CURRICULUM VITAE Inseung Kang

inseung@mit.edu | inseungkang.github.io
43 Vassar St 3015, Cambridge, MA, 02139

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 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 2018
B.S. in Mechanical Engineering 2016

EMPLOYMENT AND RESEARCH EXPERIENCE

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

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

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

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

PUBLICATIONS

Journal Articles (*indicates equal contribution)

- J13: **I. Kang**, D. Molinaro, D. Park, D. Lee, P. Kunapuli, K. Herrin, and A. Young, Online adaptation framework enables personalization of exoskeleton assistance during neurologically impaired locomotion, *Science Robotics,* (Under Review)

- J12: **I. Kang***, Y. Pan*, J. Joh, P. Kim, K. Herrin, and 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, and 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, and 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, and 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**, and 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, and 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, and A. Young, Real-time user-independent slope prediction using deep learning for modulation of robotic knee exoskeleton assistance, *IEEE Robotics and Automation Letters*, March 2021

- J5: SE. Lee, C. Kilpatrick, **I. Kang**, H. Hsu, W. Childers, and 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**, and 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**, and 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*, and A. Young, Real-time neural network-based gait phase estimation using a robotic hip exoskeleton, *IEEE Transactions on Medical Robotics and Bionics*, April 2019

- J1: **I. Kang**, H. Hsu, and 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, and 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, and 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**, and 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, and A. Young, Continuous locomotion mode classification using a robotic hip exoskeleton, *IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob)*, November 2020

- C6: D. Molinaro, **I. Kang**, J. Camargo, and A. Young, Biological hip torque estimation using a robotic hip exoskeleton, *IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob)*, November 2020

- C5: **I. Kang**, P. Kunapuli, H. Hsu, and 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**, and 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, and 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**, and A. Young, Design and evaluation of a proportional myoelectric controller for hip exoskeletons during 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, and V. Kunc, An integrated design approach for infill patterning of fused deposition modeling and its application to an airfoil, *Society of Advanced Materials and Process Engineering (SAMPE) Conference*, February 2017

Conference Abstracts

- A5: **I. Kang** and 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, and A. Young, A biomechanical analysis of adaptive assistance strategy for uphill walking using a powered hip exoskeleton, *American Society of Biomechanics Annual Conference (ASB)*, August 2020

- A3: D. Molinaro, **I. Kang**, J. Camargo, and A. Young, Estimating biological hip torque during overground ambulation: a machine learning approach, *American Society of Biomechanics Annual Conference (ASB)*, August 2020

- A2: Y. Pan, **I. Kang**, K. Herrin, and A. Young, The biomechanical effect of bilateral assistance for hemiparetic gait poststroke using a powered hip exoskeleton, *American Society of Biomechanics Annual Conference (ASB)*, August 2020

- A1: C. Kilpatrick, SE. Lee, **I. Kang**, H. Hsu, L. Childers, and 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

In Preparation

- J1: **I. Kang** and N. Seethapathi, Dynamically mapping step-to-step exploration and energetic cost during locomotor adaptation

- J2: D. Molinaro, **I. Kang,** and A. Young, Neural network estimates of human joint moments generalizes hip exoskeleton control across modes and reduces the metabolic cost of walking

- J3: R. Peterson, J. Leestma, **I. Kang**, and A. Young, machine learning-based early and late slip detection using a robotic hip exoskeleton

- C1: D. Lee, **I. Kang**, G. Kogler, F. Hammond, and A. Young, User and environmental context adaptive knee exoskeleton assistance using electromyography

PRESENTATION

Invited Seminar Talk

- ST6: AI-driven robotic exoskeletons to augment humans for improved mobility during community ambulation, Department of Mechanical Engineering and Mechanics, Drexel University, May 2022

- ST5: Improving human locomotion using machine learning-based control of robotic hip exoskeletons, The Ohio State University Bioengineering Seminar, February 2022

- ST4: Improving human locomotion using a user state adaptive control of a robotic hip exoskeleton, College of Medicine, Yonsei University, January 2021

- ST3: Robotic exoskeleton for improving human locomotion, NAVER LABS, December 2020

- ST2: User state adaptive control of a robotic hip exoskeleton to improve human locomotion during community ambulation, Samsung Electronics, December 2020
- ST1: 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

- CT6: Inverting locomotor learning algorithms from data, *Dynamic Walking Conference*, June 2022
- CT5: Real-time gait phase estimation for robotic hip exoskeleton control during multimodal locomotion, *IEEE International Conference on Robotics and Automation (ICRA)*, May 2021
- CT4: Continuous locomotion mode classification using a powered bilateral hip exoskeleton, *IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob)*, December 2020
- CT3: Electromyography (EMG) signal contributions in speed and slope estimation using robotic exoskeletons, *IEEE International Conference on Rehabilitation Robotics (ICORR)*, June 2019
- CT2: Design and validation of a torque controllable hip exoskeleton for walking assistance, *ASME Dynamic Systems and Control Conference (DSCC)*, October 2018
- CT1: Effects of assistance levels on energetic savings using a robotic hip exoskeleton, *Dynamic Walking Conference*, May 2018

