Zachary Bucknor-Smartt

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EDUCATION

Texas A&M University | College Station, TX   **Grad. May 2025**

BSc. Mechanical Engineering, Mathematics Minor, Undergraduate Thesis Research Scholar **Junior/Senior GPA: 3.66/4.0 Major GPA: 3.5**

Relevant Coursework: Mechanics of Robotic Manipulators, Dynamic Systems and Controls, Numerical Methods & Optimization, Machine Learning, Complex Analysis, Research, Data Structures and Algorithms (MIT OCW)

PROFESSIONAL SUMMARY

Dedicated and results-driven mechanical engineering student with a strong focus on software and controls, particularly interested in areas of loco-manipulation, whole-body control, task planning, path planning, optimization, control theory, machine learning, and intelligent manipulation. Proven ability to lead research initiatives, independently create and lead undergraduate research labs, collaborate on complex multidisciplinary projects, and contribute to peer-reviewed publications.

RESEARCH

Robotics and Automation Design Laboratory (Bush Combat Development Complex) | College Station, TX   **May 2024 – August 2024**

Robotics & Controls Undergraduate Researcher | Advisor: Dr. Gray Thomas, Co-Advisor: Dr. Robert Ambrose | 40 hours/week

- Develop state of the art strength amplification controllers in C++ for manipulators in multiple degrees of freedom using "virtual" spring-mass-damper systems characterized by human-environment compliance.
- Utilize Python to perform system identification on multiple-input-multiple-output robot systems to characterize human compliance, robot compliance, force transfer, and true end effector position.
- Begin leading a group of undergraduate students to publication of a journal paper and thesis in novel exoskeleton control.

Human-Empowering Robotics and Control Laboratory | College Station, TX   **November 2023 - Present**

Undergraduate Researcher | Advisor: Dr. Gray Thomas

Project 2: Direct User Control of Lower Limb Exoskeletons | 17 hours/week   *May 2024 – Present*

- Work on implementing high level control strategies to extract environmental information from thigh and shin angle using an Extended Kalman Filter approach.
- Begin implementation of direct user torque inputs into the Kalman filter state estimator, design and manufacture belt-fed constant length tension system for lower limb exoskeleton.

Project 1: Strength Amplification Arm | ~10 hours/week   *November 2023 – Present*

- Theoretically and empirically prove stability for novel force control methods and communicate viability to scientific community through academic papers. (more on this in experience above)
- Design, prototype, and implement various end-effectors on the *Haption 6D HF TAO* robot that incorporates human force-torque sensing when coupled with the environment.
- Contribute to the creation of C++ libraries around the SRI M35 series of force torque sensors and the *Haption 6D HF TAO* robot. Accomplished end effector force transformations utilizing quaternions, data IO, high pass filtering, sensor calibration, and real time single degree of freedom strength amplification.

Rani Therapeutics | San Antonio, TX   **May 2023 – August 2023**

Robotics R&D Engineering Intern | Advisor: Dr. Ashley Dacy | 40 hours/week

- Designed all components of both hardware and software for a 3-axis gantry robot with Python, OpenCV, SolidWorks, and C++ with the purpose of detecting objects at the microscale (1mm at largest), piercing with a hypodermic needle, and performing vacuuming and drug filling operations.
- Increased speed of the process in an array of $A \rightarrow R^{mxn}$ objects by utilizing Dijkstra's Algorithm between nodes (drug fill sites).
- Increased safety of the filling process drastically, completely removing all humans from the time consuming and dangerous process.

Vehicle Systems & Control Laboratory | College Station, TX   **August 2023 – November 2023**

Undergraduate Researcher | Advisor: Dr. Reza Langari | Project lost funding due to change in the professor's research focus. | 10 hrs/week

- Collaborate with PhD students, travelling researchers, and professors to develop real-time intention prediction for upper limb rehabilitation robots using Convolutional Neural Networks.
- Engage in critical literature review of new topics in intelligent and fuzzy control in order to implement learning algorithms aiding in prediction.

JOURNAL PAPERS, CONFERENCE PAPERS, SEMINARS, SPEECHES, POSTERS, AND THESES

1. **Z. Bucknor-Smartt**, J. Mustafa, W. Bannick, L. Graves, M. Korwani, G. C. Thomas, "Direct User Control of Lower Limb Assistive Exoskeletons", *IEEE Robotics and Automation Letters*, June 2025 (In progress) [Journal paper + undergraduate thesis]
2. A. Petrakian, **Z. Bucknor-Smartt**, C. Scott, G. C Thomas, "Amplifying Human Strength Through a Virtual Sprung Inertia", IEEE International Conference on Rehabilitation Robotics, May 12th, 2025 (Under Review) [Conference Paper]

