. Lee, **I. Kang**, A. Young, EMG-informed neuromusculoskeletal model for knee joint load estimation with a powered knee exoskeleton during inclined walking, American Society of Biomechanics Annual Conference, August 2020
- P6: A. Groff, S. Thai, **I. Kang**, H. Hsu, A. Young, Control Strategies of a Powered Assist Hip Exoskeleton in Subject with Stroke, American Academy of Orthotists & Prosthetists Conference, March 2019
- P5: **I. Kang**, A. Young, Understanding the Optimal Assistance Levels for Human Augmentation Using Robotic Hip Exoskeletons, The Career, Research, and Innovation Development Conference, February 2019
- P4: P. Kunapuli, **I. Kang**, A. Young, Neural Network Based Estimation of Gait Phase in a Powered Hip Exoskeleton, Biomedical Engineering Society Conference, October 2018
- P3: E.C. Kwak, D. Lee, **I. Kang**, A. Young, The Effect of Powered Assistance on Uphill Human Walking Using a Robotic Knee Exoskeleton, Biomedical Engineering Society Conference, October 2018
- P2: C. Kilpatrick, S.E. Lee, **I. Kang**, H. Hsu, L. Childers, A. Young, Investigating the Impact of Hip Exoskeleton User Interface on User Comfort and Metabolic Cost, American Academy of Orthotists & Prosthetists Conference, February 2018
- P1: **I. Kang**, H. Hsu, D. Lee, A. Young, Robotic Human Augmentation using Exoskeleton Devices, NextFlex Workshop: Powering the Internet of Everything, November 2017

PROFESSIONAL WORKSHOPS

- **I. Kang**, A. Young, M. Shepherd, D. Molinaro, G. Evangelopoulos, Online Machine Learning-based Control of Lower-Limb Exoskeletons, IEEE International Conference on Robotics and Automation, May 2022 (correspondence and main lead)

PATENTS

- U.S. Patent PCT/US21/40068: “Powered Bilateral Knee Exoskeleton” – Filed July 1, 2021
- U.S. Invention Disclosure: “Specialized AI systems for improving capability of wearable robotic systems” – Provisional Patent filed May 6, 2022

CONTRIBUTED RESEARCH FUNDING

- National Institute of Health: R03 New Investigator Award Apr 2019

- Title: Improving Community Ambulation for Stroke Survivors using Powered Hip Exoskeletons with Adaptive Environmental Controllers
- National Science Foundation: National Robotics Initiative Award Aug 2018
 - Title: Robotic Human Enhancement Enabled through Wearable Hip Exoskeletons Capable of Community Ambulation

AWARDS AND HONORS

- VIP Mentor Award, Georgia Tech's Vertically Integrated Projects Program 2021
- Outstanding Capstone Research Award, P&O Research Symposium 2018
- Best Poster Award, AAOP Conference 2018
- Highest honor upon graduation for bachelor's degree 2016
- Georgia Tech Korean Student Association Scholarship 2015

OUTREACH PROGRAM

- National Robotics Week, Georgia Tech 2017 – 2021
- US-Japan Nakatani RIES Program, Georgia Tech 2019 - 2021

MENTORING

- Dongho Park, PhD ME, Georgia Tech Fall 2021
- Patrick Kim, PURA Program, Georgia Tech Summer 2021
- Gayeon Choi, PURA Program, Georgia Tech Spring 2021
- James Joh, PURA Program, Georgia Tech Spring 2021
- Reese Peterson, MSME, Georgia Tech 2020 - 2022
- Julian Park, MSME, Georgia Tech 2019 – 2021
- Henry Luk, MSME, Georgia Tech 2019 – 2020
- Srijan Duggal, PURA Program, Georgia Tech Fall 2020
- Emily Keller, NSF SURE Program, NCSU Summer 2019
- Dawit Lee, MSME, Georgia Tech 2017 – 2018
- Hsiang Hsu, MSME, Georgia Tech 2017 – 2019
- Michael Groff, MSCS, Georgia Tech 2019
- Bailey McLain, Petit Scholar Program, Georgia Tech 2019
- Michelle Myrick, Petit Scholar Program, Georgia Tech 2017
- Harnjoo Kim, PURA Program, Georgia Tech Spring 2019
- Pratik Kunapuli, PURA Program, Georgia Tech Summer 2018
- Joonho Seo, PURA Program, Georgia Tech Spring 2017
- Alice Zou, NSF SURE Program, Johns Hopkins University Summer 2017

PROFESSIONAL MEMBERSHIPS AND SERVICES

- Student Member, ASME 2013 – Present
- Student Member, IEEE 2018 – Present
- Member, Pi Tau Sigma 2014 – Present
- Reviewer, IEEE Robotics and Automation Letters 2019 – Present
- Reviewer, IEEE Transactions on Mechatronics 2018 – Present
- Reviewer, IEEE Transactions on Robotics 2018 – Present
- Reviewer, IEEE Transactions on Biomedical Engineering 2017 – Present
- Reviewer, IEEE Transactions on Medical Robotics and Bionics 2019 – Present
- Reviewer, IEEE Transactions on Neural Systems and Rehabilitation Engineering 2020 – Present
- Reviewer, Frontiers in Neurorobotics 2018 – Present
- Reviewer, Scientific Report 2021 – Present
- Reviewer, President’s Undergraduate Research Award, Georgia Tech 2017 – 2020
- Mentor, Petit Undergraduate Research Scholars Program 2017 – 2019
- Member, Korean Scientist and Engineers Association 2014 – Present
- Co-Chair, KSEA Ygnite (Young Generation Technical and Leadership Conference 2022