CHUNCHU ZHU

500 Bartholomew Rd, Piscataway, NJ 08854-8058

chunchu.zhu@rutgers.edu chunchuzhu.github.io https://www.linkedin.com/in/chunchu-zhu-254797141

EDUCATION

Rutgers, The State University of New Jersey *Jan 2022 - Dec 2025*
Ph.D. in Mechanical Engineering New Brunswick, NJ

Case Western Reserve University *Jan 2020 - Dec 2021*
M.Sc. in Mechanical Engineering Cleveland, OH

Southern University of Science and Technology *Sept 2015 - June 2019*
B.E. in Mechanical Engineering Shenzhen, China

SKILLS

Programming	MATLAB, Python, C/C++, Java
Technical Tools	TensorFlow, PyTorch, Scikit, Git, AutoCAD, Solidworks, Mujoco, Webots, ROS, etc
Algorithms	Robotic modeling, control theory, haptic algorithm, machine learning, embedded systems, path planning, sensor fusion, optimization, OpenCV, etc.
Other	Human-robot interaction, manufacturing methods, data structure, etc

RESEARCH/WORK EXPERIENCE

Research Assistant | Rutgers University | Piscataway, NJ Jan 2022 - Dec 2025

- Developed exoskeleton controllers using **dynamic modeling** and **reinforcement learning** to assist human behavior during fast, transient dynamics in gait recovery scenarios (e.g., foot slip, trip). Implemented a wearable sensing and exoskeleton-assisted system with **Python** and **C++** for slip and fall prevention, incorporating real-time slip detection, precise torque control via **CAN**, and sim-to-real strategies to enhance balance recovery.
- Designed a **machine learning**-based framework (**RNN**, **GPDM**) for real-time activity detection and lower-limb posture estimation to enhance exoskeleton control for industrial workers with non-periodic gaits, resulting in improved balance, reduced muscle fatigue, and increased task performance across various surfaces.
- Developed a **Brain – Computer Interface** (**BCI**) enhanced knee exoskeleton system using non-invasive **electroencephalogram** for sit-to-stand and adaptive walking assistance, integrating machine learning methods (**Transformer**, **LSTM**) to enhance balance and improve ease of movement in daily activities.
- Conducted **biomechanical analysis** of human walking on solid ground versus sand, contributing to the understanding of locomotion on deformable surfaces. Developed **MPC**-based exoskeleton control strategies to enhance human mobility and stability, and reduce metabolic costs on granular terrains.
- Analyzed **balance control** strategies for Parkinson's patients and construction workers under varied gaits, developing customized exoskeleton assistance for each group. Enhanced postural stability in Parkinson's patients, while improving balance and welding performance for construction workers in **virtual reality** (**VR**). Focused on optimizing joint-level biomechanics and reducing musculoskeletal strain by replicating real-world construction environments.
- Implemented a autonomy stack for the Unitree Go2 quadruped robot that enabled autonomous **navigation** and **collision avoidance** using built-in sensors (lidar, IMU), integrating **SLAM** and **path planning**. The system operates with **ROS2** on both onboard and external computers, supporting joystick-assisted modes and real-world simulation in Unity.

Lecturer | Rutgers University | Piscataway, NJ June 2022 - August 2024

- Lecturer of the course **Dynamic System and Control**, focusing on system modeling with Ordinary Differential Equations (ODEs) and analyzing system responses to inputs and initial conditions. Emphasized the analysis of systems obtained through interconnections (e.g., feedback) and control design to ensure desirable properties like stability and performance.

Research Assistant | Case Western Reserve University | Cleveland, OH Jan 2020 - Dec 2021

- Conducted a hexapod robot simulation in **Webots** using a tripod gait and **leg-terrain interaction** models. Developed a finger motion-based control interface with **hand exoskeletons** for leg placement, with the Tip Position Mapping method improving obstacle avoidance under dynamic environments.
- Developed **stable gaits** for a hexapod robot and implemented **impedance control** to enable effective navigation across diverse terrains, including wave-influenced environments.
- Designed and manufactured a cost-effective **wave force sensor** for amphibious hexapod robot legs, utilizing thin film pressure sensors and **3D printed** soft materials for enhanced durability and responsiveness.

Undergraduate Researcher | University of Notre Dame | South Bend, IN June 2018 - Aug 2018

- Simulated a single-leg **jumping robot** in **Webots**, designing closed-loop **PID** controllers to precisely regulate both jump height and speed for enhanced performance.
- Developed and optimized the **embedded control** system for a jumping robot on **Mbed**, achieving real-time and stable locomotion through hardware integration.

