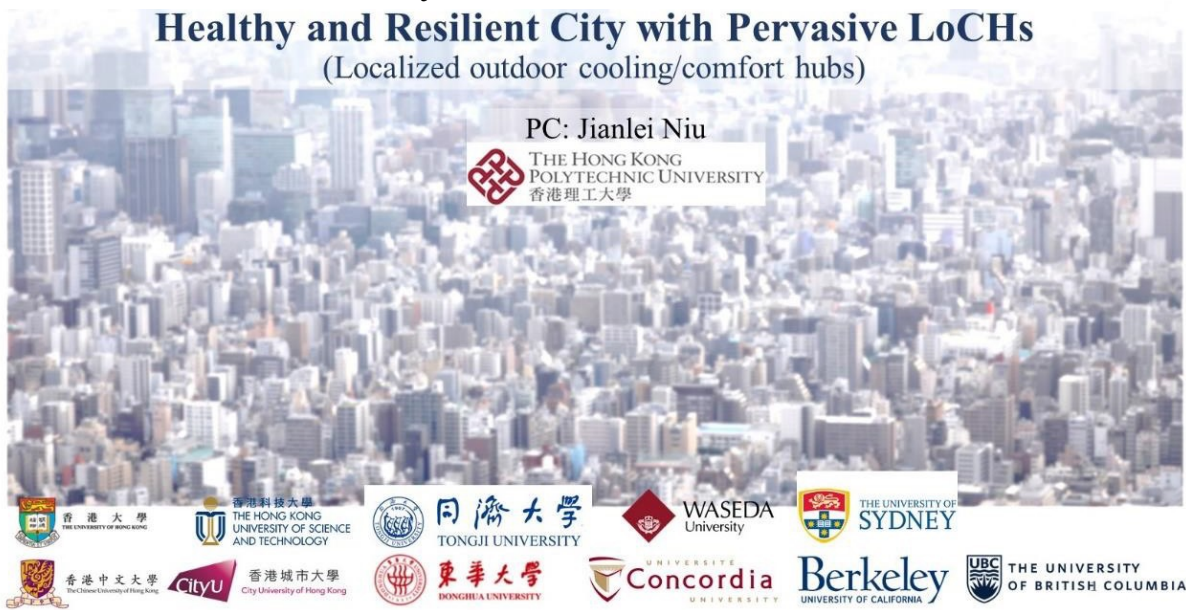


Healthy and Resilient City with Pervasive LoCHs 4th TRS project annual symposium Aug. 7-8, 2025



Theme-based Research Scheme Project 2021/22: T22-504/21R



Theme-based Research Scheme

TRS is a major RGC grant scheme that aims to focus academic research efforts on themes of strategic importance to the long-term development of Hong Kong.

Project Introduction

This project intends to build upon the team's successful RGC CRF project, which demonstrated that outdoor localised comfort hubs (LoCH) exist in a town center even in a high-density urban environment like Hong Kong with a hot, humid summer, and that, in particular, the semi-outdoor space created by lift-up building design was favorable for thermal comfort due to the combined effects of shading and induced wind downwash. We found that, even if we cannot change the climate of a whole city, we can create LoCHs to pervade all neighbourhoods in proportion to their scales. By employing a scientific microclimate design methodology based on advanced modelling and simulation of wind, heat, and moisture at the early building design and planning stage, thermal and wind comfort can be maximized and thermal stress risk be minimized, via an optimized combination of building forms and their relative locations in a precinct with assisting vegetation, water, surface materials, and ad hoc pavilions and other mechanical means, and the same idea can also be applied to infill redevelopment projects and other property development to create LoCHs in an existing neighbourhood. In this proposed project, "self-driving" optimization of building forms and architectural master-plan via big data analytics and artificial intelligence (AI) programming is the target deliverable, which combines GIS, building information modeling (BIM), enhanced with high resolution wind and thermal microclimate modelling down to the scale of the pedestrian level. The state-of-the-art of computing power will be put into use in conventional architectural design and planning practice to improve contemporary and future urban liveability and sustainability, and to cope with a rapidly changing climate.

The Symposium aims to share the research outcomes of the project team with the professional community and the public. It also seeks to engage the visions of international and industry leaders, as well as local stakeholders, with the goal of integrating academic research findings into urban renewal practices at the earliest opportunity.

Team members

Led by our Chair Professor, Ir Professor Niu Jianlei, as the Project Coordinator, the project team consists of 10 researchers from various disciplines across local universities, 10 researchers from 8 overseas universities, and 2 collaborators—one from a real estate developer and one from a software company.

Project Coordinator (PC):

Prof. Jianlei NIU, Chair Professor, Department of Building Environment and Energy Engineering (BEEE), The Hong Kong Polytechnic University; Associate Director of Otto Poon Charitable Foundation Smart Cities Research Institute



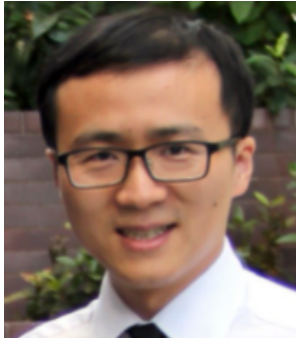
Professor Jianlei Niu received his BEng and MSc degrees from Tsinghua University and PhD from Delft University of Technology. He also had an experience of an R&D engineer with a utility manufacturer in UK during his tenure as a lecturer with Tsinghua University, researching on clean coal-combustion technologies. In the period from Feb 12, 2017 to Feb. 9, 2019, he was a Professor of Building, Environment and Energy, a conjoint appointment of School of Architecture, Design and Planning and School of Civil Engineering, The University of Sydney.

