Hao Chen

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My research/project experience includes navigation, localization, Bayesian estimation, distributed estimation, sensor/data fusion and control of unmanned aerial vehicles (UAV) and Robotics. I am currently looking for a position on perception and control of UAV, autonomous car, or Robotics.

Education

OKLAMOHA STATE UNIVERSITY (OSU) *Stillwater, OK, USA*
Ph.D. candidate in Mechanical and Aerospace Engineering. GPA: 4.00/4.00 Sep 2019 – Jun 2024(Expected)

SOUTHWEST UNIVERSITY OF SCIENCE AND TECHNOGY (SWUST) *Mianyang, Sichuan, China*
B.E. in Automation. GPA: 3.62/4.00 Sep 2015 – Jun 2019

Skills

Programming: MATLAB, Python, C++, C, and R. **Simulation:** Simulink, ROS, Gazebo **Version Control:** Git
Language: English (fluent), Mandarin (native) **Embedded system:** Arduino/STM32/Raspberry Pi
Algorithm: perception algorithm**:** EKF, MEKF, IEKF, UKF, SLAM, etc.; control algorithm: PID, LQR, MPC, etc.; machine learning algorithm: linear/logistic regression, DNN, CNN, RNN, LSTM, etc.

Research Experience

Control, Robotics and Automation Lab (CoRAL), OSU, *Stillwater, OK, USA*
Research Assistant Sep 2019– Dec 2023(Expected)
NSF-NRI: Safe Wind-Aware Navigation for Collaborative Autonomous Aircraft in Low Altitude Airspace.

- We show that the quadcopter dynamics is invariant under the action of a Lie group and design an Invariant Extended Kalman Filter (IEKF) by taking advantage of symmetry in the system dynamics. Simulations demonstrate that the IEKF produces improved transient estimation performance over a conventional EKF.
- We establish invariance properties of various thrust models and incorporate them for invariant extended Kalman filters (IEKFs) designs. Simulations show that the IEKF with the accurate thrust model improves the states and wind estimation performance (particularly in the vertical direction) for various wind fields.
- We conduct indoor and outdoor experiments for algorithm validation. For indoor experiments, we built a thrust stand for obtaining thrust model, a mobile robot for ground truth wind collection, and we used a motion capture system for pose feedback and small-size quadcopter for flight test. For outdoor experiments, we conducted multiples outdoor experiments by using a large-size quadcopter for hovering test and various wind sensors for collecting true wind.
- We extend the EKF wind estimator for multi-UAV with directed connected communication graphs by developing a sequential covariance intersection (SCI) method and a sequential weighted exponential product (SWEP) method. Since each agent's information is shared and fused, the wind field estimation of each quadcopter is expected to converge faster with better accuracy.
- We establish invariance properties of various wind models, such as radial basis and neural network wind model, and incorporate them for multi-UAV IEKFs design.

Special Environment Key Laboratory of Sichuan Province, SWUST *Mianyang, Sichuan, China*
Undergraduate Sep 2016 – May 2018
"Challenge Cup" National College Student Curricular Academic Science and Technology Works Competition: Multi-robot collaboration system for education and experimental purpose in structured environment.

- We develop path planning and collision avoidance strategy based on improved A star algorithm for multi-robot system in grid space.

Publications

- Chen, H., Bai, H. and Taylor, C.N., 2022, June. Invariant-EKF design for quadcopter wind estimation. In 2022 American Control Conference (ACC) (pp. 1236-1241). IEEE. (Published)
- Chen, H. and Bai, H., 2022. Incorporating thrust models for quadcopter wind estimation. IFAC-PapersOnLine, 55(37), pp.19-24. (Published)
- Chen, H. and Bai, H., 2023. Wind Field Estimation Using Multiple Quadcopters. Modeling, Estimation and Control Conference 2023. (Accepted)
- Chen, H. and Bai, H., 2024. Model-based invariant filters for quadcopter wind estimation. IEEE Transactions on Aerospace and Electronic Systems. (Submitted)
- Chen, H., Bai, H., Jacob, J. and Revard, B., 2024. Experimental validation of dynamics-based wind estimation for quadcopters. AIAA Science and Technology Forum and Exposition. (In preparation)
- Chen, H. and Bai, H., 2024. Temporal-spatial wind field estimation using multiple quadcopters. IEEE Transactions on Aerospace and Electronic Systems. (In preparation)