# ARINCHEYAN GERALD

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## EDUCATION

**Boston University** **Boston, MA**
**PhD in Mechanical Engineering**, *Distinguished Mechanical Engineering Fellowship* *Graduation Date: May 2025*

**Boston University** **Boston, MA**
**BS in Mechanical Engineering**, *Cum Laude, Presidential Scholarship* *Graduation Date: May 2020*

## SKILLS

**Programming Languages:** MATLAB, Python: OpenCV, ROS, Tkinter, NumPy, Arduino IDE

**Simulation Modelling:** Zemax OpticStudio, Abaqus Finite Element Analysis, Ansys Lumerical

**Computer Aided Design (CAD):** SolidWorks, AutoDesk Fusion 360, PTC Creo, Adobe Illustrator

**Manufacturing:** Photolithography, Plasma Etching, Ellipsometry, Spin Coating, 3D printing, Laser Cutting, Molding

**Soft Skills:** Data Analysis**,** Technical Writing, Project Management, Research Leadership, Experimental Design

## RESEARCH EXPERIENCE

**Material Robotics Lab, Boston University** **Boston, MA**
Doctoral Researcher *Sep 2020 - Present*

- Developed multimodal soft sensors and haptic feedback systems to improve the safety and efficacy of robotic minimally invasive surgery, funded by a $680,000 grant from the National Institutes of Health (NIH)
- Conducted *ex vivo* and *in vivo* pre-clinical tests through active collaboration with surgeons at *Brigham and Women's Hospital*, *Harvard Medical School* to improve the clinical compatibility of robots in colonoscopy
- Led two teams of 10 graduate and undergraduate researchers, directing weekly technical progress to ensure successful completion of 4 different research projects
- Authored and presented 7 research papers in leading journals and academic conferences including IROS, Hamlyn Symposium for Medical Robotics, and the Materials Research Society

## RESEARCH PROJECTS

**Soft Optical Blood Sensor for Colonosocopy** **Boston, MA**
*Material Robotics Laboratory, Boston University* *Sep 2020 - Present*

- Developed an opto-fluidic sensor for real-time blood detection behind the distal camera of the colonoscope, to reduce severe adverse events (SAEs) caused by bleeding
- Created test protocols and NASA TLX human factor studies to evaluate sensor performance in *ex vivo* clinical trials with 10 endoscopists, resulting in a 95% bleeding detection rate
- Designed a Python/ROS surgical GUI to streamline fluidic system control, effectively integrating sensor signals from an optoelectronic circuit, and reducing necessary microcontrollers and circuitry by 50%
- Fabricated sub-0.3 mm optical waveguides using cleanroom UV photolithography, spin coating, and plasma etching, and optimized waveguide designs to boost light coupling by 30% with Zemax simulations

**Soft Sensor and Haptic Feedback for Palpation** **Boston, MA**
*Material Robotics Laboratory, Boston University* *Sep 2022 - May 2023*

- Integrated a soft optical sensor and pneumatic haptic feedback glove for tumor identification during robotic and remote tissue palpation procedures
- Augmented the sensor onto a UR-5 robot arm to peform remote *in vitro* palpation on a silicone tissue phantom, detecting embedded tumors 2 to 5 mm deep while providing haptic feedback to the surgeon
- Created low cost, disposable optical sensors and silicone actuators (under $50) via rapid protyping techniques including polymer molding, adhesive bonding, laser cutting, and 3D printing

**Soft Robotic Haptic Feedback Glove for Colonoscopy** **Boston, MA**
*Material Robotics Laboratory, Boston University* *Sep 2020 - May 2022*

- Developed a wearable textile glove that delivers haptic feedback during colonoscopy to limit excessive forces above 3 N on the colon wall, enhancing patient safety
- Integrated a control system to provide proportional haptic feedback ranging from 0 to 19 N based on sensor input, utilizing pulse width modulation via an Arduino microcontroller, MOSFETs, and pneumatic solenoids.
- Developed an *in vitro* colon simulator and conducted experiments to assess the efficacy of the haptic feedback glove in mock colonoscopy procedures, resulting in a 35% reduction in surgical workload.
- Fabricated material testing fixtures using 3D printing for blocked force characterization and ASTM D751 testing of coated textile pneumatic actuators