His technology contributions are in a broad area linking thermal and fluid sciences with building environment, and his current research topics include indoor environmental quality, thermal comfort, thermal energy storage, HVAC and urban microclimate. During his tenure with HKPolyU, he secured 18 RGC CERG/GRF grants, along with two ITF grants, two RFCID/HMRF grants and one RGC/NSFC joint grant, and one RGC CRF grant as a Co-PI. He has successfully supervised over 20 PhD students.

He is the editor-in-chief of the Elsevier journal Energy and Buildings. He was awarded the fellowship by three leading societies, ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers), ISIAQ(International Society of Indoor Air Quality) Academy of Fellows, and IBPSA (International Building Performance Simulation Association) Academy of Fellows.

Co-Principal Investigator (Co-PI)

Prof Jianxiang HUANG, Associate Professor, Institute of Future Human Habitats (iFHH), Tsinghua Shenzhen International Graduate School



Jianxiang Huang is a tenured associate professor at the Institute of Future Human Habitats (iFHH), Tsinghua Shenzhen International Graduate School. Prior to iFHH, he held a tenured associate professorship at the Department of Urban Planning and Design at the University of Hong Kong, where he led the Sustainable High Density Cities Lab, an interdisciplinary research group dedicated to pioneering new theories, innovative methodologies, and cutting-edge tools for achieving sustainable urban development. He also served as the director of the Master of Urban Design Programme, the oldest of its kind in Asia. Additionally, He has published 50+ peer-reviewed journals and conference proceedings, and he is the recipient of research grants from the Hong Kong Research Grants Council, the Health and Medical Research Fund, the China National Natural Science Foundation, and most recently, the National High-level Talents Scheme. The impact of his work extends beyond academia, as he has implemented his design software packages in various real-world projects across Hong Kong, Singapore, mainland China, the US, and other countries. His professional credentials include a LEED accredited professional, a member of the American Institute of Certified Planners, and a former board member of the International Association for China Planning. He has worked as an urban designer at Sasaki Associates Inc., a design firm in the USA, where he contributed to award-winning projects recognized by prestigious organizations such as the Society of College and University Planning, International Downtown Association, the American Institute of Architects, and the Boston Society of Architects. Jianxiang Huang is the founder and CEO of EnEnP, a pioneering technology start-up at the forefront of utilizing digital innovations to advance sustainable urban development. His educational background include a Doctor of Design from Harvard University, a Master in City Planning from MIT, and a Bachelor and Master in Architecture from Tsinghua University.

Prof John Zhang LIN, Chair Professor, Department of Architecture and Civil Engineering, City University of Hong Kong



Zhang Lin graduated from Tsinghua University in air conditioning engineering in 1983, and completed his Ph.D. in Process and Environmental Technology at Massey University in New Zealand in 1994. He has been engaged in engineering consultancy for seven years. He joined the City University of Hong Kong in 1995 and is currently a chair professor of building environment. He was a visiting scholar at the Massachusetts Institute of Technology in 2001. His major research interests include advanced room air distribution (ventilation) and its associated thermal comfort, indoor air quality (IAQ), energy efficiency, and outdoor thermal comfort and tolerance. As the PI or Co-PI, he has secured 14 major competitive grants, including the Theme-based Research Scheme, Collaborative Research Fund, General Research Fund and National Natural Science Foundation of China. He has authored a book, several chapters and over 300 publications, including more than 200 refereed journal articles. According to Google Scholar, Lin's publications have been cited more than 16700 times with an H-index of 69. He is ranked among the top 2% of scientists in his domain. Lin is an editor

of the Elsevier Journal of Building and Environment and a Chartered Member of the Hong Kong Institution of Engineers.

[Prof Wilson W.S. LU, Head of Department and Chair Professor, Department of Real Estate and Construction, The University of Hong Kong](#)



Wilson Lu is Chair Professor (Digital Construction) and Head of the Department of Real Estate and Construction, Faculty of Architecture, the University of Hong Kong (HKU). He holds a BSc of Computer Science and an MSc of Construction Economics and Management. He was awarded his PhD in Hong Kong. He has worked as a research fellow at the University of Reading, UK, from 2006 to 2008. His research interests focus on Construction Management with two directions: Construction informatics: Building Information Modelling (BIM), smart construction, and big data, and blockchain; and

Construction waste management: Management, economics, and public policies.

Prof. Wilson Lu is the leader of research grants worth HK\$60+ million from various prestigious funding regimes including Hong Kong Research Grant Council (RGC), Innovation and Technology Commission (ITC), The Government Policy Innovation and Co-Ordination Office (PICO), Environment and Conservation Fund (ECF), and National Natural Science Foundation of China (NSFC).

