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Qufei Zhang

Education

08/2024-05/2026 **Information Networking Institute, Carnegie Mellon University (CMU)**, United States
MS. Mobile and Internet of Things Engineering
Selected Coursework: Design Human-Centered Software, Air Vehicle Design

09/2020-07/2024 **Beijing-Dublin International College, University College Dublin (UCD)**, China&Ireland
B. Eng. Internet of Things Engineering (First Class Hons)
Selected Coursework: Embedded Systems and Software, Federated Learning for Computer Vision

Professional Experience

01/2024-03/2024 **Algorithm Engineer**, *Big Data and Artificial Intelligence Lab, Siemens*
Advisor: Dr. Xiaoyin Che
- Developed and integrated a graph layout algorithm to optimize visualization and performance.

07/2023-09/2023 **Research Assistant**, *Computer Science Lab, City University of Hongkong*
Advisor: Prof. Jun Huang
- Collaborated to develop a 802.11(WIFI) receiver in C++ with Beamforming to decode custom packets.

01/2023-06/2023 **Computer Vision Algorithm Engineer**, *Institute of Automation, Chinese Academy of Sciences*
Advisors: Prof. Jinqiao Wang; Dr. Haiyun Guo
- Implemented a multi-task learning model for vehicle attribute detection.

Selected Projects

Asteroids AR, *Tools: Unity, ARKit, ARCore, C#*, 2024
- Developed an augmented reality game for mobile platforms (iOS and Android), where players defend Earth by shooting asteroids and UFOs using mobile device interactions.
- Integrated touch-based shooting mechanics and a scoring system displayed through custom UI elements.

Vision System for Self-Driving Cars, *Tools: Python, OpenCV, Semantic Segmentation, Object Detection, Depth Estimation*, 2024
- Implemented lane boundary detection using semantic segmentation, edge detection (Canny), and line estimation (Hough Transform). Merged redundant lines through slope and intercept clustering.
- Combined object detection and semantic segmentation to address high recall low precision object detectors, identified the closest point to estimate the minimum distance to impact.
- Developed a robust plane estimation system using RANSAC for ground plane detection from depth data, ensuring accurate road surface understanding for self-driving cars.

Trajectory Estimation for Self-Driving Cars, *Tools: Python, OpenCV, NumPy*, 2024
- Implemented a pipeline for estimating camera trajectories using 2D image sequences, feature matching, and pose estimation.
- Applied ORB for feature extraction and Brute-Force matching, with RANSAC for robust outlier removal.
- Used PnP and depth maps for camera pose estimation, visualized the estimated 3D camera trajectory

Balancing a Robot: A Control Systems Project, *Tools: MATLAB, Extended Kalman Filter, PID Controller*, 2024

- Designed and simulated a self-balancing robot based on the inverted pendulum model.
- Implemented an Extended Kalman Filter (EKF) for real-time state estimation, compensating for noisy sensor data from an accelerometer and gyroscope.
- Integrated control loops for tilt and position control, applying a cascade control strategy to maintain balance and follow a desired trajectory.

Optimizing Large Language Model Inference with Cloud Computing, *Tools: AWS, Azure, Flask, PyTorch, DeepSpeed, Raspberry Pi*, 2024

- Utilized cloud computing to optimize the inference performance of Llama2 7B models. Compared inference speeds across Raspberry Pi, desktop PC, and cloud platforms.
- Implemented a Flask-based web API to offload inference tasks from a Raspberry Pi to a cloud server.
- Utilized DeepSpeed model parallelism to distribute a full precision Llama2 7B model across multiple GPUs.
- Demonstrated a 70x increase in inference speed on cloud servers compared to local devices

Graph Layout Algorithm and System Integration for Force-Directed Graphs, *Tools: Java, Force-Directed Graphs, Cellular Grid Coordinate System, Graph Theory*, 2023

- Developed a graph layout algorithm based on a force-directed graph model using a cellular grid coordinate system for node placement and visualization.
- Tuned the parameters of the force-directed model to optimize node positioning and minimize overlap, and integrated the graph layout algorithm into a full-stack system.

Multi-Task Learning for Vehicle Classification, Detection, and Attribute Prediction, *Tools: ResNet, CNN, Transfer Learning, Multi-Task Learning, Data Augmentation*, 2023

- Built a multi-task learning model from scratch to simultaneously predict multiple vehicle attributes (e.g., color, type, brand), achieving 90% accuracy using a single-label dataset and custom loss functions.
- Enhanced an existing vehicle classification model by incorporating continuous feedback from deployed systems, improving accuracy from 54% to 89% through data augmentation techniques such as color adjustment and cropping to mitigate biases.
- Developed a two-stage debris detection pipeline by filtering vehicles first and then detecting debris, boosting detection accuracy from 35% to 70%.

