JEONGHWAN 'JAY' LEE

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RESEARCH INTERESTS

Biomechanics, Wearable Robotics, Rehabilitation Engineering, Human Motor Control

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 2024 – Present
PI: Dr. Nidhi Seethapathi
- **Direct research in physics-informed imitation learning** to develop a neuromechanics-grounded behavioral model capable of forecasting age-related neuromuscular deterioration affecting human locomotion stability.
- **Led the development and writing of a successful grant proposal,** securing $100K in funding from the MIT Generative AI Impact Consortium for 2025–2026.

WORK EXPERIENCE

Contoro Robotics   Austin, TX
Senior Robotics Engineer – Perception   Sept 2022 – Mar 2024
- **Led the development of a ROS-integrated, multi-functional robot perception pipeline** with object detection, image segmentation, 6D pose estimation, optical character recognition, and teleoperation feedback, enhancing reliability and flexibility in real-world use.
- **Designed a cloud-based human-in-the-loop segmentation and online data re-labeling 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 design, resulting in 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 Generative AI Impact Consortium
- (Accepted) Neuromechanics-grounded Imitation Learning for Predicting Locomotor Stability
- Secured $100K for 2025-2026
- PI: Nidhi Seethapathi

MIT HEALS Seed Grant
- (Under review) A Foundation Model for Understanding, Monitoring and Predicting Age-related Human Stability during Transitions
- PIs: Nidhi Seethapathi, Neville Hogan

REVIEW EXPERIENCE

Scientific Report
Journal of Biomechanics
Journal of Mechanism and Machine Theory
Journal of NeuroEngineering and Rehabilitation
Engineering Applications of Artificial Intelligence
International Conference on Rehabilitation Robotics

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, OpenSim, ROS Gazebo, Simulink, Simscape
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 the University of Texas at Austin Austin, TX
Graduate Student Representative Sept 2020 – Aug 2021

8th Fighter Wing, Republic of Korea Air Force   Wonju, South Korea
Sergeant, Information and Communications Specialist   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

Hao Su
Associate Professor, Department of Mechanical and Aerospace Engineering,
The North Carolina State University
hsu4@ncsu.edu

Steven Kautz
Professor, Department of Health Sciences and Research,
Medical University of South Carolina
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Nidhi Seethapathi
Assistant Professor, Brain & Cognitive Sciences and Electrical Engineering and Computer Science,
Massachusetts Institute of Technology
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