Prof. Wilson Lu is the author of 2 books, 200+ book chapters and journal papers. He has a Google Citation > 12000 and H-index > 64. He has been ranked as one of the Top 1% Scholar by Clarivate Analytics since 2017. He was the receiver of HKU Outstanding Young Researcher Award 2014-15, HKU Faculty Knowledge Exchange (KE) award 2018-19, and HKU Faculty Research Output Prize (ROP) award 2018-19.

Prof. Lu is the Director of iLab@hku, which is established as an urban big data lab to take the opportunities and challenges as instigated by the global visions of Smart City and Industry 4.0. It has made a significant break-through in modernizing the construction industry in Hong Kong and beyond.

Prof. Lu has been the Associate Dean (Research) of Faculty of Architecture (FoA) since March 2016. He is pledged to serve colleagues and assist the Dean of FoA with Scholarship (e.g., grant applications), Knowledge Exchange (KE), and other ad hoc businesses (e.g., Research Assessment Exercise 2020). Prof. Lu is the immediate past President of the Chinese Research Institute of Construction Management (CRIOCM).

Prof Cheuk-ming MAK Professor, Department of Building Environment and Energy Engineering (BEEE), The Hong Kong Polytechnic University



Professor Cheuk Ming Mak is a professor in the Department of Building Environment and Energy Engineering at the Hong Kong Polytechnic University and serves as an Honorary Professor in the Faculty of Dentistry at the University of Hong Kong. His research interests center on building science and the interaction between humans and both indoor and urban microenvironments.

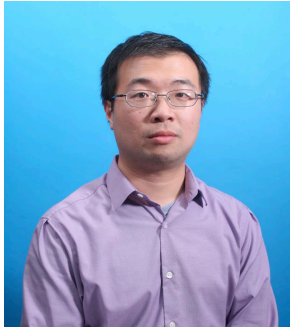
Professor Mak has held various editorial roles in several international journals, including Editor of Building and Environment (2021), Associate Editor (2019-2020), and Editorial Advisory Board Member (2017-2023). He is currently the

Associate Editor of the International Journal of Acoustics and Vibration, Associate Editor-in-Chief of the Journal of Technical Acoustics, and serves on the editorial boards of Buildings and Acoustics.

He is a Fellow of the Hong Kong Institution of Engineers (HKIE) and was the Chairman of the Hong Kong Institute of Acoustics (HKIOA) from 2006 to 2008. Additionally, he was an executive committee member of HKIOA from 2001 to 2012, and served on the Building Services Discipline Advisory Panel of HKIE from 2009 to 2011, as well as the Training Review Sub-committee (Group II) and the Education & Examinations Committee of HKIE from 2009 to 2011.

His research focuses on the building environment and related issues, including indoor environmental quality, building ventilation, acoustics, pollutant dispersion, and pedestrian wind comfort in outdoor settings. He has published over 300 peer-reviewed articles and authored numerous book chapters, books, and technical reports, with research funding exceeding HK\$23 million, primarily related to his fields of expertise. His funded projects include significant contributions from the Research Grants Council (RGC) of the Hong Kong Special Administrative Region, the University, and the Environment and Conservation Fund (ECF). Notably, he served as Project Coordinator for the RGC CRF Group Research Project titled “Development of Design Methodologies for the Improvement of Wind and Thermal Comfort in the Urban Environment” (C5002-14GF, 2015-2018).

Prof Ting-kei PONG, Professor, Department of Applied Mathematics, The Hong Kong Polytechnic University



Prof. Pong Ting-kei received his Bachelor degree and MPhil degree in 2004 and 2006, respectively, from Department of Mathematics in The Chinese University of Hong Kong. He obtained his PhD degree from Department of Mathematics in University of Washington in June 2011, and had been a Visiting Researcher at Simon Fraser University from July 2010 to March 2011. From June 2011 to July 2013, he worked as a Postdoctoral Fellow at Department of Combinatorics and Optimization in University of Waterloo. From July 2013 to July 2014, he was a PIMS postdoctoral fellow at Department of Computer Science in University of British Columbia. He joined The Hong Kong Polytechnic University on 1st August 2014, as an Assistant Professor in Department of Applied Mathematics. He is currently a Professor in Department of Applied Mathematics. His research interest is continuous optimization.

Prof Chao REN, Professor, Division of Landscape Architecture, The University of Hong Kong



Dr. Chao REN is a Professor at the University of Hong Kong. She is the Director of the Msc in Sustainable Environment Design and the Associate Director of the HKU Jockey Club Enterprise Sustainability Global Research Institute. She specializes in applied climatology and climate design. Chao's multi-dimensional, cross-disciplinary research has transferred scientific data into new knowledge to address social needs, enhance policy-making and support evidence-based designs in China, Taiwan, Singapore, The Netherlands and France since 2006. She is the Awardee of the 2023 HKU University-level Knowledge Exchange Excellence Award and the 2022 Rosie Young 90 Medal Outstanding Young Woman Scholar at HKU. She is also the Recipient of the Timothy Oke Award for early- & mid-career scientists given by the International Association for Urban Climate in 2020.

Chao's publication with focuses ranging from examining the relationship between urban climate and urban morphological characteristics, developing an urban climatic mapping system and a wind corridor plan, to analysing human thermal comfort and public health risk for subtropical high-density cities. Her latest book is 'Local Climate Zone Application in Sustainable Urban Development' published in 2024. She has been named in the World's Top 2% of Scientists List by Stanford University since 2023.

