

# FREDERICK SEBASTIAN

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## EDUCATION

<b>Ph.D.</b>	Bioengineering   <b>Northeastern University</b>   Boston, MA <i>Thesis:</i> Sex, Glaucoma, and Iris Biomechanics <i>Graduate Certificate</i> in Data Analytics Engineering	2024
<b>M.S.</b>	Biomedical Engineering   <b>Arizona State University</b>   Tempe, AZ <i>Thesis:</i> The Design of a Soft Haptic Interface for Rehabilitation of Impaired Hand Function	2018
<b>B.S.</b>	Biomedical Engineering   <b>Barrett, the Honors College</b> , Arizona State University   Tempe, AZ <i>Thesis:</i> The Development of a Comfortable Myoelectric Prosthetic Socket	2017
	Study Abroad   <b>University of Sussex</b>   Brighton, England	2015

## SKILLS

**Programming:** SQL, Python, R Studio, C & C++, MATLAB, LabVIEW, Linux, Swift, Arduino and Processing

**Processing:** Flourish, Finite Element Modeling, Design of Experiments, 3D-Printing, Rapid Prototyping, Machine Shop, Abaqus, SolidWorks, SPSS, Minitab, Mathcad, Tableau, GMP, CAPA. QM Documentation, FDA Regulatory Pathway, Microsoft Office Suite

**Languages:** English, and Malay; Tamil, Spanish, and Indonesian (limited proficiency)

## EXPERIENCE

### **Northeastern University, Boston, MA**

**Laboratory for Soft Tissue Biomechanics** | PI: Rouzbeh Amini

*Characterization of Iris Stiffness for Glaucoma Diagnosis*

Jan '20 – Present

- Applied inverse FEA to analyze in vivo iris biomechanics using AS-OCT images from healthy & glaucoma subjects, aiding diagnostic tool development
- Utilized data analytics and visualization techniques in R and Python to derive insights from large datasets on gender inequity in biomechanics
- Developed micro-indentation protocols for ex-vivo irides and automated the analysis using MATLAB and ABAQUS, reducing analysis time by 50%
- Performed biaxial mechanical testing on sclera, contributing to a novel collagen fiber model linking tissue microstructure to mechanical properties
- Optimized dynamic system responses and experimental procedures using sensor integration, directly enhancing precision in tissue biomechanics analysis
- Mentored 8 undergraduate students, all of whom achieved conference and journal publications

### **Third Pole Therapeutics, Waltham, MA**

**System & Testing Engineering Intern** | Manager: Arnold Oyola

*Developed and validated test protocols for Nitric Oxide delivery medical device*

Jan '23 – June '23

- Collaborated with the ambulatory team to develop a breath testing protocol for a sensor-based nitric oxide delivery system
- Implemented ISO-compliant risk assessment methods to ensure safety; validated the efficacy of device components using Python
- Contributed to testing and documentation of the device under an FDA-granted IDE, validating its safety and practical application in a feasibility study

### **Northeastern University, Boston, MA**

**Neuromotor Systems Laboratory** | PI: Christopher J. Hasson

*Inducing Virtual Dystonia in Healthy Subjects*

Sept '19 – Aug '20

- Developed an electrical stimulation system to induce impairment in healthy subjects
- Structured visual and audio tasks using MATLAB to pair with the electrical system
- Designed experiments and recruited participants to understand impairment adaptation

### **Dartmouth College, Hanover, NH**

**The Hill Lab** | PI: Jane Hill

*Breathomics for Tuberculosis (TB) Detection*

June '18 – July '19

- Utilized gas chromatography-mass spectrometry (GCMS) to identify and quantify volatile substances in breath samples for tuberculosis diagnosis
- Acquired machine learning and Design of Experiments (DOE) skills through collaboration with the Quantitative Biomedical Sciences department

**Arizona State University, Tempe, AZ****Bio-Inspired Mechatronics Lab** | PI: Panagiotis Polygerinos*Soft-Robotic Haptic Device for Stroke Rehab*

