

YANG, TINGTING

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SUMMARY

My research develops optimisation and machine learning methods for transportation and logistics systems, with an emphasis on algorithms that scale to real-world networks and support decision-making under uncertainty. My PhD addresses the multi-objective shortest path problem, an NP-hard problem in combinatorial optimisation, applied to multimodal public transit routing. I build large-scale, real-world multimodal transit networks of London from operational data and design algorithms that solve multi-objective journey planning in real time under dynamic network conditions. I develop evolutionary and search-based algorithms enhanced with machine learning to guide local search and improve solution quality, computational efficiency, and route diversity, and I benchmark them against established methods including Dijkstra's algorithm, A*, and McRAPTOR. I extend this to personalised routing by integrating LLM agents, using fine-tuned language models and retrieval-augmented generation to translate natural-language traveller preferences into routing objectives and linking heterogeneous travel demand to tractable optimisation formulations. Related work applies the same data-driven approach across wider logistics and supply chain problems, including the vehicle routing problem (VRP), 3D bin packing with deep reinforcement learning for online pallet loading in e-fulfilment, and CNN-LSTM models with evolved feature representations for real-time driver stress prediction from physiological signals. Across these projects I combine rigorous algorithmic design with empirical modelling to develop methods that are both theoretically grounded and deployable in complex transportation environments.

RESEARCH APPOINTMENTS

Queen Mary University of London - Student Recruitment and Widening Participation Sept 2024 – 2025

Senior Student Ambassador | As a Senior Student Ambassador at Queen Mary University of London (2024–2025), I took part in outreach with secondary school students aged 15–16 and their families. I supported a three-hour study skills workshop at Drapers' Academy that helped students build effective learning habits and plan their path to university. I also supported the Queen Mary Futures programme, which helps pupils make informed choices about higher education, and answered questions from students and parents at a careers fair at Morpeth School.

Queen Mary University of London - Digital Environment Research Institute (DERI) May – Aug 2024

PhD AI researcher | My work is to build a keyword-searchable dashboard that scrapes academic staff profiles from Queen Mary University of London and identifies each researcher's AI capabilities, letting users filter and sort staff by AI-specific techniques (e.g. Computer vision, NLP) and application area (e.g. healthcare, transportation, robotics).

Queen Mary University of London - Doctoral College Mar – Jun 2024

Data Scientist | My contribution is to build interactive Plotly/Dash dashboards to analyse and visualise the interdisciplinary ability of QMUL's PGR students and supervisors across REF categories.

Hong Kong Metropolitan University - School of Science and Technology Apr – Sep 2023

Research Assistant I | I built a GP-CNN-LSTM model that evolves features from physiological signals to predict driver stress in real time, delivering the accuracy, stability, and lead time needed for accident intervention.

The Hong Kong Polytechnic University - Department of Industrial & Systems Engineering Dec 2021 – Mar 2023

Research Assistant II | I help with the bin packing algorithm part in MROPLS, a mixed reality pallet loading system using deep reinforcement learning to optimise cargo placement without prior order information. I completed a systematic literature review of 71 articles on how XR enables human-cyber-physical interaction in IoT supply chains.

JOYBUY Logistics – B2B warehousing operations Mar 2021 – May 2021

Manager internship | Supported daily operations and monitoring across 400 warehouses nationwide, independently handling urgent incidents during peak periods such as the 618 shopping festival, and contributed to the B2B department's central management systems.

EDUCATION

Queen Mary University of London - Ph.D. in Operation Research, School of Engineering and Materials Science (2023 – 2027, Expected)

- **Multi-objective multimodal transit routing:** Built a large-scale London public transport network from real-world datasets, integrating bus, Underground, Overground, DLR, cable car, and walking modes. Formulated journey planning as a multi-objective shortest path problem considering travel efficiency and crowdedness, and developed a search framework that identifies diverse Pareto-optimal routes beyond those typically returned by conventional journey planners.
- **Personalised public transit routing with LLM agents:** Extended McRAPTOR to incorporate additional user-specific objectives, including safety, tourism, comfort, and efficiency. Designed a LangGraph-based agentic architecture for personalised multi-objective transit planning, prepared and augmented training data, fine-tuned Llama and Qwen models using QLoRA, and developed a RAG pipeline to extract travel requirements and translate natural-language preferences into routing objectives.
- **Machine-learning-assisted evolutionary optimisation:** Investigated performance limitations of the evolutionary routing algorithm developed in the first project by analysing generated solutions, search behaviour, and problem-specific features. Applied machine-learning methods to identify patterns associated with search performance and to develop adaptive, knowledge-guided local search strategies aimed at improving computational efficiency, solution quality, and route diversity.