Chao serves as a co-Chief Editor for Urban Climate, and is a member of Urban Climate Expert Team and the Study Group on Greenhouse Gas Monitoring and of the World Meteorology Organization. She also serves as the steering committee member of the Global Heat Health Information Network and Southeast Asia Heat Health Hub. She has also been elected as a Board Member of the International Association for Urban Climate (2017-2021). She has been involved in several international collaborative research reports, including the IPCC AR6 (Contributing Author of Chapter 6 Cities, Settlements and Key Infrastructure), Climate Change and Cities ARC3.3 (Lead Author of Chapter 2), the China report of the Lancet Countdown on

Health and Climate Change (Lead Author of WGII) and the 7th Global Environment Outlook (GEO-7) (Lead Author of Chapter 2) of UN Environment Programme. Locally she serve as a Member of the Strengthen Emergency Preparedness and Response Strategic Committee of the Hong Kong Red Cross.

[Prof John Wenzhong SHI, Chair Professor, Department of Land Surveying and Geo-Informatics, The Hong Kong Polytechnic University](#)



Professor John SHI is currently the Director of Otto Poon Charitable Foundation Smart Cities Research Institute of PolyU, Chair Professor in Geographic Information Science and Remote Sensing. He is Academician of International Eurasian Academy of Sciences, Fellow of Academy of Social Sciences (UK), Fellow of The Hong Kong Institute of Surveyors, and Fellow of Royal Institution of Chartered Surveyors. He earned his doctoral degree from Germany in 1994. Professor Shi also serves as President of International Society for Urban Informatics and Editor-in-Chief of the international journal Urban Informatics.

His research covers urban informatics for smart cities, geographic information science and remote sensing, artificial-intelligence-based object extraction and change detection from satellite imagery, intelligent analytics and quality control for spatial big data, and mobile mapping and 3-D modelling based on LiDAR and remote sensing imagery. He has published over 300 research articles in journals indexed by Web of Science and 20 books. He is among the world's top 2% cited researchers and owns over 40 patents.

Professor Shi has won State Natural Science Award, China's highest award for fundamental research, in 2007; Distinguished Scholar Prize by CPGIS and Smart 50 Awards (US) in 2021; Gold Medals in 2021 & 2023 International Exhibition of Inventions Geneva; Founder's Award by International Spatial Accuracy Research Association in 2020; Science and Technology Progress Award in Surveying and Mapping (Grand Award) in 2017; and Wang Zhizhuo Award by International Society of Photogrammetry and Remote Sensing in 2012.

[Prof Bo-sin TANG, Honorary Professor, Department of Urban Planning and Design, The University of Hong Kong](#)



Prof. Bo-sin TANG is now the Honorary Professor at HKU. He joined the Department of Urban Planning and Design in September 2012. Before joining HKU, he was Professor and Associate Head of the Department of Building & Real Estate at the Hong Kong Polytechnic University. He received his BSocSc (Hons.) in Economics and Sociology and MSc (Distinction) in Urban Planning from the University of Hong Kong, MBA from the Hong Kong University of Science and Technology, and PhD in Urban and Regional Planning from the London School of Economics and Political Science. He also received real estate education from the Haas Business School at the University of California Berkeley. He holds professional memberships in the Royal Town Planning Institute, the Hong Kong Institute of Planners, the Royal Institution of Chartered Surveyors and the Hong Kong Institute of Surveyors, and carries the title of a registered professional planner (Hong Kong). Before his retirement in 2023, he was the Director of the Centre of Urban Studies and Urban

Planning (CUSUP) and the former Programme Director of the MSc (Urban Planning) programme.

[Prof Kam-Tim TSE, Professor, Department of Civil and Environmental Engineering, The Hong Kong University of Science and Technology](#)



Kam-Tim TSE is a Professor of Civil and Environmental Engineering at The Hong Kong University of Science and Technology (HKUST). His research interests include aerodynamic behaviour of slender structures, structural and aerodynamic coupling, fluid-structure interaction, bluff-body aerodynamics, topographical effects on wind distribution for structural and environmental considerations, wind energy harvesting, and artificial intelligence (AI) in wind engineering. He has published over 350 refereed journal and conference papers, and consulting reports. He has received a number of international awards and best papers, including the IAWQ Junior Award in 2016 in recognition of his pioneering contributions to dynamic wind load effects and wind-resistant analysis of tall buildings. He serves as an Associate Editor for *Advances in Structural Engineering* and *Advances in Wind Engineering*. He is an Editorial Board Member of multiple international journals. He was the President of the Hong Kong Wind Engineering Society and is serving in a number of government committees, including Hong Kong wind code, air ventilation assessment, curtain wall design, appeal tribunal panels for building ordinance and town planning. He is the Program Director of Civil Infrastructural Engineering and Management at HKUST.