June '17 – May '18

- Developed a novel soft-robotics based haptic interface device for hand rehabilitation
- Utilized 3D-Printing, finite element modeling, pressure system controls, and silicone fabrication methods to prototype the device
- Designed experiments and recruited participants to study haptic feedback from healthy individuals
- Results **published** in *Frontiers in Robotics and AI* and **patent** approved by USPTO

**The National University of Singapore, Singapore****Evolution Innovation Lab** | PI: Raye Chen Hua Yeow*Research Internship Focused on Upper-Limb Rehabilitation*

May – Aug '16

- Designed & prototyped fabric actuators for Roco Technologies' EsoGLOVE™, crucial for its launch as a leading lightweight rehabilitation device
- Characterized fabric actuators using fine-tuned force sensors and Arduino control systems

**Arizona State University, Tempe, AZ****Human Performance & Sensorimotor Integration Lab** | PI: Jeffrey La Belle

Aug '14 – May '17

*Lightweight Myoelectric Prosthetic Arm*

- Developed a lightweight & low-cost prosthetic arm in a team of 4 people using rapid prototyping methods
- Utilized FDA regulatory pathways to implement device constraints
- Built & integrated vacuum forming technique for a prosthetic socket design
- Finalists in the 2016 BioAccel Solutions Challenge and angel fund (\$5,000) recipients from ASU's Edson Entrepreneur Initiative

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**TEACHING EXPERIENCE**

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**Northeastern University, Boston, MA****Teaching Assistant** | Biomechanics

Sept '19 – April '24

- Vetting and testing technology to be integrated into the classroom
- Delivering presentations to multiples classes of 50 students to explain statics and dynamics-based bioengineering projects
- Invited to instruct independently due to demonstrated teaching excellence

**Arizona State University, Tempe, AZ****Teaching Assistant** | Conceptual Approaches to Biology

Aug '17 – May '18

- Clarified challenging quantitative and biological concepts to 100 students in a lab course
- Worked in a diverse team to develop better lab pedagogy
- Mentored an undergraduate assistant TA

**Teaching Assistant** | The Human Event at Barrett, the Honors College

Jan '16 – May '17

- Responsible for teaching & grading 20 students in a course focused on critical thinking & argumentative writing
- Facilitated the development of students' projects outside of the classroom

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**LEADERSHIP, SERVICE & EXPERIENTIAL LEARNING**

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**Northeastern University***Bioengineering Graduate Student Council – Mentorship Coordinator*

May '20 – Present

- Established the peer mentor program to help first-year Ph.D. students build a community
- Mentored 6 Ph.D. students during tenure as a mentor

*Bioengineering Diversity and Inclusion Council – Member*

May '20 – Dec '22

- Actively addressed representation and systemic biases in the department and college

*Global Pathways Program – Mentor*

March &amp; Sept '21

- Coached 8 incoming graduate international students in their experimental projects