Summer Internship | Commercial Aircraft Corp. of China | Shanghai, CN June 2017 - Aug 2017

- Designed a **5−DoF robot arm** for aerospace wing panel riveting in confined spaces. Performed comprehensive static and dynamic analyses of the robot arm using **SolidWorks** and **Adams**, evaluating load distribution, vibration behavior, and potential points of failure under operational stresses. Optimized the arm's design to improve structural integrity, reduce weight, and enhance overall performance.
- Developed an algorithm for **perpendicular calibration**, improving rivet placement accuracy and reducing setup time, thereby boosting manufacturing efficiency.

Summer Internship | Timken Company | Beijing/Wuxi, CN June 2016 - Aug 2016

- Conducted a comprehensive literature review on bearing failure mechanisms, synthesizing insights to guide predictive maintenance strategies for industrial applications.
- Designed and implemented **ultrasonic testing** protocols for worn bearings, using **Fast Fourier Transform** analysis to detect early degradation and optimize replacement schedules.
- Developed a **online monitoring system** for large wind turbine bearings with MatLab, integrating real-time data collection and analysis to enhance reliability and reduce downtime in renewable energy operations.

PUBLICATIONS

Journal Papers

- J7 S. Chen, **C. Zhu**, J. Yi, T.Liu, "Muscle Synergy-Based Force Control of Human-Manipulator Interactions Under Unknown Disturbance", *ASME Journal of Dynamic Systems, Measurement, and Control* (Under Review).
- J6 **C. Zhu***, S. Chen*, X. Chen, J. Yi, "Real-Time Human Walking Gait and Slope Estimation in Contruction with a Single Wearable Inertial Measurement Unit (IMU)", *IEEE Transactions on Automation Science and Engineering* (Under Review).
- J5 **C. Zhu**, X. Chen, J. Yi, "Assistive Control of Knee Exoskeletons for Human Walking on Granular Terrains", *IEEE Robotics and Automation Letters* (Under Review).
- J4 G. Sreenivasan, **C. Zhu**, J. Yi, "Exoskeleton-Assisted Balance and Task Evaluation During Quiet Stance and Kneeling in Construction", *IEEE Transactions on Automation Science and Engineering* (Under Review).
- J3 **C. Zhu**, X. Chen, J. Yi, "Biomechanical Comparison of Human Walking Locomotion on Solid Ground and Sand", *ASME Journal of Biomechanical Engineering* (Under Review).
- J2 **C. Zhu**, J. Yi, "Knee Exoskeleton-Enabled Balance Control of Human Walking Gait with Unexpected Foot Slip", *IEEE Robotics and Automation Letters.*
- J1 J. Zhou, Q. Nguyen, S. Kamath, Y. Hacohen, **C. Zhu**, M. J. Fu, and K. A. Daltorio, "Hands to hexapods, wearable user interface design for specifying leg placement for Legged Robots", *Frontiers in Robotics and AI.*

Conference Papers

- C6 **C. Zhu**, T. Zheng, J. Yi, and A. Dutta, "Brain-Computer Interface (BCI)-Enhanced Shared Control of Wearable Knee Exoskeletons for Walking Turning Assistance", *2025 IEEE International Conference on Robotics and Automation (ICRA)*(Under Review).
- C5 **C. Zhu**, S. Maurya, J. Yi, and A. Dutta, "Brain Computer Interface (BCI)-Enhanced Knee Exoskeleton Control for Assisted Sit-to-Stand Movement", *2024 IEEE/ASME International Conference on Advanced Intelligent Mechatronics* ***Best Conference Paper****.
- C.4 G. Sreenivasan, **C. Zhu**, J. Yi, "Intersection Point-Based Analysis of Neural Balance Control Strategies in Parkinson's Patients during Quiet Stance", *America Control Conference, 2024.*
- C3 **C. Zhu***, G. Sreenivasan*, J. Yi, "Knee Stiffness in Assistive Device Control at Quiet Stance: A Preliminary Study", *Model. Est. Control Conf., 2023.* ***ASME DSCD Best Robotics Paper****
- C2 G. Sreenivasan, **C. Zhu**, J. Yi, "Neural Balance Control of Human Quiet Stance for Construction Workers", *2023 IEEE 19th International Conference on Automation Science and Engineering, Auckland, New Zealand*
- C1 **C. Zhu**, F. Han, J. Yi, "Wearable Sensing and Knee Exoskeleton Control for Awkward Gaits Assistance", *2022 IEEE 18th International Conference on Automation Science and Engineering, Mexico City, Mexico.*