[Dr Fan XUE, Associate Head \(Research\) and Associate Professor, Department of Real Estate and Construction, The University of Hong Kong](#)



Professor Xue, Fan (Frank) is an Associate Professor with the Department of Real Estate and Construction (REC), The University of Hong Kong (HKU). Frank has an interdisciplinary background in Automation (BEng), Computer Science (MSc), Systems Engineering (PhD), and IT in Construction (PostDoc – present). He serves as the Director of RPg studies for REC and the coordinator of CIC-BIM Network for the Faculty of Architecture. He is Member of the Association for Computing Machinery (ACM), Senior Member of the China Graphics Society (CGS), Member of the Hong Kong GIS Association (HKGISA), Member of the Institute of Electrical and Electronics Engineers (IEEE).

He also served as secretary of the ACM Hong Kong Chapter ('17- present), Committee Member of the CGS BIM Chapter ('20-present), Volunteer for IEEE Blockchain Community, and referees of over 30 international journals and a few national research funding schemes. He led various research grants (about HKD 8 million) in the following fields: Building and city information modeling (BIM, CIM), Derivative-free optimization, 3D point clouds (LiDAR, Augmented Reality, and radar), Blockchain and distributed applications, Construction informatics and urban semantics, Machine learning and big data analytics

Dr Ruoyu YOU, Associate Professor, Department of Building Environment and Energy Engineering (BEEE), The Hong Kong Polytechnic University



Prof. Ruoyu You received her B.Eng. degree from the Department of Building Science at Tsinghua University in 2013. She received her Ph.D. degree from the School of Mechanical Engineering at Purdue University in 2018. Dr. You joined the Department of Building Services Engineering at the Hong Kong Polytechnic University as an Assistant Professor in September, 2018. Her research interests include air quality in enclosed environments, computational fluid dynamics, contaminant transport, and laser-based sensors for indoor air quality.

Dr. You has secured multiple research funding, such as the Early Career Scheme and the General Research Fund from the Hong Kong Research Grant Council. She is a co-Principal Investigator of a large project funded by the high impact Theme-based Research Scheme. More information is available from <http://youruoyu.wixsite.com/home>.

Prof. Tanya TAN Zheng, Assistant Professor, Department of Building and Real Estate (BRE), The Hong Kong Polytechnic University



Dr Tanya Z. Tan is currently an Assistant Professor in the Department of Building and Real Estate, the Hong Kong Polytechnic University. Tanya received her M.Sc. in Sustainable and Environmental Design (Distinction) and Ph.D. in Architecture from The Chinese University of Hong Kong, in 2010 and 2016, respectively. She was a Research Fellow in the School of Civil and Environmental Engineering, Nanyang Technological University (NTU Singapore), and a Postdoctoral Fellow in the Institute of Future Cities, The Chinese University of Hong Kong. She then joined the Mechanical and Civil Engineering Department at Hautes Études d'Ingénieur, Université Catholique de Lille for teaching and research. Her research interests

focus on sustainable urban planning and design, urban climate, age-friendly cities, design and human perception. Since 2014 Tanya has been involved in teaching architectural design studio, sustainable urban planning, green building design strategies, and computer simulation (microclimate modelling and building energy performance simulation).

Invited guests

Prof. Xiangdong LI, Dean of Faculty of Construction and Environment, Director of Research Institute for Sustainable Urban Development (RISUD), Director of Otto Poon Research Institute for Climate-Resilient Infrastructure (RICRI), Chair Professor of Environmental Science and Technology, and Ko Jan Ming Professor in Sustainable Urban Development



Prof. Li's major research interests include regional environmental pollution, urban environment, and remediation of contaminated soils. His recent research projects have mainly focused on environmental changes in the fast developing regions. Prof. Li's research team has been engaged in the study of trace metals and organic pollutants in atmospheric particles, soils, sediments, and biological samples, including their impacts on human health and ecological systems. He has been the principal investigator of numerous research projects funded by RGC, NSFC, and the UGC Area of Excellence Scheme. He has published more than 250 papers, mostly in leading international journals. Prof. Li is the author of more than ten publications listed among the top 1% most cited papers in Environment/Ecology by the ISI database. His current research topics consist of the emissions, transport and environmental fate of metal and organic pollutants, and the environmental loadings and implications of emerging pharmaceutical related contaminants in surface environments. He is Deputy Editor of ACS Environmental Au, and an associate editor of Environmental Science and Technology (ES&T).

Prof. Dr. Jan Carmeliet, Full Professor at the Department of Mechanical and Process Engineering, ETH Zürich



Since June 2008, Jan Carmeliet is full professor at the Chair of Building Physics at ETH Zürich.

Jan Carmeliet, graduated from the Katholieke Universiteit Leuven (K.U.Leuven) in Engineering Architecture and got his PhD in Civil Engineering at K.U.Leuven in 1992. He has been Assistant (1998), Associate (2001) and Full professor (2004) at K.U.Leuven and part-time Professor at T.U.Eindhoven (2001-2008).

His research resulted until now in more than 400 scientific journal papers and a h-factor on google scholar of 98.

His research interests concern multiscale behaviour of porous and granular materials, heat-air-moisture flow in the urban environment and energy systems at building and urban scale. Research is based on advanced computational modelling (atomistic, discrete element, lattice Boltzmann, CFD, FEM) and advanced experimental techniques (X-ray and Neutron Tomography,...) and time-resolved imaging in wind and water tunnels (PIV, LIF).

