Chuanbeibei Shi

RESEARCH INTERESTS

The intersection of robotics, computer vision and machine learning, to improve the performance of robots using sensor fusion algorithms.

EDUCATION

Beijing Institute of Technology - *Project 985*   Aug. 2018 – Jun. 2022
B.Eng in Mechatronics and Robotics   *Beijing, China*
- *Advisor:* Yushu Yu, Mauro Bellone and Vincezo Lippiello
- *Distinguished Thesis:* Active vision for object detection on UAVs equipped with limited field-of-view LiDAR and camera

University of Bristol   Sep. 2023 – Aug. 2024
MSc in Robotics   *Bristol, UK*
- *Advisor:* Shane Windsor and Bahadir Kocer
- *Thesis:* Active sensing fusion for small UAVs

PUBLICATION

1. Yingjun Fan, **Chuanbeibei Shi**, Ganghua Lai, Yushu Yu, Yiqun Dong. *Tightly Fusion of Odometry and Kinematic Constraints for Multiple Aerial Vehicles in Physical Interconnection*, *IEEE International Conference on Robotics and Automation (ICRA)*, 2024.

2. **Chuanbeibei Shi**, Ganghua Lai, Yushu Yu, Mauro Bellone, Vincezo Lippiello. *Real-Time Multi-Modal Active Vision for Object Detection on UAVs Equipped With Limited Field of View LiDAR and Camera*, *IEEE Robotics and Automation Letters*, 2023.

3. Yuting Feng, **Chuanbeibei Shi**, Jianrui Du, Yushu Yu, Fuchun Sun, Yixu Song. *Variable Admittance Interaction Control of UAVs via Deep Reinforcement Learning*, *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.

4. Ganghua Lai, **Chuanbeibei Shi**, Kaidi Wang, Yushu Yu, Yiqun Dong. *Multi-Agent Visual-Inertial Localization for Integrated Aerial Systems with Loose Fusion of Kinematics and Odometry*, *IEEE Robotics and Automation Letters*, 2023. [**in revision**]

5. **Chuanbeibei Shi**, Yushu Yu, Yuwei Ma, Dong Eui CHANG. *Constrained Control for Systems on Matrix Lie Groups with Uncertainties*, *International Journal of Robust and Nonlinear Control*, 2023.

6. **Chuanbeibei Shi**, Yushu Yu. *Design and Implementation of a Fully-Actuated Integrated Aerial Platform Based on Geometric Model Predictive Control*, *Micromachines*, 2022.

7. **Chuanbeibei Shi**, Kaidi Wang, Yushu Yu. *Expandable Fully Actuated Aerial Vehicle Assembly: Geometric Control Adapted from an Existing Flight Controller and Real-World Prototype Implementation*, *Drones*, 2022.

8. Yushu Yu, **Chuanbeibei Shi**, Dan Shan, Vincenzo Lippiello, Yi Yang. *A Hierarchical Control Scheme for Multiple Aerial Vehicle Transportation Systems with Uncertainties and State/Input Constraints*, *Applied Mathematical Modelling*, 2022.

9. Yushu Yu, **Chuanbeibei Shi**, Yuwei Ma, Dong Eui CHANG. *Constrained Control for Systems on Lie Groups with Uncertainties via Tube-based Model Predictive Control on Euclidean Spaces*, *International Conference on Cognitive Systems and Information Processing (ICCSIP)*, 2021.

Experience

Autonomous Driving Algorithm Developer
Megvii Technology Limited

Sep. 2022 - Jun. 2023
Beijing, China

- Developed vision algorithms for obstacle detection and tracking based on multi-lidar and camera fusion.
- Assisted in the implementation of simulated driving testing software and completion of semi-closed loop and closed loop testing of the car using SUMO-Carla co-simulation.

Undergraduate Research Assistant
Beijing Institute of Technology

Jul. 2019 – Sep. 2023
Beijing, China

- *Advisor:* Yushu Yu
- Proposed a LiDAR and camera fusion method by leveraging a revised neural network to improve the detection accuracy in challenging scenarios.
- Designed a compliant control model based on reinforcement learning which allows robot to operate stably in unknown environment.

