

Wei-Hsuan Cheng

📍 Taipei, Taiwan ✉ johnnathancheng0125@gmail.com / ✉ r11631045@ntu.edu.tw in Wei-Hsuan Cheng
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Education

National Taiwan University (NTU) (Expected) Spring 2025
Master's in Biomechatronics Engineering

- Overall GPA: 4.12/4.3
- Scholarships: 2023 Master's Student Scholarship (First Place) from Dept. Biomechatronics Engineering, NTU
- Coursework:** Robotics, Optimal Control, Stochastic Control, Robust Control, System Identification, Linear Systems
- Master's Thesis:** Application of Vision- and Force-Based Supervisory Teleoperation for Robotic Dexterous Manipulation Tasks in Industrial Surveillance

National Tsing Hua University (NTHU) June 2022
Bachelor in Interdisciplinary Programme of Nuclear Science (IPNS)

- Specialising in Energy Engineering and Power Mechanical Engineering.

Skills

Programming: C++, Python, MATLAB, JavaScript, LaTeX

Robotics Research Interests: Motion Planning and Control, Kalman Filtering, Computer Vision, Vision- and Force-based Control, Application of Conformal Geometric Algebra (CGA) in Robotics

Software/Hardware/Tools: ROS 1 & 2, MoveIt2!, PCL, PyQt5, Git, Docker, SolidWorks, Fusion 360, Nvidia Jetson, STM32 MCU

Research Experience

Delta-NTU Joint Research & Development Centre [!\[\]\(95b425611cbd2b8716a140cf67c81822_img.jpg\)](#) Taipei, Taiwan
Project leader in the collaboration research project of NTU and the CTO Office in Dec 2023 – Present
Delta Electronics, Inc.

Supervisory Teleoperation of Manipulator for Surveillance

- Develop a supervisory tele-manipulation system for industrial surveillance, with hierarchical-autonomy-level structure (teleop-supervised-autonomous). A human-robot interface (HRI) is designed for the operator to teleoperate remote robot via wireless communication and perform dexterous manipulation tasks in industrial surveillance scenario (*e.g.* buttons, switches, and valves operations).
- Apply both vision- and force-based control strategies for robotic arm dexterous manipulation tasks (preparing for submitting to **RA-L** journal).

Robots and Medical Mechatronics Lab (RMML) [!\[\]\(3342c215b2a8b663596a81468d5dc314_img.jpg\)](#) Taipei, Taiwan
Master's student researcher, advised by Prof. Ping-Lang Yen Sept 2022 – Present

Project Experiences and Contributions

- Agricultural Robot:
 - Improve EKF-SLAM for agricultural tracked mobile robot by involving IMU bias estimation and on-line state covariance update.
 - Apply vision-based control scheme and object 6D pose estimation for robotic tomato harvesting.
- Surgical Robot:
 - Improve attitude and angular velocity estimation, and the visual servo control scheme for surgical robot end-effector using multi-sensor fusion and a quaternion-based EKF.

Selected Projects

Attitude and Angular Velocity Estimation of Surgical Robot Using Sensor Fusion with Optical Tracker, IMU, and Quaternion-based Extended Kalman Filter

[kf.cpp](#), May 2023

- A multi-sensor fusion framework is used for estimating the attitude and angular velocity of surgical robot end-effector, for better robustness (against occlusions) and tracking precision in minimally invasive surgeries.
- An quaternion-based EKF algorithm is derived based on a constant angular velocity model.
- The EKF algorithm is simulated in MATLAB and implemented in ROS 2 C++.

Kendo Robot- Combining Robotics Technologies with Martial Art

[kendo_robot](#), Dec 2023

- A supervisory teleoperation kendo robot system. The robotic arm holding kendo sword tracks the opponent's pose and wait for the operator's command to attack on different body positions.
- Detect and track the 3D human body by DL-based real-time human pose estimation algorithm and RGB-D alignment. An interactive GUI is built using JavaScript for real-time visualisation and robotic motion planning.
- Robotic arm IK solver and sword motion planner are designed based on a new mathematical framework, conformal geometric algebra (CGA).
- Developed using ROS 1 Python, and a web-based interactive GUI using JavaScript. ROS-JavaScript communication through web socket.

CGA IK- Closed-Form Inverse Kinematics Solver based on CGA

[cga_ik](#), Nov 2023

- Aim to promote a new mathematical framework **conformal geometric algebra (CGA)** for robotics applications.
- Implement a closed-form IK solver for 6-DoF collaborative robots based on CGA.
- Simulated and visualised in a web-based interactive GUI using JavaScript. Implemented in ROS 2 Python and tested on a real robot.

Furuta Pendulum Balancing Control and Disturbance Rejection via State-Observer Feedback and Internal Model Design

Dec 2022

- Stabilise the Furuta pendulum system by the design of state-observer feedback controller. An internal model is utilised to reject the sinusoidal process noise in the input signal of maxon motor.
- Course project of EE5128 Linear Systems @ NTU EE. System dynamics and control algorithm are simulated in Simulink, Simscape, and MATLAB.

Teaching Assistants (TAs)

Engineering Mathematics (I)

Autumn 2022

Introduction to Foreign Literature on Bio-Systems Engineering

Autumn 2022

Awards

Robotics Competition Winner (Kendo Robot) as a team leader in the course project of CSIE5074 Robotics, offered by Prof. Li-Chen Fu @ NTU EE.

Dec 2023