Prof Naiping GAO, Professor, School of Mechanical Engineering, Tongji University



Prof. Naiping Gao currently serves as the Associate Dean of the School of Mechanical Engineering at Tongji University. He is a member of ASHRAE, ISIAQ, and ASME, and a Fellow of IBPSA. Prof. Gao is also an editorial board member of the international journals *Building and Environment* and *Energy and Buildings*, and serves as an Associate Editor for *Discovery Mechanical Engineering*. Prof. Gao has led over 50 research projects and authored more than 100 SCI-indexed journal papers. He has been repeatedly recognized as a Highly Cited Scholar in the Built Environment by Elsevier and ranked among the top 2% of global scientists. Prof. Gao's research primarily focuses on numerical simulations of outdoor wind and thermal environments. As the principal contributor, he was awarded the Second Prize of the Huaxia Construction Science and Technology Award (2022) for his outstanding contributions to the numerical simulation of microclimates.

Prof Kenny Chung-sau KWOK, Emeritus Professor, Department of Civil Engineering, The University of Sydney



Professor Kenny Kwok is Professor Emeritus at The University of Sydney (since 2021) and Hong Kong University of Science and Technology (since 2008). He was previously Professor at The University of Sydney (2017-2021), Professor of Engineering at Western Sydney University (2008 to 2017), Professor of Civil Engineering at Hong Kong University of Science and Technology (1998-2008), and Lecturer, Senior Lecturer, Associate Professor, and Professor of Wind Engineering (Personal Chair 1999-2002) at The University of Sydney (1977-2002). His research interests include wind engineering, structural dynamics, vibration control, human perception of motion, and environmental fluid mechanics, particularly with respect to the dynamic behaviour of tall buildings and flexible structures in strong winds. His research focuses on fundamental aspects of building aerodynamics and wind-structure-occupant-damper interactions, and their practical applications in real life situations. He has published over 500 articles in journals, book chapters, invited and keynote papers, and conference papers. He is the recipient of 2019 American Society of Civil Engineers (ASCE) Jack E. Cermak Medal, 2019 International Association for Wind Engineering (IAWE) Senior Award and Alan G. Davenport Medal, Honorary Member of Romanian Association for Wind Engineering (2018), Life Member of Australasian Wind Engineering Society (2004), Fellow of Hong Kong Institution of Engineers (2001), and Fellow of Institution of Engineers, Australia (1993).

Prof Jianlin LIU, Professor, Department of Built Environment and Energy Engineering,
Donghua University



Prof. dr. Jianlin Liu is currently working as a full-time Professor in the Department of Building Environment and Energy Engineering (BEEE) of Donghua University (DHU) in Shanghai. He also acts as the director of the Institute of Heating, Ventilation and Air Conditioning in DHU. He has obtained his BEng, MEng and PhD degrees from Hunan University, DHU and the Hong Kong Polytechnic University (PolyU). Prior to these positions, he was the Postdoctoral Research Associate in the University of Sydney. His main areas of research expertise are urban microclimate, industrial ventilation, low carbon community design and human thermal comfort, which have been financial supported by the projects from

National Science Foundation of China (NSFC), National Science Foundation of Shanghai and industrial companies. He is head of the Youth Academic Board of China Innovation Alliance for Heating, Ventilation and Air Conditioning (CAHVAC), the Board Members for the Building Ventilation Group of China and IBPSA-China. He also acts as the Associate Editor of the international journal *Architectural Intelligence*, subject editor of *Building Simulation*, and the Editorial Board Member of *Building and Environment*.

Ms Elaine WONG, Chief Architect of Development and Standards Section in Housing
Department, HKSAR



Elaine Wong Shan, is the Chief Architect of Development and Standards Section in Housing Department, HKSAR. The Housing Department is the executive arm of the Hong Kong Housing Authority (HA), which a statutory organization tasked to develop and implement a public housing programme to help the Government achieve its policy objective on public housing. She is a Registered Architect, Member of The Hong Kong Institute of Architects and Authorized Person (List of Architects).

Elaine joined the Housing Department in 2009 and has built an outstanding career within the organization. Since 2024, she has held the position of Chief Architect (Development and Standards), overseeing the design and construction standards for public housing developments. Her responsibilities include project and design management for the planning, design, construction, budgeting, and expenditure of public housing projects at various scales, as well as supervising research and development activities related to public housing design and construction.

She plays a pivotal role in advancing green construction initiatives for Housing Authority (HA) building projects, monitoring the progress of housing programs, and driving technology development. Additionally, Elaine contributes to the formulation of construction policies and procedures, fosters international collaboration through partnerships with local, Mainland China, and overseas counterparts, and works closely with government agencies, professional institutions, and the construction industry to promote sustainable design, innovative construction technologies, and digitalization for enhanced quality, safety, and productivity in public housing development.

Ms Margaret CHAN, Chief Town Planner/Urban Design and Landscape in the Planning Department



Margaret Chan currently serves as the Chief Town Planner/Urban Design and Landscape in the Planning Department, leading a multi-disciplinary team of town planners, landscape architects, and air ventilation experts. Her team provides professional advice on urban design, landscaping and air ventilation aspects in relation to planning submissions.

