

Ajay Zubin Ratty

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Profile

A driven and highly motivated graduate student specializing in Robotics, Biomechanics, and Artificial Intelligence at Oregon State University, with a strong background in bioengineering and biomedical engineering. Passionate about advancing assistive technologies, including prosthetics, exoskeletons, and other solutions for individuals with disabilities. Brings numerous hands-on interdisciplinary experiences to develop innovative solutions that enhance quality of life.

Education

- **Master of Science in Robotics, Minor in Artificial Intelligence**
Oregon State University, Corvallis, OR | 2023 – Present
Current GPA: 3.90
- **Bachelor of Science in Bioengineering, Cum Laude**
Oregon State University, Corvallis, OR | 2020 – 2023
GPA: 3.50
- **Diploma in Biomedical Engineering**
Ngee Ann Polytechnic, Singapore | 2015 – 2018

Academic Awards

- Oregon State University Honor Roll Achievement Recipient | 2020 - 2023
- Pete and Rosalie Johnson Internship Award Recipient - Oregon State University | 2021
- Oregon State University Research Fellow | 2021
- URSA Engage Award Recipient - Oregon State University | 2021
- Oregon State University Launch Academy Tuition Scholarship | 2021
- Edusave Good Progress Award - Singapore | 2018

Research Experience

- **Robotics and Human Control Systems Lab | Oregon State University | Corvallis, Oregon | 2023 – Present**
Project: Evaluating the Effect of Proximal Pole Scaphoid Excision on Carpal Kinematics
Description: Employed a 6DOF Kinova robotic arm to simulate wrist motions on cadaveric specimens, using OptiTrack motion capture systems to study wrist stability for incremental scaphoid excision. Worked closely with specialist physicians to design experiments and ensure clinically relevant results, exploring this technique as a more accessible and promising alternative to current standards of care for treating scaphoid fractures.
- **Robotics and Human Control Systems Lab | Oregon State University | Corvallis, Oregon | 2023 – Present**
Project: Validation of a Novel Tendon-Mounted Implant in Human Cadavers
Description: Validated a novel tendon-mounted implant designed to enhance finger flexion and grip strength, utilizing a 6DOF Kinova robotic arm and force sensor in human cadaveric studies. The findings aim to guide the development of advanced implants for restoring impaired hand function.
- **Senior Capstone Project | Oregon State University | Corvallis, Oregon | 2023**
Project: Porous Microneedle Patches for Therapeutic Monitoring of Parkinson's Treatments
Description: Developed a point-of-care diagnostic device to measure drug concentrations for Parkinson's treatment. Contributed to prototyping key components, including the microneedle array, microneedle wicking pad, applicator device, and imaging apparatus, ensuring integration and functionality across the system.
- **Robotics and Human Control Systems Lab | Oregon State University | Corvallis, Oregon | 2022 – 2023**
Project: Evaluating Frictional Forces at Tendon-Implant Interface with Varying Non-Fouling Coatings
Description: Evaluated frictional forces at tendon-implant interface with varying non-fouling coatings applied to novel orthopedic implants that passively amplify muscle-tendon force for patients that have undergone tendon transfer surgeries following spinal cord injury.
- **Fogg Lab | Oregon State University | Corvallis, Oregon | 2021 – 2022**
Project: Image Analysis of Gynecological Cancer Cells
Description: Performed measurements for invasion depth for different cervical cancer cell lines and measuring cell coverage area and tube formation using Fiji (image J).

- **Fogg Lab | Oregon State University | Corvallis, Oregon | 2021**
Project: Qualitative Analysis of Transcriptomic Data
Description: Conducted qualitative pathway analysis of transcriptomic data using custom Python scripts run through Jupyter Notebook. This analysis characterized different genes at various stages of endometriosis, contributing valuable insights to this area of research.
- **Rocheft Polymer Lab | Oregon State University | Corvallis, Oregon | 2021**
Project: Upgrading Wildfire-Resistant Shelters with a Superabsorbent Polymer Layer
Description: Developed experiments to evaluate the effectiveness of superabsorbent polymers in deployable protective layers for wildfire situations. Designed absorption and burn tests, demonstrating that the polymer could absorb 100 times its weight in water and reduce heat influx by 97%.
- **Ngee Ann Polytechnic Biomedical Engineering Department | Singapore | 2018**
Project: LED Array for Infrared Therapy
Description: Designed a wearable that consisted of a LED array emitting infrared light to promote cellular proliferation and angiogenesis for tissue healing. Participated in the Tan Kah Kee Innovation Competition (national innovation competition).
- **Ngee Ann Polytechnic Biomedical Engineering Department | Singapore | 2017**
Project: Wearable Glucosamine Cream Dispenser
Description: Developed a mechanism for a wearable device that dispenses specified amounts of glucosamine cream at scheduled intervals to support individuals with joint pain or arthritis. This device was designed to provide consistent, on-demand delivery of treatment, improving adherence to prescribed regimens and enhancing user convenience.
- **Ngee Ann Polytechnic Biomedical Engineering Department | Singapore | 2016**
Project: Parkinson's Diagnostic Device
Description: Created a wearable device using accelerometers and gyroscope sensors to monitor tremors in Parkinson's patients. The device serves as a diagnostic and continuous monitoring tool, aimed at providing real-time data to health-care providers for better management of symptoms and personalized treatment plans.