Thesis Title: Trustable Public Transit through Integrated Multimodal Transit Networks and Trip Planning. Supervised by Reader Jun Chen <https://www.sems.qmul.ac.uk/staff/jun.chen/> and Prof. Greg Slabaugh <https://www.qmul.ac.uk/eecs/people/profiles/slabaughgreg.html>.

The Hong Kong Polytechnic University - M.Sc. Industrial and Logistics Systems (2021 – 2022)

- Built a strong foundation in **Operations Research and combinatorial optimisation**, including shortest path problems, Vehicle Routing Problems (VRP), bin packing, optimisation modelling, and data-driven decision-making, with applications in logistics, supply chain management, and resource planning.

Tianjin Normal University - B.Sc. Management Science and Engineering (2017 – 2021)

Thesis (Outstanding Thesis Award, Top 1%): Investigated factors influencing consumers' online purchase intentions for fresh food using empirical data analysis, with a case study of the Tianjin Higher Education Mega Centre. 3.7/ 4.0 in my senior year, rank 1/60 in Operations Research Courses.

TEACHING EXPERIENCE

Teaching Assistant, Queen Mary University of London (2024 – 2025) | Supported EMS506U Numerical Methods and Data Science in Engineering, EMS418U Computational and Mathematical Modelling, and EMS603U Vehicles for the Future.

SKILLS

Python (5 years+), Matlab (5 years), Java (Running application), Gurobi, Google Colab, Lingo, Lindo

Operations Research and optimisation including multi-objective optimisation, shortest path problems, VRP, 2D/3D bin packing, evolutionary algorithms, NSGA-II, Pareto optimisation and local search; machine learning and deep learning including Random Forest, classical classification models, K-Means, CNN, RNN, LSTM, CNN-LSTM and deep reinforcement learning; NLP and LLM methods including LexRank, LLaMA, Qwen, QLoRA, LangGraph and RAG; graph modelling and public transit routing; libraries including PyTorch, TensorFlow, Hugging Face Transformers, Scikit-learn, NumPy, Pandas, NetworkX, DEAP and Inspyred.

PUBLICATIONS

- Yang, T., Xue, C., & Chen, J. (2027) ChatPlanner: A large language model framework for personalized public transit routing. Transportation Research Part C: Emerging Technologies .
- Yang, T. & Chen, J. (2026). Comparing crossover operators for priority-based multi-modal transit routing: A study on weight mapping strategies. GECCO Companion '26, San Jose, Costa Rica. ACM.
- Yang, T., Tsang, Y.P., Wu, C.H. et al. (2025). Mixed reality-based online 3D pallet loading problem to achieve augmented intelligence in e-fulfilment processes. Operations Management Research, 18, 612–627. [JCR Q1, IF: 7.8]
- Yang, T., Xue, C. & Chen, J. (2024). Design of Driver Stress Prediction Model with CNN-LSTM: Exploration of Feature Space using Genetic Programming. IJCNN 2024, Yokohama, Japan, pp. 1–8.
- Tsang, Y.P., Yang, T., Chen, Z.S., Wu, C.H., & Tan, K.H. (2022). How is extended reality bridging human and cyber-physical systems in the IoT-empowered logistics and supply chain management? Internet of Things, 20, 100623. [JCR Q1]

UNDER REVIEW / WORK IN PROGRESS

- Yang, T., Chen, J., & Slabaugh, G. Multi-objective priority value encoded evolutionary algorithm for multi-modal public transit routing. Transportation Science (This paper is undergoing revision).
- Yang, T., Chen, J., & Slabaugh, G. A knowledge-based local search with ML for multi-objective evolutionary public transit routing. IEEE Transactions on Evolutionary Computation (Plan to submit in Nov. 2026).
- Yang, T., Chen, J., & Slabaugh, G. Standardised, multi-city, large-scale RAPTOR-compatible dataset specifically for evolutionary algorithm research. Scientific Data.
- Yang, T., Xue, C., Huang, S., & Slabaugh, G. TEEG-INCR: Millisecond-Scale Incremental Updates for Public-Transit Earliest-Arrival Routing at City Scale [Plan to submit in Nov. 2026].