She is a Fellow of the Hong Kong Institute of Planners and a member of both the Royal Town Planning Institute and the Hong Kong Institute of Urban Design. She is also a Registered Town Planner, and holds

PRC Registered Urban Planner Qualification.

She received her Bachelor of Arts degree from the University of Cambridge and her Master degree in Urban Planning from the University of Hong Kong. She also holds an undergraduate law degree from the University of London and a Postgraduate Certificate in Arts and Cultural Enterprises from the University of the Arts London.

Ms Theresa W.S. YEUNG, President of the Hong Kong Institute of Planners, Managing Principal for Arup in East Asia



Theresa Yeung is the President of the Hong Kong Institute of Planners, and a Fellow Member of the Institute. She currently serves as Managing Principal for Arup in East Asia, responsible for the operations in Hong Kong, Japan, Macau, Mainland China, South Korea and Taiwan.

A seasoned and dynamic leader, Theresa has a track record of leading complex, multi-disciplinary projects across diverse sectors that create positive impact to communities. With a profound understanding of the East Asia market landscape, she brings unique insight and strong cross-industry network to position clients for sustainable success in an increasingly dynamic environment. Theresa sits on a number of important statutory bodies and plays a key role in the planning industry, influencing from policy level. Beside the President of the Hong Kong Institute of Planners, she currently serves as a Member of the Advisory Committee on Built Heritage Conservation, a Member of Beat Drugs Fund Association and its Governing Committee, a Member of Appeal Panel (Estate Agents Ordinance), a Non Official Member (Representing HKIP) of Harbourfront Commission, a Member of Planning Subcommittee of Land and Development Advisory Committee, a Member of Infrastructure Development Advisory Committee of Hong Kong Trade Development Council, and is a Member of Supervisory Board of Hong Kong Housing Society, a Member of Special Committee on Planning, Design and Construction of Hong Kong Housing Society, a Member of the Community Aspects Panel of BEAM Society, a Member of Green Building Faculty of Hong Kong Green Building Council, a Director of Professional Green Building Council and an Advisor of Our Hong Kong Foundation.

Mr. William SIN



Mr. William Sin has long been dedicated to issues surrounding urban spaces. In 2011, he co-founded the NGO “Hong Kong Public Space Initiative” along with a group of like-minded passionates and is serving as its Research Director. Meanwhile, he is also the Chief of Innovation Strategy at “Good Lab”, a social innovation organisation. Over the years, Mr. Sin has ventured into various fields, initiating numerous place-making and community innovation projects. He firmly believes in the intrinsic connection between urban spaces and people. To make a place truly engaging, fostering social interaction within the community is the most essential principle.

Ms. Kelly LIN



Kelly Lin is a chartered town planner who has experiences in both public and private sectors. Interested in community planning and social innovation, Kelly has led and coordinated many community projects to explore innovative solutions to urban issues. Some of the projects include age-friendly housing design, revitalisation of public wet markets, and improvement in public space design. Being the Research Director of Hong Kong Public Space Initiative, Kelly has collaborated with multiple parties, and conducted several research and experimental projects, including assessment of public spaces in private developments and how informal public spaces can be better utilised. She values public spaces as the assets of a city – giving the breathing grounds for people to relax, mingle, and have fun, and believes that the users are always the best design inspiration as they know very well how to utilize the space.

Symposium agenda

Date: 7 – 8 August, 2025

Venue: Z211, Hong Kong Polytechnic University

DAY 1: 7th August

8:30 Arrival and Early morning tea

9:00 - 9:15 Opening speech, Prof. Xiangdong LI

9:15 – 11:00 Invited lectures

9:15 – 10:00 Invited Lecture #1 (online)

- Chair: Prof. Jianlei Niu
- Speaker: Prof. Jan Carmeliet
- Presentation title: Urban microclimate modeling for heat mitigation planning
- Abstract: In this lecture, we present the cutting-edge UrbanMicroclimateFoam model, developed over the past decade by the ETH Zurich group led by Prof. Jan Carmeliet. Built within the OpenFOAM framework, this high-resolution microscale model simulates complex urban microclimate dynamics by integrating wind flow, buoyancy-driven effects, solar and longwave radiation exchange, and the heat and moisture storage in urban materials.

A key innovation lies in the detailed vegetation modeling, employing a multiscale porous media approach. This allows for the explicit representation of plant transpiration and shading through sink and source terms in the RANS equations, an essential component for understanding the cooling impact of green infrastructure.

The model is driven by boundary conditions derived from mesoscale simulations (WRF), creating a powerful bridge between regional weather patterns and localized urban heat effects.

In the second part of the lecture, we introduce a set of quantitative indices to assess pedestrian heat exposure, vegetation cooling performance, and walkability. These are applied in real urban contexts to evaluate the effectiveness of various heat mitigation strategies, especially in the face of urban densification pressure. A clustering methodology is used to delineate local microclimate zones, enabling context-sensitive and spatially targeted interventions.

