Hun Chan (Bryan) Lee

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RESEARCH INTEREST

- Design, fabrication, and optimization of soft actuators and sensors for advanced soft robotic systems.
- System modeling and control for soft robotic systems
- Developing and integrating soft optics / visual sensors into the soft robotic platforms

EDUCATION

Boston University   **Boston, MA**
Ph.D. Candidate, Mechanical Engineering   Sept. 2021 ~ Present
Advisor: Prof. Sheila Russo

Purdue University   **West Lafayette, IN**
Master of Science, Mechanical Engineering   Aug. 2016 ~ Aug.2018
Advisor: Prof. Raymond Cipra   *GPA: 3.81 / 4.00*

Purdue University   **West Lafayette, IN**
Bachelor of Science, Mechanical Engineering   *Aug. 2012 ~ May.2016*
(Highest Distinction)   *GPA: 3.96 / 4.00*

RESEARCH EXPERIENCE

Material Robotics Lab, Boston University   *Sept. 2021 – Present*
Advisor: Prof. Sheila Russo

- Developed and optimized a monolithic layer-by-layer fabrication process for soft-rigid hybrid robots, achieving seamless system integration of a soft actuator, an ionic resistive sensor, and a rigid-flexible mechanical controller. [J1]
- Designed and prototyped an innovative Miura-ori pattern-inspired soft retractor with a capacitive sensor for neurosurgical applications, enhancing precision and adaptability in surgical procedures. [C1, C2]
- Leading a team of four people to develop an autonomous soft-rigid hybrid robotic system for laser-assisted surgery, incorporating optical proprioceptive sensors interpreted using machine learning. [Work in progress]

Cipra Lab, Purdue University   *Aug. 2016 – Aug. 2018*
Advisor: Prof. Raymond Cipra

- Developed and optimized the design of a wearable, 3-D printed prosthetic hand with compliant joints, leveraging rapid prototyping techniques. [J5]
- Utilized MATLAB image processing techniques to analyze the motion of the prosthetic hand [J5]

Vlachos Research Group, Purdue University   *Jan. 2015 – May. 2016*
Advisor: Prof. Pavlos Vlachos

- 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.   **Seoul, South Korea**
Research and Design Team Member   *Aug. 2018 – Aug. 2021*

- Shadowed over 150 preclinical and clinical trial cases across various general surgery divisions and directly worked with clinicians to gather and incorporate their feedback to refine surgical imaging systems.
- Developed and integrated a YOLOv5 object detection machine learning model into a handheld RGB and NIR dual-imaging system, enhancing parathyroid gland (PG) identification rates and viability diagnostic accuracy. [J3, J4]
- Led the research and development of hardware for the Laser Speckle Contrast Imaging (LSCI) system, a laser-based blood flow meter and acquired Korean Good Manufacturing Practice (K-GMP) certification for the system. [P1, J4, C3]
- Developed and implemented over 20 experimental protocols and designed electro-mechanical testing system instruments to improve the functionality of fluorescence laparoscopy systems that integrate RGB and NIR imaging.

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. Bhrugubanda, 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   *Jan. – May 2017 & Jan. – May 2018*
- 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 Method for Proprioceptive Soft-Foldable Robots, Oral Presentation at *Society of Engineering Science (SES),* Minneapolis, MN, October 8-11, 2023
- A Monolithic Fabrication Strategy for Millimeter-Scale, Self-Sensing Actuators, Oral Presentation at *Materials Research Society (MRS),* San Francisco, CA, April 25-27, 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