

Benjamin Forbes

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RESEARCH SUMMARY

My research centers on creating human-centered robotic systems that utilize the strengths of humans - for long horizon and high order control, and robots - for accurate and repetitive movements. This paradigm drives my work in developing **learning-based shared autonomy** algorithms for human embodiment in robotic systems using human cues such as eye gaze. I am also interested in creating **robust tactile sensing** for contact-rich robotic manipulation in extreme environments. I believe that policies utilizing tactile sensing and human body language lead to safer and more comfortable human-robot interaction.

EDUCATION

- **University of California, Los Angeles** *Expected June 2030*
PhD, Mechanical Engineering - Design, Robotics, and Manufacturing Los Angeles, CA
 - Advisor: Dr. Veronica Santos
- **Northwestern University** *March 2024*
B.S./M.S., Mechanical Engineering Evanston, IL
 - Advisor: Dr. Edward Colgate
 - Thesis Project: Electroadhesion and the Capstan Effect

FELLOWSHIPS, GRANTS & AWARDS

- **DOD SMART Fellowship (did not accept)** 2025
U.S. Department of Defense
 - Awarded to research underwater tactile sensing and manipulation at Naval Undersea Warfare Center, Keyport
- **Big Ten Postgraduate Scholarship** 2024
Big Ten Conference
 - Awarded graduate scholarship for exceptional academic and athletic achievement in the Big Ten Conference
- **First Prize ASME/SME Student Manufacturing Design Competition** 2023
North American Manufacturing Research Conference (NAMRC)
 - First prize for work on my senior capstone: "Desktop Robotic English Wheeling System"
- **Academic All-Big Ten (3x)** 2022-2024
Big Ten Conference
 - Received for maintaining GPA above 3.0 during the Big Ten Conference competition season
- **Big Ten Distinguished Scholar (2x)** 2023-2024
Big Ten Conference
 - Awarded for maintaining GPA above 3.7 while competing as a Division 1 athlete in the Big Ten Conference

RESEARCH EXPERIENCE

- **Biomechanics Lab, University of California, Los Angeles** *Sept 2024 - Present*
Graduate Student Researcher - Advisor: Dr. Veronica Santos Los Angeles, CA
 - Designed waterproof optical-based tactile sensor for use in learning dexterous manipulation policies in marine environments
 - Created simulation in MuJoCo for training of shared autonomy control algorithms for teleoperation of a bimanual robotic system
 - Utilized Varjo headset and eyetracking capabilities to as policy input predict the user's task intent
- **Human Fusions Institute, UCLA/ Case Western Reserve University/ Cleveland State University** *Oct 2024 - Present*
Controls Team Lead - Advisor: Dr. Veronica Santos Los Angeles, CA
 - Developed optimization-based control scheme for serial robot manipulators that maximizes the manipulability and avoids singularities that increases the feeling of human embodiment during teleoperation
 - Deployed the controller in a bimanual robotic system with a Franka Emika FR3 and Universal Robots UR5e in ROS2 to complete complex manipulation tasks
- **Center for Robotics and Biotechnology, Northwestern University** *June 2023 - June 2024*
Graduate Student Researcher - Advisor: Dr. Edward Colgate Evanston, IL
 - Explored the idea of using a capstan to amplify the holding force of a thin-film electroadhesive clutch by deriving mechanical equations relating the wrapping angle to the holding force of the clutch
 - Built comprehensive test rigs with load cells to measure the holding force of the clutch when voltage was applied across it - which validated of the theoretical equations

- Utilizing my analysis, designed, manufactured, and assembled a novel actuator for high-force, high-displacement applications
- **Advanced Manufacturing Processes Lab, Northwestern University** June 2023 - Jan 2024
Graduate Student Researcher - Advisor: Dr. Kornel Ehmann Evanston, IL
 - Designed specialized robot end-effector and custom desktop hardware to automate English wheeling - a sheet metal forming process
 - Integrated load cell in the frame of the English wheel and using a NI DAQ, LabVIEW for implemented force feedback into the control algorithm of the UR5e robot arm

TEACHING EXPERIENCE

- **Teaching Assistant - Dynamics of Rigid Particles and Bodies** Fall 2024
University of California, Los Angeles
 - Prepared materials for and taught a weekly 2 hour long discussion section consisting of a review of material and practice problems, with attendance of approximately 80 students
 - Average Overall TA Evaluation: 8.47 / 9.00
- **Grader - Computer Integrated Manufacturing II: CAD/CAM** 2023-2024
Northwestern University
 - Evaluated student homework and labs on CAD/CAM systems and manufacturing processes ranging from injection molding to FDM printing

PROFESSIONAL EXPERIENCE

- **Northwestern University Segal Design Institute** June 2022 - Sept 2022
Design Engineering Intern Evanston, IL
 - Designed and manufactured and polished multiple biomedical products for infant video fluoroscopy, gait training, and diabetes management
- **WAGIC, Inc.** June 2021 - Sept 2021
Product Design Engineer Remote via Fresno, CA
 - Tested products, communicated safety concerns, and remodeled "AutoSpout" - a hands free faucet attachment - with necessary considerations for safety compliance and injection molding optimization
- **Clovis Sports Magazine** June 2020 - Oct 2020
Content Coordinator Fresno, CA
 - Head writer for a monthly local sports magazine covering highschool sports

ACADEMIC & PROFESSIONAL SERVICE

- **Assistant Head Swim Coach** Sept 2024 - Present
Bruin Swim Club
 - Coached children aged 7-15 years to swim competitively by developing age-appropriate training programs and skill progressions
- **Executive Committee Member** 2020 - 2024
Student Athlete Advisory Committee, Northwestern
 - Liaised between varsity athletes and university administration, making departmental changes to better the lives of student-athletes
 - Led planning for student-focused events and community outreach programs

SKILLS

- **Programming Languages and Robotics:** Python, ROS2, MATLAB, C++, LabVIEW, R
- **CAD/Engineering Software:** SolidWorks, OnShape, CREO
- **Manufacturing & Fabrication:** CNC Machining, 3D Printing, Laser Cutting
- **Data Acquisition & Analysis:** National Instruments DAQ, Load Cells, Sensor Integration, Signal Processing
- **Research Skills:** Experimental Design, Statistical Analysis, Technical Writing, Patent Filing

PUBLICATIONS

- [J.1] Suarez, D., Chen, F., Kang, P., **Forbes, B.**, Gao, M., Ineza, O., Benton, K., Dewberry, N., Jaiswal, C., Gokaraju, B., Ehmann, K., & Cao, J. (2024). **On the feasibility of an integrated English wheel system.** *Journal of Manufacturing Systems*, Vol. 73, pp. 373-384. DOI: 10.1016/j.jmsy.2024.05.003

IN PREPARATION

- [C.2] **Forbes, B.**, Harber, E., Penaloza, J., Yared, H., Kasmalkar, P., & Santos, V. J. (2025). **H2Opti: A Vision-based Underwater Tactile Sensor.** *In Preparation*, 2025.