Yuxuan Liu

+86-18810875508 | lyuxua@foxmail.com | X-911A for iDI, No.2279 Lishui Rd., Shenzhen 518055

Education

Tsinghua University 09/2021 - Present

Master of Science in Data Science and Information Technology | GPA: **3.98**/4.00; Ranking: **8**/134

Core Courses: Advanced Signal Processing: Methods and Practice (A+), Nanogenerators and Self-powered Systems (A-), Operations Research (A-), Fundamentals of Information Theory (A), Course Project of Embedded Systems (A)

Beijing Jiaotong University 09/2017 - 07/2021

Bachelor of Engineering in Communications Engineering | GPA: **3.86**/4.00; Ranking: **7**/254

Core Courses: Signals and Systems (97/100), Digital Signal Processing (94/100), Digital Electronics Technology (96/100), Fundamentals of Wireless Communications (90/100), Principles of Communication Systems (92/100), Electromagnetic Field and Magnetic Waves (94/100)

Selected Publications

[C1] **Yuxuan Liu***, Haoyang Wang*, Fanhang Man, Jingao Xu, Fan Dang, Yunhao Liu, Xiao-Ping Zhang, Xinlei Chen, *"MobiAir: Unleashing Sensor Mobility for City-scale and Fine-grained Air-Quality Monitoring with AirBERT"*, **ACM MobiSys'24** (Acceptance Rate≈16.3%, DOI)

[C2] Weichen Zhang, **Yuxuan Liu**, Xuzhe Wang, Xuecheng Chen, Chen Gao, Xinlei Chen, *"Demo Abstract: Embodied Aerial Agent for City-level Visual Language Navigation Using Large Language Model"*, **ACM/IEEE IPSN'24** (DOI)

[C3] Haoyang Wang, Xinyu Luo, Ciyu Ruan, Xuecheng Chen, Wenhua Ding, **Yuxuan Liu**, Xinlei Chen, *"Poster: Fusing Event and Depth Sensing for Dynamic Objects Localization and Tracking"*, **ACM HotMobile'24** (DOI)

[C4] Yuhan Cheng, Xuecheng Chen, Yixuan Yang, Haoyang Wang, **Yuxuan Liu**, Xinlei Chen, *"Poster: Olfactory Sensing in Turbulent Airflow via Collaborative Robots"*, **ACM HotMobile'24** (DOI)

[C5] Chenyu Zhao, Ciyu Ruan, Shengbo Wang, Jirong Zha, Haoyang Wang, Jiaqi Li, **Yuxuan Liu**, Xuzhe Wang, Xinlei Chen, *"Demo Abstract: Bio-inspired Tactile Sensing for MAV Landing with Extreme Low-cost Sensors"*, **ACM/IEEE IPSN'24** (DOI)

[C6] Xuecheng Chen, Haoyang Wang, Yuhan Cheng, Haohao Fu, **Yuxuan Liu**, Fan Dang, Yunhao Liu, Jinqiang Cui, Xinlei Chen, *"DDL: Empowering Delivery Drones with Large-scale Urban Sensing Capability"*, **IEEE JSTSP**, 2024 (DOI)

[C7] **Yuxuan Liu***, Haoyang Wang*, Chenyu Zhao, Jiayou He, Wenbo Ding, Xinlei Chen, *"CaliFormer: Leveraging Unlabeled Measurements to Calibrate Sensors with Self-supervised Learning"*, **ACM UbiComp/ISWC'23** (CPD Workshop, DOI)

[C8] Haoyang Wang, Fanhang Man, Zihan Wang, **Yuxuan Liu**, Xinlei Chen, Wenbo Ding, *"Poster Abstract: TENG-enabled Self-powered Human-machine Interfaces for the Metaverse"*, **ACM/IEEE IPSN'23** (DOI)

[C9] **Yuxuan Liu***, Yifei Sun*, Ziteng Wang, Xiaoli Qu, Dezhi Zheng, Xinlei Chen, *"C-RIDGE: Indoor CO2 Data Collection System for Large Venues Based on Prior Knowledge"*, **ACM SenSys'22** (DATA Workshop, DOI)

[C10] **Yuxuan Liu**, Xinyu Liu, Fanhang Man, Chenye Wu, Xinlei Chen, *"FAD: Fine-grained Air Pollution Data Enables Smart Living and Efficient Management"*, **ACM SenSys'22** (DOI)

[J1] **Yuxuan Liu**, *"Design of an Internet of Things (IoT)-based shipping monitoring platform and database system"*, **The Journal of New Industrialization**, 2020,10(03):126-128+133 (ISSN 2095-6649)

Conference Presentation

- Paper Presentation: MobiAir, ACM MobiSys'24, Tokyo, Japan, June 2024
- Paper Presentation: CaliFormer, ACM UbiComp/ISWC'23, Cancún, Mexico, October 2023
- Paper Presentation: C-RIDGE, ACM SenSys'22, Virtual, November 2022
- Demo Presentation: FAD, ACM SenSys'22, Virtual, November 2022

Research Experience

City-scale and Fine-grained Air Quality Sensing 09/2021 – 06/2024

Adviser: Prof. Xinlei Chen

➢ ***CaliFormer: Leveraging Unlabeled Measurements to Calibrate Sensors with Self-supervised Learning***

- Proposed CaliFormer, a sensor calibration model based on representation learning to extract temporal- and spatial-invarient knowledge shared among tasks to address the calibration issue in environmental data.