HONORS & GRANTS

- Travel Grant, GECCO 2026 (May 2026)
- Finalist, STEM for Britain, Houses of Parliament, London (Mar 2025)
- Second Prize with 100 USA dollars grant, Silver Medal, IEEE ITSS Best Poster Award (Oct 2024)
- Panel Moderator, IEEE Women in Engineering Workshop, Cairo / London / Beijing (Oct 2024)
- Summer Research Camp, The Chinese University of Hong Kong (Aug 2022)
- Summer Research Camp, Tsinghua-Berkeley Shenzhen Institute (July 2022)

SERVICE & AFFILIATIONS

- Vice Chair, IEEE QMUL Student Branch (Jun 2025 – Present)
- Senior Student Ambassador, QMUL Student Recruitment & Widening Participation (2024 – 2027)
- Reviewer, Scientific Programming, IF: 1.453 (2022 – 2023)
- Member: Informs, IEEE CIS, IEEE Intelligent Transportation Systems Society (ITSS), Association for Computing Machinery (ACM)

Publication and abstract

How is extended reality bridging human and cyber-physical systems in the IoT-empowered logistics and supply chain management? | Second author | Accepted by Internet of Things 2022

Due to the rapid development of the Internet of Things (IoT), logistics and supply chain operations have been digitally transformed. Physical objects are interconnected to perform real-time monitoring and decision support through cyber-physical systems. Besides machine-to-machine communications, humans play an essential role in IoT-empowered supply chain operations to monitor and configure [IoT](#) devices and interact with [IoT](#) systems for enhanced industrial intelligence. Extended reality (XR) technologies are exploited for immersive visualisation to strengthen the connectivity between human and cyber-physical systems. However, the role and development of XR in the IoT-empowered supply chain scenarios are not revealed. Therefore, this article attempts to introduce readers to the latest XR technologies and summarise significant research opportunities/challenges raised by the current literature to facilitate further interest in this topic. The systematic literature review process analysed 71 research articles from 1,207 relevant publications using text mining models, including the bag of words (BoW) and LexRank algorithms. Consequently, the article synthesises emerging XR solutions for human-cyber-physical interaction to guide the next-generation XR research for logistics and supply chain management. At the same time, human-centricity can be emphasised in future research agendas for Industry 5.0.

Mixed reality-based online 3D pallet loading problem to achieve augmented intelligence in e-fulfilment processes | First author | Accepted by Operations Management Research 2023

Pallet loading operations support palletisation and truckload optimisation for e-fulfilment processes. Currently, the pallet loading problem is optimised offline using available cargo information, which is advantageous compared to typical freight operations but results in inefficiency when handling fragmented e-commerce orders. This research develops a mixed reality-based online pallet loading system (MROPLS) supported by deep reinforcement learning technology and online algorithms that dynamically decide cargo placements and orientations without prior information for pallet loading operations. The MROPLS proposes a 3-dimensional maximal-rectangle non-guillotine cutting strategy combined with a deep Q-network to increase space utilisation effectively. This approach is achieved using the lookahead algorithm, which predicts upcoming packages in the online pallet loading process and optimises package spatial location and orientation decision-making. We conduct simulation experiments to verify the system's feasibility and performance by considering SF Express, DHL and Royal Mail package and ISO pallet sizes. The interaction effects between package types, pallet sizes and lookahead values were found and summarised to determine optimal system settings. With

the aid of MROPLS, human intelligence in the online pallet loading process can be augmented, resulting in optimal palletisation in warehouse automation.

Design of driver stress prediction model with CNN-LSTM: Exploration of feature space using genetic programming | First author | Accepted by IEEE IJCNN **2024**

Road traffic accidents, primarily caused by driver-related issues such as stress, result in numerous fatalities and injuries. Effective prediction of driver stress within the driving phase is paramount for real-time accident intervention, while it requires prediction accuracy, stability, and enough predictive lead time. Physiological data contains rich information related to driver stress levels, which can be captured by machine learning models. However, those models are mainly developed for and perform well in static stress detection tasks, not addressing practical requirements of predictive lead time and performance stability. This study introduces a novel approach, the GP-CNN-LSTM model, Which employs a Convolutional Neural Network (CNN) with a Long Short-Term Memory (LSTM) network and Genetic Programming (GP), leverages GP to explore the feature space upon physiological sensor signals, and relies on CNN-LSTM to predict driver stress. Experiments show that this model achieves high accuracy for a 60-second forward stress prediction, with more stability compared to Fractional Fourier Transform-based benchmark models. We found explainable effective signals and features described by math functions via genetic programming that helped in improving the accuracy and stability of driver stress prediction.

