Ruochen WU

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EDUCATION BACKGROUND

Central South University (CSU) 09/2018 – 06/2022

B.Eng. in Transportation Equipment and Control Engineering | **GPA:** 3.47/4.0 (WES)

Courses: Advanced Mathematics | Linear Algebra | Probability and Statistics | Fundamental of Computer Programming (C++) | Computer Engineering Graphics | Analog Electronics Technology | Digital Electronics Technology | Fundamental of Control Engineering (MATLAB) | Locomotive Vehicle Engineering | Artificial Intelligence and Automatic Drive | Vehicle Structural Strength and Dynamics (ANSYS) | Electric Traction Drive and Control

Delft University of Technology (TUDelft) 09/2023 – today

MSc. in Multi-Machine Engineering(MME), Mechanical Engineering | GPA: 8.2/10.0

Courses finished: Control System Design | Dynamics and Interaction of Material and Equipment | Drive & Energy Systems | Reliability & Maintenance of Transport Equipment | Operation & Maintenance | Measurement Technology | Machine Learning for Transport and Multi-Machine System | System Analysis and Simulation

RESEARCH EXPERIENCES

Delft AI Energy Lab & Austrian Institute of Technology (AIT) 09/2024 – now

AI for Science – Interpretable Intraday Price Prediction Integrating Kolmogorov-Arnold Networks and Large Language Models

Master Graduation, Supervisor: Dr. Jochen CREMER

- Developed an interpretable intraday price prediction model for Austria's electricity market, enhancing both predictive accuracy and model interpretability through deep learning, and proposed actionable trading strategies based on model outputs.
  - Built a predictive model for intraday buying and selling prices in Austria's electricity market using the Torch architecture, focusing on time-series data for precise forecasts;
  - Incorporated the Knowledge-Augmented Neural Network (KAN) to increase model transparency, transforming the neural network from a "black box" into an interpretable "white box";
  - Utilized Large Language Models (LLM) to extract, analyze, and interpret training outcomes, enabling the discovery of concise, accurate, and highly interpretable formulas within the predictive framework;
  - Developed tailored trading strategies based on the predictive insights, providing structured guidance for market participants on optimized buying and selling decisions.

Adaptive Metastructures, Mechanisms and Machines Lab (JAM Lab) 06/2024 – 10/2024

Novel Invention – Design and Control strategy of a Novel SMA-SMP Based Morphing Structure

Research Assignment, Supervisor: Dr. Jovana JOVANOVA

- Designed and fabricated an innovative morphing structure incorporating multiple shape memory materials (SMMs), along with a temperature detection system and a control system to enable advanced shape transformations.
  - Proposed a recoverable morphing structure capable of achieving stable, continuous, and complex deformations, setting a foundation for more versatile applications;
  - Expanded the potential of SMM-based soft robotics by advancing from discrete thermal deformation of fixed shapes to stable and controlled continuous deformation, thereby enhancing functional adaptability;
  - Developed a high-interpretability temperature detection system based on unsupervised learning to enable precise control of complex morphing structures;
  - Created control logic and implemented a responsive control system using a PID controller for accurate real-time adjustments;
  - Fabricated a fully functional prototype and conducted experimental validations to confirm system performance and reliability.
- **Expected Publication:** IEEE/ASME Transactions on Mechatronics (submitted)

Advanced Lithography for Opto-Electronic Nanochips Lab (Alien Lab) 02/2023 – 04/2023

Functional Extension – External Measurement Circuit for AFM

Visiting Student, Advisor: Dr. Xiaorui ZHENG

- Designed and established a circuit on frequency response in high frequency cases for Atomic Force Microscope (AFM) which is totally independent to the inner circuit.
  - Adopted modular design when determining the general scheme to face the different demands of CAFM functions in different cases on an OXFORD MFP-3D Origin AFM equipment;
  - Using Altium Designer software, finished electronic designs of the transmission section in different size and environmental noise;
  - Invented a Pre-Test device to imitate the connection between the head of AFM platform and external circuit, which helps to lower the risk of damage on the probe.

Key Laboratory for Rail Traffic Safety Appointed by Ministry of Education 04/2022 – 12/2022

Numerical Modeling – Transmission of Coughing Droplets in a Train

Team Member, Advisor: Dr. Fan WU

- Performed and compared numerical simulations of prevailing ventilation modes on the transmission and spatial distribution features of coughing droplets in a passenger cab of high-speed trains.