*Young Scholar's Program – Mentor*

Summer '22 &amp; '23

- Mentored 4 high school students in our lab with experimental techniques

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## PUBLICATIONS & PATENTS

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1. **Sebastian, F.**, Vargas, A.I., Clarin, J., Hurgoi, A., Amini, R. (2024). "Meta Data Analysis of Sex Distribution of Study Samples Reported in Summer Biomechanics, Bioengineering, & Biotransport Annual Conference Abstracts." ASME. J Biomech Eng. November 2023; 1-29.
2. Manav, Y.A., **Sebastian, F.**, Baskota, A., Kuo, J.C., Amini, R., Lal, A., and Davaji, B. (2024) "Towards GHz Ultrasound Enabled Noninvasive Hydrogel Metrology for Mechanobiology." MEMS, Austin, Texas, USA, pp. 276-279.
3. Pinto Costa, R., Nwotchouang, B. S. T., Yao, J., Biswas, D., Casey, D., McKenzie, R., **Sebastian, F.**, Amini, R., Steinman, D. A., and Loth, F. (2022). "Impact of Blood Rheology on Transition to Turbulence and Wall Vibration Downstream of a Stenosis." ASME. J Biomech Eng. April 2023; 145(4): 041001.
4. Polygerinos, P., **Sebastian, F.**, Fu, Q., & Santello, M. "Soft Robotic Haptic Interface with Variable Stiffness for Rehabilitation of Sensorimotor Hand Function." US Patent 11,446,545. 2022
5. **Sebastian, F.**, Fu, Q., Santello, M. and Polygerinos, P. (2017). "Soft Robotic Haptic Interface with Variable Stiffness for Rehabilitation of Neurologically Impaired Hand Function." Frontiers in Robotics and AI, 4(69).
6. Yap, H. K., **Sebastian, F.**, Wiedeman, C. and Yeow, C. (2017). "Design and Characterization of Low-cost Fabric-based Flat Pneumatic Actuators for Soft Assistive Glove Application." ICORR, London, pp. 1465-1470.
7. Ji, F., Islam, M.R., **Sebastian, F.**, Schilpp, H., Wang, B., Hua, Y., Amini, R., & Sigal, I.A. (2024) "Capturing sclera anisotropy using direct collagen fiber models. Linking microstructure to macroscopic mechanical properties." Cold Spring Harbor Laboratory, bioRxiv.
8. **Sebastian, F.**, DelCiello, H., Pant, A.D., Pathak-Ray, V., Dorairaj, S., & Amini, R. "Image-Based Inverse Modeling Analysis of Iris Stiffness Across Sex in Patients With a History of Angle-Closure Glaucoma." Transl. Vis. Sci. Technol. (*under review*)
9. Pant, A., **Sebastian, F.**, Khoiy, K., Repeto, R., Dorairaj, S., & Amini, R. "Computational Modeling of Laser Peripheral Iridotomy and the Effects of Size & Location." JAMA Ophthalmol (*under review*)
10. **Sebastian, F.**, Kondiboyina, V., Dorairaj, S., & Amini, R. "Assessing the Influence of Environmental Factors and Sex on Porcine Iris Stroma Stiffness through Micro-Indentation." J. Biomech. Eng. (*in preparation*)
11. Wang, B., Hua, Y., **Sebastian, F.**, Amini, R., Sigal, I.A., "Disagreement Between Structural and Mechanical Anisotropies of Equatorial Sclera." (*in preparation*)

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## CONFERENCES

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"Sex Differences in Iris Stiffness Among Healthy and Post-Peripheral Iridotomy Eyes," speaker. XXVI Biennial Meeting of the International Society for Eye Research, Buenos Aires, Argentina. International Society for Eye Research. 2024.

"Increasing Students' Exposure to Research Via Applied Homework Problems Integrated in Research Manuscripts," speaker. Summer Biomechanics, Bioengineering, and Biotransport Conference, poster presentation. American Society of Mechanical Engineers, Lake Geneva, WI, 2024.

"Sex Differences in Iris Stiffness in Patients With a History of Angle-Closure Glaucoma: An In-vivo Image-Based Inverse Modeling Analysis," poster presentation. Summer Biomechanics, Bioengineering, and Biotransport Conference, poster presentation. American Society of Mechanical Engineers, Lake Geneva, WI, 2024.

"Meta Data Analysis of Sex Distribution of Study Samples Reported in SB<sup>3</sup>C Abstracts," Cutting-Edge Connections in PhD Research: Healthcare Innovation, poster presentation. Northeastern University, Boston, MA, 2023.

"Mechanical Properties of Porcine Iris Stroma Using Micro-Indentation: The Effect of Temperature and Hydration," Summer Biomechanics, Bioengineering, and Biotransport Conference, speaker. American Society of Mechanical Engineers, Vail, CO, 2023.

"Mega Data Analysis of Sex Distribution of Study Samples Reported in Summer Biomechanics, Bioengineering, & Biotransport Annual Meeting Abstracts," Summer Biomechanics, Bioengineering, and Biotransport Conference, speaker. American Society of Mechanical Engineers, Vail, CO, 2023.

"Nonlinear and Anisotropic Mechanical Response of Fish Skin," Summer Biomechanics, Bioengineering, and Biotransport Conference, poster presentation. American Society of Mechanical Engineers, Vail, CO, 2023.

"The Influence of Experimental Environment on the Mechanical Properties of Porcine Iris Stroma Using Micro-Indentation," The Association for Research in Vision and Ophthalmology, poster presentation. Investigative Ophthalmology & Visual Science. New Orleans, LA, 2023.