

Yupei Cai

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EDUCATION

Columbia University

Master of Science in Mechanical Engineering

GPA: 3.86/4.0

New York City, United States

Aug. 2023–May 2025

Sun Yat-sen University

Bachelor of Engineering in Aeronautical and Astronautical Engineering

GPA: 3.6/4.0

Guangzhou, CN

Sep. 2019–Jun. 2023

PUBLICATIONS

1. Robert M. Carrera, **Yupei Cai**, Keshu Cai, et al. *Characterizing Standing Postural Coordination Across the Reaching Workspace With A Six-Degree-of-Freedom Biomechanical Model* **IEEE Transactions on Neural Systems and Rehabilitation Engineering** (Under review).
2. Robert M. Carrera, **Yupei Cai**, Keshu Cai, et al. *Postural Models to Control Cable-Driven Parallel Robots for Rehabilitation: A Pilot Study on Squat Assistance* **Robotics and Automation Letters** (Under review).
3. **Yupei Cai**. *Comparison of Different Clustering Methods Applied to Omics Datasets*, 2022 7th International Conference on Machine Learning Technologies (ICMLT 2022).

RESEARCH EXPERIENCE

Columbia University, Robotics and Rehabilitation Laboratory

Graduate Researcher supervised by Prof. **Sunil K. Agrawal**

New York, USA

Feb. 2024 –May 2025

- Investigated postural coordination during multi-directional, multi-height reaching tasks in immersive VR environments, developing a **6-DoF kinematic model** to quantify pelvis–chest interactions.
- Designed and implemented experiments using **VICON motion capture** and synchronized **electromyography (EMG)** to study biomechanics of balance, stability, and muscle activation in squatting tasks.
- Developed and integrated a **revolute-joint robotic model** into the **RobUST Framework** within Unity VR, enabling real-time robotic assistance and squatting control with seven Vive trackers.
- Analyzed EMG data showing that pelvis-driven robotic support reduces Vastus medialis overactivation while preserving tibialis and soleus balance, highlighting the rehabilitation potential for spinal cord injury (SCI) patients.
- Collaborated with a multidisciplinary team to translate experimental findings into **robotic control strategies** for SCI rehabilitation; prepared manuscripts for submission to *IEEE Transactions on Neural Systems and Rehabilitation Engineering* and the *Journal of Biomedical Science*.
- Planned future clinical studies to validate robotic assistance protocols on SCI patients, bridging biomechanics research with real-world rehabilitation applications.

The University of Hong Kong, MARS Laboratory

Research Intern supervised by Prof. **Fu Zhang**

Hong Kong, China

Jun. 2025 –Present

- Developed frontend modules for UAV ground station software, integrating real-time point cloud and video data into a unified interface.
- Applied **Draco compression** to UAV-mounted LiDAR point cloud data; built a software pipeline to receive, decompress, and forward point cloud data to web clients.
- Integrated **Hikvision cameras** with **RK3588 RGA and VPU hardware acceleration**, converting images into RTSP video streams and relaying them via **mediaMTX**.
- Contributed to the open-source **QGroundControl (QGC)** project by embedding a web-based renderer for UAV-transmitted point clouds, enabling interactive visualization such as translation, rotation, scaling, and flight path tracking.
- Modified QGC's layout to achieve synchronized display of **flight control data, video streams, and point cloud information** on the same interface with interactive features.

INTERNSHIP EXPERIENCE

Würzburg Dynamics

Software Engineering Summer Intern

Shen Zhen, China

Aug. 2024 –Sept. 2022

- Developed in the project of the Lung CT Image Automatic Segmentation based on the 3D Region Growth Method; studied the standard and method of labeling, the relevant parameters of CT, and the basic medical structure of lung and kidney.
- Utilized 3Dslicer in the ribs and thorax 3D reconstruction and applied Volume Rendering function; then operated VTK, ITK and OpenCV to preprocess CT images, such as removing noise and smoothing images.
- Researched and referred to the related algorithm research literature, wrote specific algorithm programming codes of region growth deploying MATLAB.

TEACHING EXPERIENCE

Columbia University, Department of Mechanical Engineering

Teaching Assistant

New York, USA

Sept. 2024 –May 2025

- Assisted in teaching **Introduction to Control Theory, Advanced Machine Dynamics** for graduate students.
- Led weekly recitation sessions and office hours, clarifying concepts in robotics, dynamic, and control.
- Designed and graded assignments, projects, and exams, ensuring fair assessment and timely feedback.
- Provided guidance on software tools such as **MATLAB, Simulink**, supporting students in course projects.

SKILLS

- **Programming:** Python, C/C++, MATLAB
- **Language:** English (fluent), Chinese (native)
- **Tools:** Robot Operating System (ROS), Gazebo, CAD, TensorFlow, PyTorch