XINLEI ZHANG

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EDUCATION

Intelligent Manufacturing | ***Shien-Ming Wu School of Intelligent Engineering*** 09/2020 - 06/2024 (Expected)
South China University of Technology (SCUT) Guangzhou, China

Overall GPA 3.75/4.0, Top 15%

Related Courses

- Applied Calculus II 96/100, Linear Algebra 97/100, Probability and Statistics 89/100
- Artificial Intelligence Technology and Applications 90/100
- Big Data Analytics and Applications in Industry 98/100
- Classical Control Theory 92/100

RESEARCH INTERESTS & VISION

My research interests lie in the fundamental problems in **robotics**, including **control & automation**, **system dynamics & modeling**, **SLAM**. I pay extra attention to the medical robots and I envision medical scenarios powered by intelligent and automatic robots.

RESEARCH EXPERIENCE

The Lab of Magnetic Controlled Robot, SCUT 09/2021-Now
Research Assistant, advised by Dr. Heng Wang

Magnetic-Inertial Probe Tracking 09/2021-12/2021

- **Innovation:** While most existing electromagnetic tracking systems consist of multiple electromagnets acted as the magnetic source (e.g., NDI 3-D Guidance trakSTAR), **only one electromagnet is required** as the magnetic source in our work. The 9-axis measurements, including 6-axis inertial and 3-axis magnetic measurements of the probe, were fused to enable its 6-D tracking.
- **Contribution:** I involved in this work in **developing the 6-D tracking algorithm**, using the state estimation technique (extended Kalman filter) to achieve the 6-D tracking. During this work, I found the ambiguity problem of common magnetic tracking system and proposed this problem as **a new research direction** in our lab.
- **Outcome:** 1.) one Chinese patent which is under pending; 2.) one new research direction.

On Ambiguity in 6-DoF Magnetic Pose Estimation 01/2022-Present

- **Innovation:** In the last work, the system including one magnetic source, one 3-axis magnetic sensor and one 6-axis inertial sensor is capable of 6-D tracking. But, why the system including one magnetic source and one 3-axis magnetic sensor failed? In this work, we fundamentally investigated the ambiguity problem in magnetic pose estimation, including its definition, categorization, identification algorithm and impact on pose estimation, which can serve as a theoretical framework to analyze the ambiguity problem in magnetic tracking system. With our framework, **if only one 3-axis magnetic sensor is used in a magnetic tracking system, ambiguity in any magnetic tracking system can be analyzed. Minimum system with only two magnetic sources is proposed, which can be remedied and achieve 6-D tracking. Three magnetic sources system is proposed which is free from ambiguity**.
- **Contribution:** I **proposed and investigated** the ambiguity problem in the theoretical level with the assistance of my advisor. And I **designed and conducted** experiments to demonstrate my theoretical framework with the assistance of one graduate student in our lab.
- **Outcome:** 1.) One manuscript has been submitted to IEEE Transaction on Robotics (***T-RO***), which is under the first round review; 2.) This work has been extended to one **Chinese National Training Program of Innovation and Entrepreneurship for Undergraduates** (total funding amount $1300), called ' The Electromagnetic Tracking System in Medical Application with Minimum Number of Electromagnets '.

Multiple Permanent Magnets Pose Estimation 06/2023-Present

- **Innovation:** In the previous work, we focused on the magnetic tracking system utilizing electromagnets as external sources and 3-axis sensors as tracking targets. In the medical scenario of minimally invasive surgery, permanent magnets which can serve as passive tracking targets are preferred due to its wireless tracking capability. **In this work, we developed a fixed multiple-magnetic-sensor-array, which was used to track three (or more) permanent magnets simultaneously. The state estimation problem in this system was investigated**.
- **Contribution:** I involved in this work in investigating the state estimation problem of this multi-target and multi-sensor system.
- **Outcome:** This work is currently in progress and we're designing experiments to demonstrate our system.

PUBLICATION & PATENT

On Ambiguity in 6-DoF Magnetic Pose Estimation | ***First Author*** 05/2023
Xinlei Zhang, Shuda Dong and Heng Wang, *Member, IEEE*
*Submitted to IEEE Transaction on Robotics (**T-RO**), under the first round review*

A Virtual Ultrasonography Simulator for Skill Training Using Magnetic-Inertial Probe Tracking 03/2023
Heng Wang, Shuangyi Wang, Suqi Liu, Shuda Dong, Xinlei Zhang
Chinese Patent, under pending

RELATED COURSE PROJECTS

Tendon-Driven and Flex Sensor Based Gesture Sensing Hand Exoskeleton | ***Team Leader*** Spring 2023

- **Summary:** This project aimed to design a hand exoskeleton system which can provide the people with hand strength deficit with enough grasp force for daily life. We used 10 motors to stretch tendons to achieve **independent control of all five fingers** of a hand. Besides, we used flex sensors to measure the bending extent of each finger, to add **safety insurance**, **reconstruct the gesture** and achieve **close-loop gesture control**.

Machine Learning & IMU Based Classifier on Ping-Pong Players' Motion | ***Team Leader*** Fall 2021

- **Summary:** This project aimed to develop a motion classifier to supervise the training process of novice ping-pong players. In this project, we used **two 6-axis inertial sensors** to collect the **motion data** of the upper-arm and the hand of one ping-pong player. We designed **a classifier based on machine learning technique-ensembling neural network and decision tree** to distinguish the motion of forehand drive and backhand stroke. Besides, we designed **a default detect algorithm** to detect the wrong motion during training which may bring damage to the player.

SELECTED AWARDS & HONORS

Honorable Mention (Second-Class Award), Mathematical Contest in Modeling (International) 05/2023
Top 3500 teams among total 11296 teams

Third-Class Award, Alibaba Cloud Programming Contest in SCUT 03/2023
Top 30 teams among total 180 teams

Undergraduate Internship Scholarship, China Scholarship Council & University of Alberta 08/2022
Only 1 in South China University of Technology and total 9 in China

National First Prize & Excellent Defense, Micro Sensing and Intelligent Technology Contest 10/2021
Top 20 teams among total 500 teams

Third-Class University Scholarship, South China University of Technology Freshman Year
Top 7 among total 55 students

EXTRA-CURRICULAR-ACTIVITIES

Journalist for School Events 03/2023-Now
I usually write activity/academic speech/lecture posts for School Social Media Public Account

SKILLS

Languages: Chinese (Native), English (IELTS 6.5/9.0)
Programming: MATLAB & Simulink, Python, C, C++, R
Others: SolidWorks, Embedded System Development, Photo & Video Editing, LaTex & Markdown