- Created the 3D model of the car and turned to mesh data, used the incompressible Navier-Stokes equations as the governing equation of the flow field;
- Through computational fluid dynamics (CFD) simulation, analyzed the droplet distribution， revealed that under the current ventilation modes, the airflow barrier was formed in the middle of the aisle, and more than 77.36% of the released droplets were limited to accumulate on the releasing side;
- Using ANSYS FLUENT, under the given boundary conditions, found that strong recirculation flows appeared in the circumstance of top air supply mode which suppressed the longitudinal transport of droplets;
- The outcomes can be useful to optimize air-conditioning flow and reduce infection risks in high-speed trains and other means of public transportation with similar ventilation strategies.

➢ **Publication:** Xu, Renze & Wu, Fan & Li, Xueliang & Yu, Chao & Li, Hengkui & **Wu, Ruochen** & Wu, Yilin. (2022). Numerical comparison of ventilation modes on the transmission of coughing droplets in a train compartment. *Journal of Wind Engineering and Industrial Aerodynamics*. 231. 105240. 10.1016/j.jweia.2022.105240.

Key Laboratory for Rail Traffic Safety Appointed by Ministry of Education 01/2022 – 05/2022
Optimization Design – Air Duct in the Driver's Cab of EMU
Graduation Project, Advisor: Dr. Fan WU

➢ Performed and compared numerical simulations of different air supply modes of the air conditioning system in the driver's cab of China Railway CR200JS-G (a Chinese-built Higher-Speed Rail Electric Multiple Unit), and generated an optimization design of the air conditioning duct in the cab.
- Using Rhino software, established the original model of the current scheme of the driver's cab, especially the details of the air duct of the air conditioning system;
- Through computational fluid dynamics (CFD) simulation, choosing the k-ε turbulence model and the Reynolds-averaged Navier-Stokes (RANS) approach, evaluated the rationality of the air duct design of the original model by drawing the temperature cloud diagram and velocity cloud diagram to determine the uniformity of the temperature field and air velocity field;
- Based on CFD simulation results, propose optimization design schemes, evaluated the rationality, advantages, and disadvantages of each scheme by analyzing the internal flow field;
- According to the evaluation results of the original model, the optimization scheme could increase the airflow of several key outlets by up to 2.27 times of that of the original one, making the airflow ratio of each outlet more reasonable.

➢ **Result:** The simulation results are being used by CRRC Dalian to optimize the design of the driver's cab.

Key Laboratory for Rail Traffic Safety Appointed by Ministry of Education 02/2021 – 07/2021
Original Design – An Automatic Service Robot in Train Compartments
Core Member (Structural, Functional, and Electronic Design Team), Advisor: Dr. Fan WU

➢ For China Railway CRH380A (a high-speed rolling stock), designed an automatic service robot prototype with automatic cruise control, air quality monitoring, cleaning, plasma disinfection, and vending functions.
- Implemented the mechanical and electronic design of the positioning and navigation module: used the simultaneous localization and mapping (SLAM) technique, gyroscope sensors, and LIDAR for robot positioning, enabled pathfinding and obstacle avoidance with the rapidly-exploring random trees (RRT) algorithm;
- Used mecanum wheels and shock absorbers for omnidirectional, smooth, and quite movement in compartments, controlled by CTDS 1000 series servo motor drivers;
- Verified the specifications of ready modules like air quality monitoring and disinfection, designed transformers and rectifying circuits, etc., for the integrated robot system.

INTERNSHIPS

Zhejiang Jingfei Aviation Manufacturing Co., Ltd., Jinhua | *Engineer Assistant* 01/2022 – 02/2022

➢ Assisted senior engineers in 2D/3D drawings and design of aircraft wing parts (ribs, front/center/rear spar, skin panel, etc.);
➢ Verified mathematical models of aviation products, processed and compiled internal documents.

LEADERSHIP EXPERIENCES

Class President, Head of Innovation Committee 10/2018 – 06/2022
Press Corps Officer, News and Publicity Center, Central South University 10/2018 – 02/2019

AWARDS & HONORS

Outstanding Graduate (15%), CSU 04/2022
Outstanding Student (10%), CSU 04/2020

Third-Class Scholarship (30%), CSU 05/2019, 05/2021
Second-Class Scholarship (15%), CSU 05/2020

Excellent Display Board, 2020 Innovation and Entrepreneurship Annual Meeting of Central South University Students 06/2020

SKILLS & PROFICIENCIES

Programming: Python / C / C++
Languages: Mandarin (*Native-speaker*), Jinhua Dialect (*Native-speaker*), English (*Proficient*, IELTS 7, GRE 330+4)
Hobbies: Basketball, Saxophone