

# Yupei Cai

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## EDUCATION

<b>Columbia University</b> Master of Science in Mechanical Engineering GPA: 3.86/4.0	New York City, United States Aug. 2023–May 2025
<b>Sun Yat-sen University</b> 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

<b>Columbia University, Robotics and Rehabilitation Laboratory</b> Graduate Researcher supervised by Prof. <b>Sunil K. Agrawal</b>	New York, USA Feb. 2024 –May 2025
<ul style="list-style-type: none"><li>– Investigated postural coordination during multi-directional, multi-height reaching tasks in immersive VR environments, developing a <b>6-DoF kinematic model</b> to quantify pelvis–chest interactions.</li><li>– Designed and implemented experiments using <b>VICON motion capture</b> and synchronized <b>electromyography (EMG)</b> to study biomechanics of balance, stability, and muscle activation in squatting tasks.</li><li>– Developed and integrated a <b>revolute-joint robotic model</b> into the <b>RobUST Framework</b> within Unity VR, enabling real-time robotic assistance and squatting control with seven Vive trackers.</li><li>– 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.</li><li>– Collaborated with a multidisciplinary team to translate experimental findings into <b>robotic control strategies</b> for SCI rehabilitation; prepared manuscripts for submission to <i>IEEE Transactions on Neural Systems and Rehabilitation Engineering</i> and the <i>Journal of Biomedical Science</i>.</li><li>– Planned future clinical studies to validate robotic assistance protocols on SCI patients, bridging biomechanics research with real-world rehabilitation applications.</li></ul>	

<b>The University of Hong Kong, MARS Laboratory</b> Research Intern supervised by Prof. <b>Fu Zhang</b>	Hong Kong, China Jun. 2025 –Present
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- 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

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### 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

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### 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

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