Neural Network-based Intrusion Detection System with Explainable AI (XAI), *Tools: TensorFlow/Keras, SHAP (Explainable AI), CICDDoS2019 Dataset, Neural Networks*, 2023

- Incorporated the Shapley Additive Explanations (SHAP) algorithm to foster a transparent decision-making mechanism with the CICDDoS2019 dataset, augmenting system security and reliability.

Digital Voltmeter with Averaging, *Tools: C8051F020 Development Board, SPI, IIR Filter, C Programming*, 2023

- Developed a digital voltmeter using the C8051F020 board to accurately measure and display voltage on a serial seven-segment display via SPI communication.
- Implemented an IIR filter to smooth voltage readings, reducing display flicker and improving stability.

Digital Communication System in MATLAB, *Tools: MATLAB, 16-QAM Modulation, Hamming Code, BER Calculation*, 2023

- Implemented a time domain simulation of a (7; 4) Hamming code-based communication system using 16-QAM modulation.
- Plotted the BER versus $\frac{E_b}{N_0}$ curve to compare simulated and theoretical BER and estimated the coding gain.

Electromagnetic Simulation and Analysis in MATLAB, *Tools: MATLAB, Finite Difference Methods, Relaxation Methods, Laplacian Equation*, 2023

- Researched electric field behaviors on charged planes, used finite difference and relaxation methods to approximate Laplacian equation solutions.
- Devised an algorithm correlating convergence time, sample step, relaxation weight, and visualized field surfaces.

Web-based App Store System, *Tools: HTML, CSS, SQL, Adobe XD, Wireframing, Prototyping*, 2023

- Designed and developed a web-based app store system, going through ideation, wireframing, and prototyping stages.
- Created a database structure, optimized search functionality, and implemented secure user registration.
- Integrated user reviews and comments into the system, improving user decision-making.
- Used Adobe XD to visualize the app's layout and user flow.

Optimized MOSFET Amplifier Design, *Tools: SPICE Simulation, MOSFET Design, Analog Circuit Design* , 2022

- Designed a high-gain MOSFET amplifier, optimizing for varying loads, biasing, and saturation region operation,
- Packaged in .asc format for further development, deepening knowledge in solid-state physics.

Analog Communication System, *Tools: Fourier Analysis, MATLAB, Analog Modulation, Signal Processing* , 2022

- Developed a synchronization-free analog modulation scheme, applying Fourier analyses on signal waves and enhanced frequency domain characteristics.
- Analyzed phase noise and harmonic distortion.

Sequential Machine Design in Verilog, *Tools: Verilog, ALU, ModelSim, Test Benches*, 2022

- Designed a modular sequential machine including an ALU unit and data channel to meet control inputs and timing requirements.
- Wrote functional test benches and performed compilation and simulation on the ModelSim platform.

Optimal Path Search, *Tools: A* Algorithm, Dynamic Programming, Algorithm Visualization*, 2021

- Developed an optimal pathfinding algorithm using A*, optimizing the heuristic function based on known map information and visualizing the algorithm.
- Read topographic data into a 2D array and computed the path of least resistance across terrain.
- Implemented dynamic programming to calculate the optimal path.

Publications

Qufei Zhang, Yunshuang Wang, Gengsheng Li, Barry Cardiff, Pasika Ranaweera. "Optimizing Federated Learning on Non-IID Data with Clustering and Model Sharing" (under review)

Jiahui Han, **Qufei Zhang**, Xiaoying Yang, and Jinyi Wang. "MIAE: A Mobile Application Recommendation Method Based on a Neural Tangent Kernel (NTK) Model." 2023 IEEE International Conference on Big Data.

Teaching Experience

09/2023-01/2024 **Teaching Assistant**, *COMP2011J: Object Oriented Programming*

Taught by Prof. Sean Russell, UCD

I addressed student queries and provided guidance on Java coding assignments.

03/2023-07/2024 **Teaching Assistant**, *EEEN1002J: Intro to Electronic Systems*

Taught by Prof. John Healy, UCD

I mentored students during weekly lab sessions, focusing on Arduino programming and hardware integration, facilitated tutorial sessions, and graded lab assignments.

Skills

Programming C#, Unity Foundation, OpenCV, ARcore, ARkit, PyTorch, Python, Java, C, MATLAB, Python, mySQL, HTML, CSS, LaTeX

Personal Development Driven, Empathetic, Honest, Curious, Growth Mindset, Critical Thinking, Optimistic, Proactive, Resilient