Data Mining and Analysis Research Assistant
North Carolina State University

Jul. 2021 – Aug. 2021
Raleigh, USA

- *Advisor:* Muhammad Shahzad
- Utilized the spatiotemporal data of the supply and utilization of 12 electric scooters sharing systems to study and identify similarities and differences in the use of such systems in 11 different cities.
- Used Python to conduct data mining and analyze the situation of the dockless e-scooter sharing (DES) system, helping users understand the differences in urban traffic behavior and the use of micro-transport platforms.

Machine Learning & Artificial Intelligence Research Assistant
Massachusetts Institute of Technology

Jul. 2019 – Aug. 2019
Boston, USA

- *Advisor:* Vivienne Sze
- Mastered decision-making and the application of classic algorithm Q-learning through participating in the summer school of machine learning and artificial intelligence courses.
- Used the artificial neural network to identify the author by inputting the picture of the painting.

Project

Active Vision for Object Detection on UAVs with Camera and LiDAR
Research Intern

Jul. 2021 – Aug. 2023
BIT, China

- Derived and completed the preprocessing code for transforming the point cloud into multiple-channel images including point cloud accumulation, projection, and upsampling point cloud images.
- Tested the early fusion, cross fusion, and late fusion of the images transformed from the point cloud and captured by cameras, and trained the early fusion object detection CNN based on Darknet.
- Derived the perception constraints to keep the region of interest in the Field-of-view (FOV) of the camera and LiDAR, and designed the model predictive control from the perception constraints.
- Conducted the multi-modal sensor active vision on a real world small scale UAV

Geometric Tube-based MPC for Aerial Robots
Research Intern

Jul. 2019 – Mar. 2021
BIT, China

- Proposed original ideas on constrained control of systems on the manifold with uncertainties and input/state constraints via tube-based MPC on Euclidean space.
- Proved the input-to-state stability and recursive feasibility of the entire control algorithm.
- Finished the simulation coding on MATLAB, applied the methodology to aerial robots, developed the real-world program of the MPC for aerial robots, and wrote related academic papers.

Robust Control of Multiple Aerial-Vehicle Transportation Systems
Research Intern

Dec. 2020 – Sep. 2021
BIT, China

- Derived the mathematical model of the multiple aerial-vehicle transportation systems.
- Designed a hierarchical control scheme for multiple aerial-vehicle transportation systems to deal with the uncertainties and constraints.
- Developed the numerical simulation code on MATLAB based on the modeling and the control scheme, conducted several comparisons with other existing control schemes

Innovation Practice-Intelligent Robots I - Obstacle Avoidance Car   Sep. 2020 – May 2021

Research Intern   *BIT, China*

- Used labelimg to mark the data of car pictures and wood blocks and set up data sets for training.
- Called camera on Raspberry Pi based on Keras, TensorFlow, OpenCV and YOLOV3 for real-time deep learning to identify cars and blocks.
- Extracted rectangular boxes based on camera on Raspberry Pi and OpenCV-Python for image recognition to realize face recognition and tracking and ranging of multi-target color wood blocks.
- Avoided obstacles automatically based on camera on Raspberry Pi and ultrasonic and infrared sensors for controlling the rotation of the motor after detecting the obstacles in front and left and right by serial communication from Raspberry Pi to Arduino.

Rotor-Wing Amphibious Unmanned Aerial Vehicle (UAV)   Sep. 2018 – Oct. 2019

Research Intern   *BIT, China*

- Established preliminary UAV model based on Matlab, retained the main structure of the submarine in the body design, and embedded the "X" layout design of the quadrotor UAV.
- Applied the numerical method of differential equations to determine the final positioning of the target motion state of the submarine.
- Predicted the integral formula value by setting the differential equation and constructing the estimation formula.
- Adopted a four-rotor retractable structure to control forward and backward, and equipped with sensors and cameras to sense and monitor changes in the surrounding environment, switch between flight and diving modes, and optimize path.

PROFRESSIONAL ACTIVITIES

Reviewer(Conferences): ICRA 2023, IROS 2023, ICRA 2024

TECHNICAL SKILLS

Technical Skills: Python, C/C++, MATLAB, HTML/CSS, JavaScript, JAVA
Developer Tools: Git, PyCharm, VS Code, Visual Studio, IntelliJ
Libraries: Pandas, NumPy, Matplotlib

HONORS & AWARDS

Distinguished Thesis – School of Mechatronic Engineering at Beijing Institute of Technology 2022