Publications

- **Ajay Ratty**, Cay Mierisch, MD, Michael Pavol, Marielle Ngoue, MD, Delaney Keane, DO, Madeleine Vergun, Ravi Balasubramanian. Evaluating the effect of incremental scaphoid proximal pole excision on carpal kinematics: A cadaver study. *Journal of Orthopedic Research*, *in preparation*.
- Hantao Ling, **Ajay Ratty**, Prabhleen Kaur, Yanming Di, Michael Pavol, Ravi Balasubramanian. Measuring Friction at the Interface between a novel Force-Amplifying Implant and Rabbit Tendon with and without a Non-fouling Coating: An In Vitro Study. *Journal of Orthopedic Research*, *in preparation*.
- Sean Bullock, Hans Bestel, **Ajay Ratty**, Omar Nazir, MD, and Ravi Balasubramanian. Advancing the ECRL-to-FDP tendon transfer using novel hierarchical implantable mechanisms: A cadaver study. *Hand Journal*, *in preparation*.

Conference Presentations

Oregon Bioengineering Symposium | Portland, Oregon | Nov. 2024

- Podium presentation: Effects of Incremental Scaphoid Proximal Pole Excision on Carpal Kinematics.

Oregon State University College of Engineering Expo | Corvallis, Oregon | Jun. 2023

- Poster presentation: Porous Microneedle Patches for Therapeutic Monitoring of Parkinson's Treatments.

Northwest Biomechanics Symposium | Seattle, Washington | May 2023

- Poster presentation: Evaluating frictional forces at tendon-implant interface with varying non-fouling coatings applied to novel orthopedic implants that passively amplify muscle-tendon force for patients that have undergone tendon transfer surgeries following spinal cord injury.

Oregon State University College of Engineering Expo | Corvallis, Oregon | Jun. 2021

- Poster presentation: Upgrading Wildfire-Resistant Shelters with a Superabsorbent Polymer Layer.

Other Projects

Upper Extremity Assistive System | Oregon State University | 2024

Description: Designed an assistive system to support individuals with upper-body limitations caused by degenerative nerve disorders or physical trauma. The system utilized a 6DOF Kinova robotic arm with retrofitted forearm mounts to guide users' forearms along pre-planned trajectories for task execution. Motion capture technology was employed to plan and optimize these trajectories, ensuring precise and efficient movement. This innovation aimed to enhance users' independence and quality of life by facilitating easier completion of daily activities.

- **Autonomous Nerf Gun System | Oregon State University | 2024**

Description: Designed and built a robotic arm system equipped with a modified toy Nerf gun to autonomously detect and fire darts at a target using computer vision. Integrated a custom mount, modified trigger mechanism, and control scripts for precise targeting.

- **Autonomous PiCar Navigation | Oregon State University | 2024**

Description: Programmed a PiCar for line-following and obstacle avoidance using ultrasonic sensors and computer vision. Demonstrated real-time adjustments for path tracking and obstacle detection.

- **Human-Interactive Robotic Arm | Oregon State University | 2023**

Description: Developed a system using a Kinova Jaco robotic arm to detect and respond to human hand movements through OpenCV and a webcam. Programmed the arm to dynamically interpret gestures, enabling it to perform reactive actions such as waving or adopting a 'sad' posture in real time, demonstrating responsive human-robot interaction.

- **Nitinol Actuated Exo Skeletal Glove | Personal Project | 2022-Present**

Description: Designed and built an exo-skeletal glove utilizing Nitinol actuators to provide assistive support for individuals with impaired hand function. The project focuses on creating a lightweight, wearable device that enhances hand mobility and grip strength through controlled actuation, leveraging the unique properties of Nitinol for responsive and energy-efficient movement.

Work Experience

Graduate Teaching Assistant, Oregon State University | Corvallis | Sep. 2023 - Present

Assisted in the delivery of courses through the following responsibilities:

- Graded assignments, exams, and provided feedback to students.
- Restructured course content to enhance clarity and student understanding.
- Held office hours to provide academic support and clarify course material.
- Assisted in exam preparation and proctored exams to ensure fair student assessment.
- Fostered a collaborative learning environment to support academic development.
- Supported instructors with administrative tasks for smooth course execution.

