CURRICULUM VITAE

Inseung Kang
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ACADEMIC POSITION

Postdoctoral Associate
MIT Motor Control Lab (PI: Nidhi Seethapathi Ph.D.) Jan 2022 - Current
Department of Brain and Cognitive Sciences
Massachusetts Institute of Technology

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

EMPLOYMENT AND EXPERIENCE

Graduate Research Assistant Aug 2018 – Aug 2021
School of Mechanical Engineering
Georgia Institute of Technology

Graduate Teaching Assistant Aug 2016 – Aug 2018
School of Mechanical Engineering
Georgia Institute of Technology

CAD/CAM Instructor Spring 2017, 2018
School of Biological Sciences
Georgia Institute of Technology

Research Assistant Summer 2014
Neuro-Robotic Rehabilitation Team | The Center for Bionics
Korea Institute of Science and Technology

PUBLICATIONS

Journal Articles (*indicates equal contribution)

- J12: **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, August 2022

- 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, Effects of Assistance During Early Stance Phase Using a Robotic Knee Orthosis on Energetics, Muscle Activity, and Joint Mechanics 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 (ISMR), 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 (DSCC), 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 (DSCC), 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**, D. Molinaro, D. Park, D. Lee, P. Kunapuli, K. Herrin, A. Young, Online Adaptation Framework Enables Personalization of Exoskeleton Assistance During Neurologically Impaired Locomotion, Science Robotics

In Preparation

- J1: D. Molinaro, **I. Kang,** A. Young, Neural Network Estimates of Human Joint Moments Generalizes Hip Exoskeleton Control Across Modes and Reduces the Metabolic Cost of Walking, Science Robotics
- J2: R. Peterson, J. Leestma, **I. Kang**, A. Young, Offline Detection of Early and Late Slips While Walking in a Hip Exoskeleton, IEEE Transactions on Biomedical Engineering

PRESENTATION

Invited Seminar Talk

- T6: AI-driven robotic exoskeletons to augment humans for improved mobility during community ambulation, Department of Mechanical Engineering and Mechanics, Drexel University, 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, College of Medicine, Yonsei University, 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, IRIM RoboGrads Student Seminar Session, Georgia Tech, August 2020

Conference Podium 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 (ICRA), 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 (DSCC), October 2018
- T1: Effects of assistance levels on energetic savings using a robotic hip exoskeleton, Dynamic Walking Conference, May 2018

Conference 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 (ICRA), 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 (ASB), 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, Georgia Tech, 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 (BMES), October 2018
- P3: EC. 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 (BMES), October 2018
- P2: C. Kilpatrick, SE. 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

RESEARCH FUNDING

- Burroughs Wellcome Fund: Career Awards at the Scientific Interface (CASI) Sep 2022
    - Title: A Generalizable Exoskeleton Control Framework to Enhance Mobility
    - Currently under review

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
    - Lead PI: Aaron Young Ph.D.

- National Science Foundation: National Robotics Initiative Award Aug 2018
    - Title: Robotic Human Enhancement Enabled through Wearable Hip Exoskeletons Capable of Community Ambulation
    - Lead PI: Aaron Young Ph.D.

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

DIVERSITY EQUITY AND INCLUSION

- Diversity and Inclusion Badge Program (DIBP) Fall 2022
- Community of practice representative for the lab in the MIT BCS department 2022

OUTREACH PROGRAM

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

TEACHING

- Graduate Teaching Assistant 2016 - 2018
  - Creative Decision and Design (competition-based robot design course)
  - Several advising/mentoring teams were placed in the top 3 teams.
- Teaching Practicum Spring 2019
  - Senior Capstone Design
  - Advising team received the Best Overall Project Award

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 – 2021
- Student Member, IEEE 2018 – 2021
- Member, IEEE 2022 - 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, Frontiers in Neurorobotics 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, IEEE Access 2021 – 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