

JEONGHWAN ‘JAY’ LEE

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AREA OF RESEARCH

Biomechanics, Rehabilitation Engineering, Computational Musculoskeletal Modeling, Wearable Robotics, Data-driven Optimization with Machine Learning

EDUCATION

Ph.D. in Mechanical Engineering, University of Texas at Austin, TX 2022

Advisor: Dr. James Sulzer

Dissertation: Approaches in optimization and machine learning towards post-stroke gait

M.S. in Mechanical Engineering, Seoul National University, Seoul, South Korea 2017

Advisor: Dr. Kunwoo Lee

Thesis: Needle steering scheme within limited DOFs for MR-guided breast needle intervention robot

B.S. in Mechanical Engineering, Hanyang University, Seoul, South Korea 2013

CURRENT AFFILIATION

Massachusetts Institute of Technology (MIT)

Cambridge, MA

Postdoctoral Associate in Department of Brain and Cognitive Sciences

Apr 2025 – Present

- **Developing physics-informed, neuromechanics-grounded predictive simulation of human motion** by integrating modern generative AI with computational neuromechanics to advance understanding of human embodiment.
- **Collaborating interdisciplinary research projects:** i) data-driven functional and cognitive assessments of the cutaneous mechanouronal interface for neuroprostheses; ii) exploration of how humans and generative AI compress information into flexible, efficient representations in vision and language.

INDUSTRY EXPERIENCE

Contoro Robotics

Austin, TX

Senior Robotics Engineer – Perception

Sept 2022 – Mar 2025

- **Led the development of a ROS-integrated, multi-functional robot perception pipeline** with object detection, segmentation, 6D pose estimation, optical character recognition, and teleoperation feedback.
- **Designed a cloud-based human-in-the-loop segmentation and online data relabeling workflow** combining instance and zero-shot segmentation, achieving 2% operational failures and improving model robustness through continuous data annotation.
- **Established a decentralized machine learning model training pipeline** for customer-specific training, collaboratively enhancing a global model by 10% in performance and scalability.
- **Developed an automated, multi-step hand-eye calibration methodology** for a multi-camera setup (eye-in-hand, eye-to-hand, and stereo), achieving localization accuracy within 0.5% of working distance.
- **Led impactful technical demonstrations** that played a pivotal role in securing \$4.7 million in Seed and \$12 million in Series A funding.

Harmonic Bionics, Inc. (now Bioness Medical)

Austin, TX

System Validation Engineer Intern

May 2019– Aug 2019

- Developed C/C++ EtherCAT library and dual-motor haptic demo kits for exhibitions, demonstrating advanced motion control capabilities.

RESEARCH EXPERIENCE

The University of Texas at Austin

Austin, TX

Graduate Research Assistant

Sept 2017 – Aug 2022

- Led three **data-driven research initiatives** in human movement biomechanics to advance wearable robotics for post-stroke gait rehabilitation, culminating in four first-authored publications.
- Mentored two master's students in research on gait biomechanics related to cognitive decline and exoskeleton and published two co-authored publications.
- Managed the **end-to-end research process**: study conceptualization, securing funding, data collection/analysis (kinematics, kinetics, and EMG), interpretation, visualization, publication authorship, and presentation.
- Collaborated with a **multidisciplinary team** of neuroscientists, clinicians, and engineers to drive innovative solutions.

Korea Institute of Science and Technology (KIST)

Seoul, South Korea

Research Assistant

Mar 2017 – July 2017

- Devised a **non-invasive, patient-specific surgical tool navigation method** for orbital reconstructive surgery, achieving up to 50% improvement in registration and tool tracking accuracy using a 3D-printed phantom model.

Seoul National University

Seoul, South Korea

Graduate Research Assistant

Mar 2016 – Feb 2017

- Developed a **needle steering scheme** using pivoted super-elastic Nitinol for an MR-guided breast needle intervention robot, enhancing insertion angle control with a targeting error of less than 5mm.
- Designed a **vehicle door and driver's seat mockup** with ten adjustable parameters, enabling controlled ingress/egress experiments.

