

# JEONGHWAN ‘JAY’ LEE

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## EDUCATION

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<b>Ph.D. in Mechanical Engineering</b> , University of Texas at Austin, TX	2022
<b>M.S. in Mechanical Engineering</b> , Seoul National University, Seoul, South Korea	2017
<b>B.S. in Mechanical Engineering</b> , Hanyang University, Seoul, South Korea	2013

## KEY STRENGTHS

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### Biomechanics and Wearable Sensing for Rehabilitation Engineering:

Human Subject Research Design, Biomechanics of Human Movement, Signal Processing, Musculoskeletal Modeling/Simulation, Statistical analysis, Data visualization

### Robotics:

Mechanical Design Optimization, Computer Vision, Machine Learning, Sensor Integration

	Proficient	Moderate
Programming Languages	Python, C/C++, MATLAB	C#, CSS, SQL
Robotics Middleware	Robot Operation System (ROS / ROS2)	
ML Frameworks / Statistics	SciPy, R, PyTorch	TensorFlow
Simulation Frameworks	OpenSim, Gazebo	MATLAB Simulink
Design Tools	SolidWorks	Eagle
Software Platforms	Docker	

## PROFESSIONAL EXPERIENCE

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### Robotics Engineering - Perception

Sept 2022 – Present

Contoro Robotics, Austin, TX

- Led the development of a robot perception pipeline for environmental perception, navigation, teleoperation, and 6D pose extraction from objects, achieving accuracy within 2% based on working distance.
- Developed a human-in-the-loop segmentation workflow by incorporating instance and zero-shot segmentation, significantly reducing failure rates.
- Built a comprehensive shipping label scanning workflow, integrating barcode scanning and optical character recognition using open-source object detection and the Google Vision API.

### Graduate Research Assistant

Aug 2017 – Aug 2022

University of Texas at Austin, Austin, TX

- Characterized post-stroke gait subtypes using time-series kernel k-means clustering on gait data.
- Identified kinematic predictors for post-stroke quadriceps spasticity for wearable exoskeleton control using machine learning regression techniques.
- Examined the biomechanical effects of exoskeleton weight distributions on gait to determine optimal design parameters for lower extremity robotic exoskeletons.
- Assessed the impact of kinematic and kinetic gait features on supervised machine learning classifications of dual-task gait.

- Optimized an affordable single-DOF linkage mechanism for human-like end-effector motion using a numerical optimization solver and a large gait database (100+ subjects).
- Verified IMU-based motion capture systems' capability to track small gait kinematic changes by comparing them to an optical motion capture system.

### **System Validation Engineer Intern**

May 2018 – Aug 2018; May 2019 – Aug 2019

Harmonic Bionics, Inc., Austin, TX

- Developed a C/C++ library and tutorial applications for EtherCAT motion controllers and sensor interfaces.
- Built haptic interface demo kits with dual motors for a technical conference exhibition.

### **Research Assistant**

Mar 2017 – July 2017

Korea Institute of Science and Technology (KIST), Seoul, South Korea

- Tested a non-invasive, patient-specific surgical tool navigation method for orbital reconstructive surgery, improving registration and tool tracking accuracy by up to 50% using a 3D-printed phantom model.

### **Graduate Research Assistant**

Sept 2013 – Aug 2014 / Mar 2016 – Feb 2017

Seoul National University, Seoul, South Korea

- Developed a needle steering scheme with pivoted super-elastic Nitinol for an MR-guided breast needle intervention robot, improving insertion angle and tip movement.
- Designed a vehicle door and driver's seat mockup with ten adjustable parameters for ingress/egress experiments.
- Researched 2D/3D image registration for robot-assisted total knee replacement surgery.

### **Research Assistant**

Sept 2014 – Feb 2016

The University of Texas Health Science Center (UTHealth), Houston, TX

- Contributed to spinning off a new venture from a laboratory setup, developing the initial product and establishing scalable engineering processes (now Endoquest Robotics).
- Prototyped and tested hysteresis of a 7-DOF dual-segmented cable-driven continuum robotic manipulator for single-port surgery using a motorized testbed.

## **TEACHING EXPERIENCE**

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### **Graduate Teaching Assistant, Mechanical Engineering**

The University of Texas at Austin, Austin, TX

- Coordinated quizzes, exams, projects, grading and labs.
  - ME 397 Introduction to robot modeling and control Spring 2021
  - ME 140L Mechatronics Laboratory Fall 2018; Spring 2019; Spring 2020
  - ME 340 Mechatronics Fall 2019

### **Graduate Student Mentor, Mechanical Engineering**

The University of Texas at Austin, Austin, TX

- 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

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### *In review / In preparation*

1. **Lee, J.**, Seamon, A. Bryant., Lee, K. Robert., Kautz, A. Steven., Neptune, R. Richard., & Sulzer, J. S. (2024), Post-Stroke Stiff-Knee Gait: Are there different types or different severity levels? (in preparation)
2. **Lee, J.**, Lee, K. Robert., Seamon, A. Bryant., Kautz, A. Steven., Neptune, R. Richard., & Sulzer, J. S. (2024), Between-limb difference in peak knee flexion angle can identify persons post-stroke with Stiff-Knee gait. *Clinical Biomechanics* (in review)

### *Journal Publications*

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

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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.
3. Woo, S., **Lee, J.**, Kim, Y., and Lee, K., 2016. Efficient registration methods between 2D X-ray and 3D CT data of different parts of human skeleton, Asian Conference on Design and Digital Engineering (ACDDE2016), Jeju, South Korea, Oct 26-28.

## PATENTS

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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.

## PROFESSIONAL TRAINING AND CERTIFICATES

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**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

## TECHNICAL SKILLS

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	<b>Proficient</b>	<b>Moderate</b>
<b>Programming Languages</b>	Python, C/C++, MATLAB	C#, CSS, SQL
<b>Robotics Middleware</b>	Robot Operation System (ROS / ROS2)	
<b>ML Frameworks / Statistics</b>	SciPy, R, PyTorch	TensorFlow
<b>Simulation Frameworks</b>	OpenSim, Gazebo	MATLAB Simulink
<b>Design Tools</b>	SolidWorks	Eagle
<b>Software Platforms</b>	Docker	

## HONORS AND AWARDS

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**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

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**Graduate Student Representative** Sept 2020 – Aug 2021  
Korean Student Association at the University of Texas at Austin Austin, TX

**Sergeant, Office Administrator** Sept 2006 – Nov 2008  
8<sup>th</sup> Fighter Wing, Republic of Korea Air Force Wonju, South Korea

## REFERENCES

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### **James Sulzer**

Associate Professor, Staff Scientist, Department of Physical Medicine and Rehabilitation,  
MetroHealth Hospital / Case Western Reserve University  
[jss280@case.edu](mailto:jss280@case.edu)

### **Ashish Deshpande**

Professor, Walker Department of Mechanical Engineering,  
The University of Texas at Austin  
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### **Richard Neptune**

Professor, Walker Department of Mechanical Engineering,  
The University of Texas at Austin  
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### **Hao Su**

Associate Professor, Department of Mechanical and Aerospace Engineering,  
The North Carolina State University  
[hsu4@ncsu.edu](mailto:hsu4@ncsu.edu)

### **Steven Kautz**

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