Comparing crossover operators for priority-based multi-modal transit routing: A study on weight mapping strategies| First author | Accepted by ACM GECCO **2026**

Evolutionary algorithms are increasingly applied to multimodal public transit routing, where priority-value encoding reduces invalid solutions by eliminating repair steps. The advantage of this method is to reduce the number of invalid solutions. However, crossover performances for the priority-value encoding scheme on multigraph public transit routing are not systematically investigated. To this aim, three crossover operators are compared : (1) Simulated Binary Crossover (SBX), (2) Arithmetic Crossover (AriX), and (3) Weighted Mapping Crossover (WMX), under a multi-objective priority-value encoding framework for the public transit routing problem. For Weight Mapping Crossover, two new strategies are considered: WMX with inverse strategy and WMX with random strategy. Across multiple journey cases, WMX with random strategy is most compatible with the priority-value encoding and our initialization design, achieving the best coverage, the second-best convergence, and the most stable spread. From the WMX with inverse strategy, this work notices that designing and selecting crossover operators should take into account the characteristics of other components (e.g., initialization) to achieve a good balance. Insufficient exploration leads to less diverse solutions, but pushing exploration to extremes-such as through overly disruptive crossover-can sometimes produce the opposite effect. These findings provide practical guidance for crossover operator design in evolutionary approaches to public transit routing optimization.

ChatPlanner: A Large Language Model Framework for Personalized Public Transit Routing | First author | Accepted at Transportation Research Part C **2026**

Personalized public transit routing in public transit systems remains challenging due to the difficulty of capturing and integrating diverse user preferences into routing algorithms. This paper presents ChatPlanner, a novel framework that leverages Large Language Models (LLMs) to enable preference-aware public transit routing. Our approach employs fine-tuned LLMs with Retrieval-Augmented Generation (RAG) to extract routing parameters and interpret nuanced user preferences from natural language queries, subsequently integrating these preferences into the objective function of a public transit routing algorithm. This study designs preference-aware datasets incorporating eight personas and five contexts to establish scoring standards for both fine-tuning and RAG. This work conducted three experiments to validate the solutions' feasibility, extraction of routing information and preferences, and solution set quality and completeness. Results demonstrate that ChatPlanner generates feasible solutions reliably. Fine-tuning enforces the required output structure and learns general preference patterns, while RAG provides query-specific context to resolve imprecise or conversational expressions and calibrate continuous scores. The combination of both achieves the highest accuracy in routing information extraction and user preference interpretation. Results based on selected case studies show that by capturing user preferences, ChatPlanner identifies valuable solutions across different dimensions that existing route planners overlook, generating more valuable route alternatives. This research establishes a new paradigm for integrating natural language understanding into transportation optimization.

Multi-objective priority value encoded evolutionary algorithm for multi-modal public transit routing | Under review at Transportation Science **2026**

Public transport plays a critical role in providing time-efficient and human-centric routing solutions. Algorithms for public transit routing have primarily focused on travel time and transfer efficiency even when extended to incorporate active travel (e.g., walking). Traditional algorithms focus on improving the computation cost and ignore the human-centric criteria (e.g., crowding level, walking) as well as the benefit they offer. Considering human-centric criteria brings complexity in handling large-scale data, making

multi-graphs, and designing an effective optimization framework. To tackle this, an evolutionary-based optimization framework is proposed. This paper presents four key contributions. First, a large-scale real-world dataset is cleaned, processed, and compiled for graph construction and route search under the proposed framework. Second, a multi-graph formulation that explicitly captures multi-modal transportation is proposed. Third, this work explicitly considers crowding as an objective alongside travel time, enabling route evaluation based on both efficiency and passenger comfort. Fourth, this work adapts and combines the priority value representation scheme with weight mapping crossover for multi-modal public transit routing. This framework enables effective utilization of active travel within the optimization process, which is directly reflected in the quality of the resulting solutions. Contrary to the common assumption that avoiding crowding requires longer journeys, results reveal that (i) when stations are densely distributed, (ii) timetables are sparse, or (iii) transit paths are circuitous, active travel routes that reduce crowdedness without sacrificing travel time exist. Such solutions have always existed but remain undiscoverable by traditional routing solvers. This work provides practical guidance for transit planners seeking to promote sustainable, comfortable, and efficient journeys. Importantly, this framework offers the flexibility to integrate a wide range of other objectives.