3. A. Petrakian, **Z. Bucknor-Smartt**, G. C Thomas, "Formulating Controllers for Human Strength Amplification", Texas Regional Robotics Symposium, April 30th 2024 [Conference Poster]
4. **Z. Bucknor-Smartt** "Amplifying Human Strength Through a Virtual Sprung Inertia", Gulf Coast Undergraduate Research Symposium, Rice University, November 9th 2024 [Symposium Research Speech]
5. I. Lansdowne, **Z. Bucknor-Smartt**, J. Foltyn, J. Kong, M. Guttman, "TURTLE's Low Cost, Open-Source Quadruped", Texas Regional Robotics Symposium, April 30th 2024 [Conference Poster]
6. **Z. Bucknor-Smartt**, "An Introduction to Computer Vision: Object and Edge Detection", TAMU HowdyHack, September 28th 2023 [Technical Seminar]

EXPERIENCE

Texas A&M University | College Station, TX   **January 2025 – May 2025**
Course Grader | ~ 7 hours/week
- Incoming undergraduate grader for MEEN 408/612, a stacked undergraduate/graduate course focusing on forward, inverse, and differential kinematics of robot manipulators, path planning, motion planning, dynamics of robot manipulators and control algorithms; PD/PID control, computed torque algorithm.
- Originally took the class under Dr. Kiju Lee, now to serve as a grader for Dr. Gray Thomas and Dr. Robert Ambrose, effectively widening my knowledge of methods in robot kinematics, dynamics, and non-linear control.

Texas A&M University | College Station, TX   **January 2024 – September 2024**
Mechanical Engineering Peer Teacher | ~ 5 hours/week
- Author notes in subjects of feedback control (MEEN 364), electronic systems and signals (ECEN 215), calculus (MATH 151/152/251), and differential equations (MATH 308).
- Provide tutoring to students in subjects of proficiency, tailoring sessions towards areas of difficulty.

Texas A&M University | College Station, TX   **March 2023 – Present**
Mechanical Engineering Ambassador | 5-7 hours/week
- Providing a peer-to-peer perspective to prospective students, freshmen, and current mechanical engineering students.
- Lead weekly prospective student presentations and serve on student panels for prospective students and their parents.
- Meet individually with current and prospective students for tutoring services, general advice and information.
- Provide prospective graduate students with research advice, including research lab tours and resources on campus to successfully start a career in research at Texas A&M.

ACTIVITIES & PROJECTS

Los Alamos National Laboratories Aggies Invent | College Station, TX   **November 2024**
Chief Technical Officer of Team NewClear Solutions | 2nd Place Winner
- Led a multidisciplinary team of engineering students in developing a multi-DOF teleoperation automation system for Los Alamos National Laboratories' nuclear waste management.
- Presented technical solutions, budget projections, and feasibility analyses to a panel of LANL judges, including Dr. Beth Boardman and Matthew Hammond, securing 2nd place in the competition.

T.U.R.T.L.E Robotics | College Station, TX   **August 2022 – Present**
Robotics Organization President | Undergraduate Laboratory Principal Investigator | 10-20 hours/week
- Lead a dynamic organization of 250+ members, overseeing and leading lab operations, robotics projects, and events of the organization.
- Organized and facilitated regular meetings, promoting open communication, collaboration, and accountability among members.
- Teach weekly introductory robotics classes during the semester to members looking to increase their knowledge in CAD, soldering, C++, Python, microcontroller programming, and manufacturing methods.
- Represented the organization in public speaking engagements, media interviews, and community events, effectively promoting the organization's mission and impact.

T.U.R.T.L.E Robotics | College Station, TX   **August 2023 – Present**
Robotics Team Lead | Partial Hand Amputee Prosthesis | ~ 5 hours/week
- Leading a team of engineers to design and test an EMG prosthetic hand for Kaeden Olson, a child in Brenham born with ABS.
- Mechanical design work with intent to create a safe prosthetic in which sensor data collection (EMG), finger actuation, and stability can occur.
- Implemented and optimized random forest classifier models and PID feedback control to classify hand gestures from forearm EMG signals and mimic gestures in innovative prosthetic hardware.
- Achieved live prediction accuracy of 96% with 5 distinct gestures and 0 steady state error using a PID controller.

SKILLS

- *Technical*: Python, C++, Embedded C, MATLAB, Simulink, R, Drake, Gazebo, OpenCV, TensorFlow, Scikit-learn, ROS2, SolidWorks, Multisim, LabView, Git, Linux, Human Subject Experiments (authoring IRB protocols), human signal processing (EMG), Academic Writing
- *Knowledge*: Real Time Feedback Control Systems, System Identification, Bayesian State Estimation, Machine Learning, Robot Dynamics, Object Oriented Programming, Legged Locomotion, Manipulation
- *Certifications*: OSHA Certification, Mechanical Design (CSWA), Additive Manufacturing, Sustainable Engineering