

Hun Chan (Bryan) Lee

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RESEARCH INTEREST

- Design, integration, and fabrication of soft actuators and sensors for advanced soft robotic systems.
- System modeling and control for soft robotic systems
- Development of soft robotic technologies for laser-assisted surgical applications.

EDUCATION

Boston University

Ph.D. Candidate, Mechanical Engineering

Advisor: Prof. Sheila Russo

Boston, MA

Sept. 2021 ~ Present

Purdue University

Master of Science, Mechanical Engineering

Advisor: Prof. Raymond Cipra

West Lafayette, IN

Aug. 2016 ~ Aug. 2018

GPA: 3.81 / 4.00

Purdue University

Bachelor of Science, Mechanical Engineering

(Highest Distinction)

West Lafayette, IN

Aug. 2012 ~ May. 2016

GPA: 3.96 / 4.00

RESEARCH EXPERIENCE

Material Robotics Lab, Boston University

Advisor: Prof. Sheila Russo

Sept. 2021 – Present

- Developed and optimized a monolithic layer-by-layer fabrication process for soft-rigid hybrid robots, achieving seamless integration of a soft actuator, an ionic resistive sensor, and a rigid-flexible mechanical controllers. [P1]
- Designed and prototyped an innovative Miura-ori pattern-inspired soft retractor with capacitive sensor for neurosurgical applications, enhancing precision and adaptability in surgical procedures. [C1, C2]
- Leading the development of an autonomous soft-rigid hybrid robotic system for laser-assisted surgery, incorporating optical proprioceptive sensors interpreted using machine learning. [Work in process]

Cipra Lab, Purdue University

Advisor: Prof. Raymond Cipra

Aug. 2016 – Aug. 2018

- Developed and optimized the design of a 3-D printed prosthetic hand with compliant joints [P5]
- Utilized advanced image processing techniques to analyze the motion of the prosthetic hand [P5]

Vlachos Research Group, Purdue University

Advisor: Prof. Pavlos Vlachos

Jan. 2015 – May. 2016

- Constructed and optimized a realistic circulation loop and compliance chamber model, accurately replicating the intricate blood flow patterns in cerebral aneurysms

WORK EXPERIENCE

IntheSmart Co., Ltd.

Research and Design Team Member

Seoul, South Korea

Aug. 2018 – Aug. 2021

- Developed and implemented over 20 experimental protocols and designed electro-mechanical testing instruments to improve the functionality of fluorescence laparoscopy systems which integrates RGB and NIR imaging.
- Led the research and development of an upgraded hardware version for the Laser Speckle Contrast Imaging (LSCI) system, culminating in the successful acquisition of the Korean Good Manufacturing Practice (K-GMP) certification. [P1, J4]
- Designed and implemented a machine learning algorithm to optimize the performance of the Laser Speckle Contrast Imaging (LSCI) system, enhancing parathyroid gland identification rate and feasibility diagnostic accuracy. [J3, J4]
- Shadowed over 150 preclinical and clinical trial cases across various general surgery divisions to gather and incorporate clinician feedback to refine surgical imaging systems

PUBLICATIONS (J: Journal Article, C: Conference Proceeding, P: Patent, *Equally Contributed)

JOURNAL ARTICLES

J1. Lee, H.C., Elder, N., Leal, M., Stantial, S., Vergara Martinez, E., Jos, S., Cho, H. and Russo, S., 2024. A fabrication strategy for millimeter-scale, self-sensing soft-rigid hybrid robots. *Nature Communications*, 15(1), p.8456.

- J2. Lee, H.C., Pacheco, N.E., Fichera, L. and Russo, S., 2022.** When the end effector is a laser: A review of robotics in laser surgery. *Advanced Intelligent Systems*, 4(10), p.2200130.
- J3. Kim, Y., Lee*, H.C., Kim*, J., Oh*, E., Yoo, J., Ning, B., Lee, S.Y., Ali, K.M., Tufano, R.P., Russell, J.O. and Cha, J., 2022.** A coaxial excitation, dual-red-green-blue/near-infrared paired imaging system toward computer-aided detection of parathyroid glands in situ and ex vivo. *Journal of biophotonics*, 15(8), p.e202200008.
- J4. Oh, E., Lee, H.C., Kim, Y., Ning, B., Lee, S.Y., Cha, J. and Kim, W.W., 2022.** A pilot feasibility study to assess vascularity and perfusion of parathyroid glands using a portable hand-held imager. *Lasers in surgery and medicine*, 54(3), pp.399-406. ***Cover Article***
- J5. Lee, H.C. and Cipra, R., 2020.** Design of a Novel Locking Ratcheting Mechanism for a Body-Powered Underactuated Hand. *Journal of Medical Devices*, 14(1), p.011101.

CONFERENCE PROCEEDINGS

- C1. Van Lewen D., Wang C., Lee H.C., Devaiah A., Upadhyay U., and Russo S., 2024.** Monitoring Forces in Soft Robotic Brain Retraction via Origami Sensing Modules. *The Hamlyn Symposium on Medical Robotics*
- C2. Van Lewen, D., Wang, C., Lee, H.C., Devaiah, A., Upadhyay, U. and Russo, S., 2024, May.** Capacitive Origami Sensing Modules for Measuring Force in a Neurosurgical, Soft Robotic Retractor. In *2024 IEEE International Conference on Robotics and Automation (ICRA)* (pp. 5302-5308). IEEE.
- C3. Bhargubanda, S., Lee, H.C., Kifle, N., Kim, Y. and Cha, J., 2023, March.** Multi-directional adjustable two-camera housing module for medical applications. In *Design and Quality for Biomedical Technologies XVI* (Vol. 12370, p. 1237002). SPIE.

PATENT

- P1. Jaepyeong, Cha. and Lee, H.C., Optosurgical LLC, 2023.** Method and apparatus for biometric tissue imaging. **U.S. Patent Application 17/854,084.**

TEACHING EXPERIENCE

Teaching Assistant

Electromechanical Design

Sept. 2022 -Dec. 2022

- Assisted the electromechanical system design lab sessions (Topics: Arduino, electromechanical system design)

Machine Design

Aug. 2018 – Aug. 2021

- Instructed the machine design lab sessions (Topics: the kinetics and kinematics of machine, the stress analysis of machine components)

Mechanical Engineering Design, Innovation, and Entrepreneurship

Aug. – Dec. 2016 & Aug. – Dec. 2017

- Instructed the design lab session and guided in applying engineering principles to open-ended problems.

Conference Presentations

- A Monolithic Fabrication Strategy for Millimeter-Scale, Self-Sensing Actuators, Oral Presentation at *Materials Research Society (MRS)*, San Francisco, CA, April 25-27, 2023
- A Monolithic Fabrication Method for Proprioceptive Soft-Foldable Robots, Oral Presentation at *Society of Engineering Science (SES)*, Minneapolis, MN, October 8-11, 2023

Honors and Awards

- Distinguished Mechanical Engineering Fellowship 2021
- Dean's List 2012-2016
- Semester Honor 2012-2016
- EPICS AMD Design Award 2014
- School of Mechanical Engineering Scholarship 2013

Technical Skills

- 3D Modeling:** SOLIDWORKS, CATIA
- Simulation:** Abaqus
- PCB Designing:** Altium
- Programming:** Python, MATLAB, C, ROS, MicroROS, TensorFlow