Conference Poster Presentation

- CP9: **I. Kang**, and N. Seethapathi, Mapping step-to-step exploration and energetic cost to comprehend human locomotor adaptation, *Society for the Neural Control of Movement*, July 2022
- CP8: D. Molinaro, **I. Kang**, and A. Young, CNN-based hip moment estimates for hip exoskeleton control, *IEEE International Conference on Robotics and Automation (ICRA)*, May 2022
- CP7: B. McLain, D. Lee, **I. Kang**, and 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
- CP6: A. Groff, S. Thai, **I. Kang**, H. Hsu, and A. Young, Control strategies of a powered assist hip exoskeleton in subject with stroke, *American Academy of Orthotists & Prosthetists Conference*, March 2019

- CP5: **I. Kang** and A. Young, Understanding the optimal assistance levels for human augmentation using robotic hip exoskeletons, *The Career, Research, and Innovation Development Conference at Georgia Tech*, February 2019

- CP4: P. Kunapuli, **I. Kang**, and A. Young, Neural network-based estimation of gait phase in a powered hip exoskeleton, *Biomedical Engineering Society Conference (BMES)*, October 2018

- CP3: EC. Kwak, D. Lee, **I. Kang**, and A. Young, The effect of powered assistance on uphill human walking using a robotic knee exoskeleton, *Biomedical Engineering Society Conference (BMES)*, October 2018

- CP2: C. Kilpatrick, SE. Lee, **I. Kang**, H. Hsu, L. Childers, and A. Young, Investigating the impact of hip exoskeleton user interface on user comfort and metabolic cost, *American Academy of Orthotists & Prosthetists Conference*, February 2018 – **Best Poster Award**

- CP1: **I. Kang**, H. Hsu, D. Lee, and A. Young, Robotic human augmentation using exoskeleton devices, *NextFlex Workshop: Powering the Internet of Everything*, November 2017

PROFESSIONAL WORKSHOP

- **I. Kang**, A. Young, M. Shepherd, D. Molinaro, and G. Evangelopoulos, Online machine learning-based control of lower-limb exoskeletons, *IEEE International Conference on Robotics and Automation (ICRA)*, 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 - Invited to submit a full proposal submission after the initial review (82 out of 201 eligible applicants selected)

CONTRIBUTED RESEARCH FUNDING

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

o   Title: Improving Community Ambulation for Stroke Survivors using
    Powered Hip Exoskeletons with Adaptive Environmental Controllers
o   Lead PI: Aaron Young Ph.D.

- National Science Foundation: National Robotics Initiative Award   Aug 2018
    o   Title: Robotic Human Enhancement Enabled through Wearable Hip
        Exoskeletons Capable of Community Ambulation
    o   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) Certificate   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
- Georgia Tech Robotics Summer Camp   Summer 2019

TEACHING

- Graduate Teaching Assistant   2016 - 2018
    o   Creative Decision and Design (competition-based robot design course)
    o   Several advising/mentoring teams were placed in the top 3 teams.
- Teaching Practicum   Spring 2019
    o   Senior Capstone Design
    o   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 SERVICE

- Reviewer
  - **Journal Article**: IEEE Robotics and Automation Letters, IEEE Transactions on Mechatronics, IEEE Transactions on Robotics, IEEE Access, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Medical Robotics and Bionics, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Scientific Report, Frontiers in Neurorobotics
  - **Conference Proceedings**: IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE International Conference on Rehabilitation Robotics (ICORR), IEEE International Conference on Biomedical Robotics and Mechatronics (BioRob), ASME Dynamic Systems and Control Conference (DSCC)
  - **Research Award**: President's Undergraduate Research Award at Georgia Tech
- Mentoring Program
  - Petit Undergraduate Research Scholars Program, Georgia Tech (2017 – 2019)
- Conference Organizing Committee
  - Co-Chair: Korean-American Scientists and Engineers Association (KSEA), Ygnite Conference (Young Generation Technical and Leadership Conference), 2022

PROFESSIONAL MEMBERSHIP

- Member, IEEE — 2022 - Present
- Student Member, ASME — 2013 – 2021
- Student Member, IEEE — 2018 – 2021
- Member, Pi Tau Sigma — 2014 – Present
- Member, Korean-American Scientists and Engineers Association — 2014 – Present