## WORK EXPERIENCE

**Mechanical Engineering Dept., Boston University** **Boston, MA**
*Graduate Teaching Assistant* *Sep 2021 - May 2022*

- Advised 30+ senior design and product design teams, providing technical mentoring based on design thinking principles and additive manufacturing techniques
- Conducted 3D printer equipment training and held office hours for 50+ students, contributing to their skill development and practical knowledge of rapid prototyping best practices
- Managed and coordinated high volume (20+) weekly 3D print requests for students, ensuring timely completion of final design projects

**Boston University Material Robotics Lab** **Boston, MA**
*Undergraduate Research Assistant* *Jan 2018 - May 2020*

- Engineered a soft robotic sensing sleeve to control excessive forces during colonoscopy, earning a $10,000 Distinguished Summer Research Fellowship for advancements in minimally invasive surgical robots
- Characterized sensors through experimental protocols utilizing Instron universal testing machines, calibrating incident compressive forces ranging between 0-3 N to optical loss signals from the sensor
- Conducted finite element analysis simulations to model soft actuator inflation under 8 kPa pressure, characterizing the maximum actuator height and its interaction with the colon wall.
- Designed a surgical user interface using MATLAB to qualitatively map the magnitude of incident forces based on real time signal data from 3 sensors

**TVS Motor Company** **Hosur, India**
*Manufacturing Intern* *Jun 2018 - Aug 2018*

- Improved competency of engineers and new recruits by developing training modules on technical product information
- Created 2 augmented reality (AR) models of a motorbike transmission and clutch with informational popups, interactive animations, and part disassembly sequences
- Collaborated with factory engineers and identified 5 crucial areas to integrate augmented reality training models within manufacturing processes, including motorbike assembly, inventory management, and machine maintenance

## LEADERSHIP EXPERIENCE

**Boston University Material Robotics Lab** **Boston, MA**
*Research Mentor* *Sep 2020 - Present*

- Guided and mentored 8 undergraduate researchers through semester research projects, resulting in a 100% completion rate for all projects.
- Reviewed and revised research proposals submitted by undergraduate and graduate researchers, leading to an 80% funding approval rate
- Created 5+ comprehensive training modules to orient new researchers to lab manufacturing processes and equipment

**Boston University UAV Team** **Boston, MA**
*Vice President* *May 2019 - May 2021*

- Led hands-on training for beginner UAV projects, resulting in a 50% increase in club membership and engagement
- Organized and facilitated 2 hackathons to prototype and test UAV designs, resulting in an increase in project completion rate amongst participating members
- Managed inventory levels and coordinated with vendors to procure materials for UAV kits within a $100 budget, resulting in cost savings for the club.

## PUBLICATIONS

1. **Gerald A.**, Palkawong na Ayuddhaya K., McCandless M., Hsu P., Pang J., Mankad A., Chu A., Aihara H., and Russo S., "Ex Vivo Evaluation of a Soft Optical Blood Sensor for Colonoscopy", Device, 2024. Link
2. **Gerald A.**, and Russo S., “Soft Haptics for Minimally Invasive Surgery”, Nature Reviews Materials, 2024. Link
3. **Gerald A.**, Ye J., Batliwala R., Hsu P., Pang J., and Russo S., "Soft Optical Sensor and Haptic Feedback System for Remote and Robot Assisted Palpation", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2023. Link
4. **Gerald A.**, Batliwala R., Ye J., Hsu P., Aihara H., and Russo S., "A Soft Robotic Haptic Feedback Glove for Colonoscopy Procedures", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022. Link
5. **Gerald A.**, Batliwala R., Ye J., Hsu P., Aihara H., and Russo S., "A Haptic Feedback Glove for Minimally Invasive Surgery", The Hamlyn Symposium on Medical Robotics, 2022. Link
6. **Gerald A.**, McCandless M., Sheth A., Aihara H., and Russo S., "A Soft Sensor for Bleeding Detection in Colonoscopies", Advanced Intelligent Systems, 2022. *Cover Article* Link
7. McCandless M., **Gerald A.**, Carroll A., Aihara H., and Russo S., "A Soft Robotic Sleeve for Safer Colonoscopy Procedures", IEEE Robotics and Automation Letters, 2021. Link