The University of Texas Health Science Center (UTHealth)

Houston, TX

Research Assistant

Sept 2014 – Feb 2016

- Prototyped and tested hysteresis of a 7-DOF dual-segmented cable-driven continuum robotic manipulator for single-port surgery using a motorized testbed.
- Contributed to transitioning a lab innovation into a commercial venture, supporting initial product development and establishing scalable engineering processes (now Endoquest Robotics).

TEACHING EXPERIENCE

The University of Texas at Austin

Austin, TX

Graduate Teaching Assistant, Mechanical Engineering

- ME 340 Mechatronics (Fall 2019)
- ME 140L Mechatronics Laboratory (Fall 2018, Spring 2019, Spring 2020)
- ME 397 Introduction to robot modeling and control (Spring 2021)

The University of Texas at Austin

Austin, TX

Graduate Student Mentor, Mechanical Engineering

- Mentored 10+ freshman students to develop a semester-long research project.

- Freshman Introduction to Research In Engineering (FIRE) Program (Fall 2018, Fall 2019)

PEER REVIEWED ARTICLES

Journal Publications

1. Lee, J., Seamon, B. A., Lee, R. K., Kautz, S. A., Neptune, R. R., & Sulzer, J. S. (2025). Post-stroke Stiff-Knee gait: are there different types or different severity levels?. *Journal of NeuroEngineering and Rehabilitation*, 22(1), 36.
2. Lee, J., Lee, R. K., Seamon, B. A., Kautz, S. A., Neptune, R. R., & Sulzer, J. (2024). Between-limb difference in peak knee flexion angle can identify persons post-stroke with Stiff-Knee gait. *Clinical Biomechanics*, 106351.
3. Lee, J., Akbas, T., & Sulzer, J. (2023). Hip and knee joint kinematics predict quadriceps hyperreflexia in people with post-stroke Stiff-Knee gait. *Annals of Biomedical Engineering*, 51(9), 1965-1974.
4. Normand, M. A., Lee, J., Su, H., & Sulzer, J. S. (2023). The effect of hip exoskeleton weight on kinematics, kinetics, and electromyography during human walking. *Journal of biomechanics*, 152, 111552.
5. Chiarello, M., Lee, J., Salinas, M. M., Hilsabeck, R. C., Lewis-Peacock, J., & Sulzer, J. (2022). The effect of biomechanical features on classification of dual-task gait. *IEEE sensors journal*, 23(3), 3079-3089.
6. Lee, J., Li, L., Shin, S. Y., Deshpande, A. D., & Sulzer, J. (2021). Kinematic comparison of single degree-of-freedom robotic gait trainers. *Mechanism and Machine Theory*, 159, 104258.
7. Park, S. M., Lee, J., Park, S., Lee, J. W., Park, M., Kim, Y., & Noh, G. (2020). Practical bending-angle calculation for an automated surgical plate bending apparatus. *Journal of Mechanical Science and Technology*, 34, 2101-2109.
8. Lee, J., Mekuria, K., Son, T. G., Jeong, W. S., Choi, J. W., & Kim, Y. (2019). A novel noninvasive patient-specific navigation method for orbital reconstructive surgery: A phantom study using patient data. *Plastic and Reconstructive Surgery*, 143(3), 602e-612e.
9. Kim, Y., Choi, E. S., Seo, J., Choi, W. S., Lee, J., & Lee, K. (2019). A novel approach to predicting human ingress motion using an artificial neural network. *Journal of biomechanics*, 84, 27-35.
10. Kim, H., Son, T. G., Lee, J., Kim, H. A., Cho, H., Jeong, W. S., ... & Kim, Y. (2019). Three-dimensional orbital wall modeling using paranasal sinus segmentation. *Journal of Cranio-Maxillofacial Surgery*, 47(6), 959-967.
11. Park, S., Lee, J., Park, S. M., Noh, G., Lee, J. W., Park, M. S., & Kim, Y. (2019). A novel motorized bending apparatus for surgical plates. *Journal of Mechanical Science and Technology*, 33, 3743-3748.

Conference Proceedings

12. Lee, J., Shin, S. Y., Ghorpade, G., Akbas, T., & Sulzer, J. (2019, June). Sensitivity comparison of inertial to optical motion capture during gait: implications for tracking recovery. In 2019 IEEE 16th international conference on rehabilitation robotics (ICORR) (pp. 139-144). IEEE.