For the following classes:

- ME 217: Mechanical Engineering Dynamics | Fall 2024
- ME 351: Introduction to Instrumentation and Measurement Systems | Winter/Spring 2024
- ME 317: Intermediate Dynamics | Fall 2023

Sea Terminal Operator, Singapore Armed Forces | Singapore | Jul. 2018 – Jul. 2020

- Performed duties within a specialized unit that aids the Republic of Singapore Navy in loading land vehicles onto naval Landing Ship Tanks via crane operation and precision marshaling.
- Deployed for overseas training exercises.
- Attained the rank of Corporal First Class, awarded to the top 30% of enlistees.
- Additional roles: Battalion Innovation In-Charge, Company Stores 2nd In-Charge, and Auxiliary Instructor.

Assistant Engineer, Beth-El (Asia Pacific) Pte Ltd | Singapore | Mar. 2018 – May 2018

- Designed a new threat detection system booth for the Singapore-Malaysia immigration border checkpoint.
- Performed maintenance work on nuclear, biological, and chemical filters at Singapore Mass Rapid Transit (train) stations.
- Investigated anti-corrosive solutions to improve the lifespan of blast doors, including galvanization options.

Quality Management Intern, Becton Dickinson | Singapore | Mar. 2017 – Aug. 2017

- Devised Measurement Systems Analysis to evaluate the statistical practicality and expediency of new testing methods for product reliability.
- Products tested included Becton Dickinson Venflon cannulas, Odon birth assist device, Uniject pre-fillable injection, and Kade (confidential re-naming as of 2017).
- Developed testing methods that became standardized global protocols for Becton Dickinson factories.
- Attained a Certificate of Training in TRIZ Innovation.

Leadership Experience

BMES Prosthetic Hand Design Team Lead, Oregon State University | Corvallis, Oregon | 2022–2023

- Led a multidisciplinary team of engineering undergraduate students within the Biomedical Engineering Society's Prosthetic Hand Design Team to design and build a functioning prosthetic hand.

3 SAF Transport Battalion Innovation In-Charge, Singapore Armed Forces | Singapore | 2019 – 2020

- Contributed to the Battalion's digitization efforts by transforming the paper-based "Book-In Book-Out" system into a trialed and highly praised digital system. This new system is planned for expansion to other units.

Unit Company Stores 2nd In-Charge, Singapore Armed Forces | Singapore | 2018 – 2020

- Managed unit-specific operation and training equipment for my military unit.

Mentoring Experience

Charles Hong – Biomedical Engineering REU Student, Georgia Institute of Technology

Katya Morozov – Physics REU Student, University of California, Santa Barbara

Kyle Wern – Mechanical Engineering Undergraduate Researcher, Oregon State University

Jackson Mcloughlin – Mechanical Engineering Undergraduate Researcher, Oregon State University

Immersion/Exchange Experience

Kunming University of Science and Technology (KUST) | Kunming, China | 2015

- Completed a graded engineering module on Digital Logic while engaging with local students and activities to gain insight into Chinese culture and traditions.

Volunteer/Outreach Experience

K-12 STEM Outreach Event, Volunteer | Independence, Oregon | 2022

- Organized Family Science and Engineering Night at Independence Elementary School to increase STEM awareness through hands-on engineering experiments for K-12 students and their parents.

Paya Lebar Wellness Center, Volunteer | Singapore | 2016

- Conducted surveys to identify unmet needs of elderly residents and facilitated community meetings to address their concerns.

Orphanage in Cambodia, Volunteer | Siem Reap, Cambodia | 2013

- Assisted in rebuilding and repainting the orphanage while organizing activities to foster social interaction with locals.

Technical Skills

Robotics/Biomechanics:

Kinova Next Gen & Jayco Robotic Arms, ROS/ROS2, Gazebo, RVIZ, OptiTrack Motion Capture System

Computer Aided Design/Engineering Design:

Solidworks, Fusion 360, DesignSpark, Eagle PCB

Programming Tools/Coding Languages/Version Control:

Python, C, C#, HTML, Visual Studio Code, MATLAB, OpenCV, GitHub

Prototyping/Manufacturing/Testing

3D Printing (FDM & SLA), Arduino, Nikon NEXIV VMR-3020, Usen Leak Tester, INSTRON Force Tester, SMD Soldering, FAUL-HABER Motors, Futek Load Cells

Data Analysis/Signal Processing/Image Analysis:

IBM SPSS 26, Minitab, MATLAB, Biomedical Signal Processing, Fiji-ImageJ

Others:

Blender, LaTeX, Microsoft Office, Video editing, Biorender, Inkscape

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