- Pioneered the integration of self-supervised learning into sensor calibration tasks to address the challenge of limited labels in environmental data.
- Introduced a Transformer-based model architecture and designed a Masked Language Modeling (MLM) pre-training task to train the calibration model effectively.
- The MAE of data calibrated by CaliFormer can be reduced to **16.54** $\mu g/m^3$, achieving a **30%** improvement compared to the SOTA methods. Furthermore, the model exhibited strong robustness under different labeling rates.

➢ ***MobiAir: Unleashing Sensor Mobility for City-scale and Fine-grained Air-Quality Monitoring with AirBERT***
- Proposed MobiAir, the first accurate city-scale and fine-grained air quality monitoring system based on MCS.
- Developed AirBERT to separate the spatially mixed gas measurements by extracting non-stationary and non-Markovian features and modeling the mutual influences among sensor readings.
- Designed a knowledge-informed training strategy to enhance performance of MobiAir and reduce the demand for city-scale labeled data.
- Implemented a modular sensing front-end with separate chambers and active airflow design, which aims to collect highly mobile air quality data under high sampling rates.
- City-wide deployement and experimental results demonstrate MobiAir reduces sensing errors by **96.7%** with only **44.9ms** latency, outperforming the SOTA baseline by **39.5%**.

➢ ***FAD: Fine-grained Air Pollution Data Enables Smart Living and Efficient Management***
- Proposed FAD, a multi-source environmental data-driven system, using fine-grained air pollution data to realize smart city.
- Designed a low-cost and high-precision portable sensing device to collect high-spatial-resolution air pollution data. It can be deployed on highly mobile vehicles (e.g., buses, drones) to perform Mobile Crowdsensing (MCS) tasks.
- Designed four services: Advice for healthy life, Route planning, Toxic gas leakages finding & warning, and High pollution-emission sources locating to improve residential living quality and official city management efficiency.
- Deployed over **300** devices in **17** cities and regions across China, with a total annual device operating time exceeding **1.5 million** hours and a data volume exceeding **2 billion** records. Experiments show that the data spatial resolution can be up to **45m**, representing an improvement of over **40 times** compared to traditional static sensing methods.

Smart Sensing and Energy Conversion Based on Self-powered TENG   09/2021 - 02/2023
Adviser: Prof. Wenbo Ding

➢ ***TENG-enabled Self-powered Human-machine Interfaces for the Metaverse***
- Proposed a human-machine interface (HMI) system based on the soft self-powered TENG (Triboelectric Nanogenerator) to address the limited degrees of freedom issue encountered in traditional HMIs.
- Implemented an ergonomically designed TENG sensor prototype deployed on a human joint to collect electrical signals generated during body movements (e.g., the arm), and utilized simple Artificial Neural Networks (ANN) to reconstruct and visualize the angles of motion.
- The recognition resolution of bending angle of human arms can be up to **15°**, and our system can map real movements in the digital world.

➢ ***Distributed Low-frequency Mechanical Energy Conversion based TENG Prototype***
- Designed standalone layered TENG sensors with low-cost acrylic sheets, simulated wave motion, collected sensor data with electrostatic meter, and analyzed signal waveforms using LabVIEW.
- Investigated the impact of materials, contact area, and movement speed on signal intensity by altering substrate materials, roller dimensions, and sensor tilt angles, and enhanced signal through stacking multiple layers of sensors.
- Validated effectiveness of converting low-frequency mechanical energy into electrical energy by illuminating LEDs.

Low-Carbon Winter Olympics - Intelligent Data Collection and Processing   09/2021 - 10/2022
Advised by Prof. Xinlei Chen & Prof. Dezhi Zheng

➢ ***C-RIDGE: Indoor CO_2 Data Collection System for Large Venues Based on Prior Knowledge***
- Proposed C-RIDGE, a low-power sensing system for high-resolution CO_2 data collection in large venues.
- Proposed a power optimization and anomaly detection module based on prior physical knowledge in sensor design, and develop a sensor deployment strategy driven by data and physical models as the deployment method.

- Deployed **45** C-RIDGE systems in the National Speed Skating Oval during the 2022 Beijing Winter Olympics, and carried out **15-day** data collection of CO_2 concentrations with data released on Zenodo.
- Experiments demonstrated that C-RIDGE achieved a **36.1%** reduction in power consumption. The anomaly detection module achieved a **100%** detection rate for anomalies and effectively identified abnormal trends.

Extracurricular Activity

Director, **Symphony Orchestra, Bejing Jiaotong University**   2018 - 2020
- Performed at various activities, including "Call It a Concert" and "Music Salon" Themed Music Concert, etc.

Honors

2024 | **Outstanding Thesis** (M.Sc.) of Tsinghua University & **Outstanding Graduate** of Beijing

First place of the Best Poster, International Workshop on Learning and Information Theory

Third prize of TBSI Retreat Student Poster Contest, Tsinghua University

2023 | **The Award of BEST PRESENTATION in CPD Session**, ACM UbiComp/ISWC

Second-class Overall Excellence Scholarship, Tsinghua University

2017-2021 | **First-class Academic Excellence Scholarship**, Beijing Jiaotong University (top 3%)

First-class Arts Excellence Scholarship, Beijing Jiaotong University (top 5%)

Second-class Sports Excellence Scholarship, Beijing Jiaotong University (top 5%)

Merit Students, Beijing Jiaotong University (top 3%)

Honorable Mention of Mathematical Contest in Modeling/Interdisciplinary Contest in Modeling (MCM/ICM)

Third prize at the College Student Computer Design Contest

Skills

Programming Language: Python, Matlab, C, Assembly Language, Latex, MySQL, Java, HTML, CSS, JSP

Software & Platform: VS Code, Pycharm, Matlab, Eclipse, Multisim, Tina-TI, Protues, Keil5, Wireshark, NS2