CONFERENCE PRESENTATIONS

1. Lee, J., Shin, S. Y., Ghorpade, G., Akbas, T., & Sulzer, J., 2019, Sensitivity comparison of inertial to optical motion capture during gait: implications for tracking recovery. In 2019 IEEE 16th international conference on rehabilitation robotics (ICORR), Toronto, Canada, June 24–28.
2. Lee, J., Park, S.B., Lee, K., and Jo, Y.H., 2017. Computational Model to Steer Super Elastic Needle for an MRI Guided Breast Intervention Robot, Computer Assisted Radiology and Surgery Proceedings of the 31st International Congress and Exhibition, Barcelona, Spain, June 20-24.

GRANT PROPOSAL DEVELOPMENT

MIT HEALS Seed Grant

- Title: Data-driven functional and cognitive assessments of the Cutaneous Mechanorelational Interface (CMI)
- PIs: Dr. Nidhi Seethapathi and Dr. Hugh Herr
- Contribution: Co-led development of the end-to-end research plan and prepared the full draft.
- Awarded \$200K (Oct 1st, 2025 – Sept 30, 2026)

MIT Generative AI Impact Consortium

- Title: Neuromechanics-grounded imitation learning for predicting locomotor stability
- PI: Dr. Nidhi Seethapathi
- Contribution: Led development of the end-to-end research plan and prepared the full draft.
- Awarded \$100K (June 1, 2025 – May 31, 2026)

NIH R01 (R01HD100416)

- Title: Combining neurophysiology and biomechanics to delineate post-stroke gait impairments
- PI: Dr. James Sulzer
- Contribution: Supported preliminary data analysis and developing research plans.

REVIEW EXPERIENCE

Scientific Report

Journal of Biomechanics

Journal of Mechanism and Machine Theory

Journal of NeuroEngineering and Rehabilitation

Engineering Applications of Artificial Intelligence

IEEE Transactions on Neural Systems and Rehabilitation Engineering

SKILLS

Programming: Python, C/C++, C#, MATLAB, Bash/Shell

Statistics / ML Platform: SciPy, R, PyTorch, TensorFlow

DevOps / SysAdmin: Docker, Git, Linux/Unix

Robotics Middleware: Robot Operation System (ROS / ROS2)

Simulation Tools: MuJoCo, Isaac Gym/Lab, OpenSim, Simulink, Simscape, ROS Gazebo

Design Tools: SolidWorks, Eagle

PROFESSIONAL TRAINING AND CERTIFICATES

Data Science and Applied Machine Learning

May 2021

The University of Texas at Austin, Department of Statistics and Data Sciences

Scalable Machine Learning: Methods and Tools

May 2021

The University of Texas at Austin, Department of Statistics and Data Sciences

PATENTS

1. Kim, Y., **Lee, J.**, Park, S., Park, S.M., Cho, H., Kim, L., Noh, G., Lee, J.W., Lee, B.H., 2020. Automatic bending apparatus of plate for surgery, Republic of Korea (KR) Patent, No. 1021566940000.

HONORS AND AWARDS

Brain Korea 21 Plus , Seoul National University, Seoul, South Korea	2014
Merit-based Scholarship , Seoul National University, Seoul, South Korea	2014
Academic Scholarship , Hanyang University, Seoul, South Korea	2011

EXTRACURRICULAR SERVICES

Korean Student Association at UT Austin Graduate Student Representative	Austin, TX Sept 2020 – Aug 2021
8 th Fighter Wing, Republic of Korea Air Force Sergeant, Information and Communications Specialist	Wonju, South Korea Sept 2006 – Nov 2008

REFERENCES

James Sulzer

Associate Professor, Staff Scientist, Department of Physical Medicine and Rehabilitation,
MetroHealth Hospital / Case Western Reserve University

jss280@case.edu

Richard Neptune

Professor, Walker Department of Mechanical Engineering,
The University of Texas at Austin

rneptune@mail.utexas.edu

Steven Kautz

Professor, Department of Health Sciences and Research,
Medical University of South Carolina

kautz@musc.edu

Nidhi Seethapathi

Assistant Professor, Brain & Cognitive Sciences and Electrical Engineering and Computer Science,
Massachusetts Institute of Technology

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