10:00 – 10:15 Morning Tea breaks

10:15 – 11:00 Invited Lecture #2

- Chair: Prof. Tim K.T. TSE, Prof. Ruoyu YOU
- Speaker: Prof. Naiping GAO
- Presentation title: Study on the coupled wind, thermal, and moisture mechanisms at the microscale in residential areas
- Abstract: As global urbanization accelerates, its impact on the microclimate has become increasingly significant, leading to a range of environmental issues, such as the UHI effect. Trees play a crucial role in regulating the microclimate. However, there has been relatively little

experimental and simulation research on the combined effects of wind, thermal, and moisture dynamics involving trees, particularly in the context of the dynamic changes in solar position, where the interaction between trees and the microclimate has been insufficiently studied. Additionally, conventional numerical simulation methods face challenges in balancing computational accuracy and efficiency when modeling the effects of trees. In this report, Prof. Gao presents the latest advancements in research on the coupled wind, thermal, and moisture mechanisms at the microscale in residential areas. The report focuses on three key aspects: the physiological responses of trees to microclimate fluctuations, numerical simulations of the interactions between trees and the microclimate under varying solar positions, and the energy transfer processes in residential areas with different levels of vegetation coverage. Through scientific microclimate modeling combined with optimization measures at the planning and design stages, it is possible to improve the microclimate and minimize heat stress risks.

11:00 – 12:00 Presentation from the students

- Topic: Urban wind and microclimate modeling (PART1)
- Chair: Prof. Ruoyu YOU, Prof. Tim K.T. TSE

11:00-11:15	Jue WANG and Ruoyu YOU	A multi-scale modelling framework for calculating pedestrian-level wind distributions in real urban environments
11:15-11:30	Houzhi WANG , Wei MA, Jianlei NIU, and Ruoyu YOU	Deep learning based surrogate models for fast prediction of urban wind environments
11:30-11:45	Jiwei ZOU , Lin WANG, Senwen YANG, Liangzhu Leon WANG Michael LACASSE	Predicting and Mitigating Urban Overheating with Nature-Based Solutions: A Machine Learning Approach Supported by Field Measurement Data

11:45-12:00 Discussion

12:00 – 14:00 Lunch Break

14:00 – 15:00 Presentation from the students

- Topic: Urban wind and microclimate modeling (PART2)
- Chair: Prof. Tim K.T. TSE, Prof. Ruoyu YOU

14:00-14:15	Yunfei FU , Yunlong WANG and Tim K.T. TSE	Daytime radiative cooling technology driven thermal environment management in urban heat source buildings
14:15-14:30	Bingchao ZHANG , Cruz Y. LI, Yunfei FU and Tim K.T. TSE	Design and optimization of a horizontal windcatcher modified from LED video walls
14:30-14:45	Daniel Ziyue PENG , Bingchao ZHANG and Tim K.T. TSE	Thermal environment in a street canyon with aerodynamic interference from dense billboards

14:45-15:00 Discussion

15:00 – 15:15 Afternoon Tea breaks

15:15 – 17:15 Presentation from the students

- Topic: Thermo-Physiology and Human-Behaviour based Thermal Comfort Metrics
- Chair: Prof. John Zhang LIN, Dr Yongxin XIE, Dr Yichen YU

15:15-15:30	Hao WANG and John Zhang LIN	A modified $k - \varepsilon$ turbulence model to better account for the buoyancy effect
15:30-15:45	Kumar DHARMASASTHA , and Jianlei NIU	Coupled simulation of CFD and human thermoregulation model in outdoor wind environment
15:45-16:00	Junwei LIN, Ying JIANG , Yongxin XIE, and Jianlei NIU	Enhancements of whole-body thermal sensation model for non-uniform and transient environments
16:00-16:15	Peiyang DU , Yongxin XIE, and Jianlei NIU	Explore health risks that the elderly face during heatwaves due to their degraded perceptual responses
16:15-16:30	Siqi ZHOU , Yichen YU, and Jianlei NIU	Human body convective heat transfer coefficient under non-stationary turbulent wind
16:30-16:45	Cheng ZHAO , Yichen YU, and Jianlei NIU	The influence of clothing moisture content on heat and moisture transfer between the human body and the environment
16:45-17:00	Yuchun ZHANG and John Zhang LIN	Improved human heat storage model for dynamic conditions incorporating the time-lag relationship between weighted mean skin temperature and metabolic rate

17:00 – 17:15 Discussions

17:15 End of DAY 1

DAY 2: 8th August

8:30 Arrival and Early morning tea

9:00 – 11:30 Invited lectures

9:00 – 9:45 Invited Lecture #3

- Chair: Prof. Wilson W.S. LU
- Presenter: Ms Elaine WONG
- Presentation Title: Optimizing Design for better Human Thermal Comfort
- Abstract:

The Hong Kong Housing Authority (HA) has been incorporating green concepts and principles into the planning and design of its public housing to improve resident's living environment.

Micro-climate Studies and Air Ventilation Assessments

Microclimate studies and air ventilation assessments (AVA) are tools HKHA use to make better environmental decisions when designing estates. These tools enable us to look closely and accurately at environmental factors such as wind flow, natural building ventilation, daylight penetration, thermal comfort, and air pollutant emissions in relation to estate sites and buildings. Based on the microclimate study, we can optimize estate design in mass orientation, sizing, design and other consideration.

Optimization of Indoor Thermal Comfort

To optimize indoor thermal comfort in buildings, thoughtful shading and ventilation strategies are essential. When designing public spaces at the block level, factors such as window-to-wall ratio, the orientation of windows and walls, headroom, glazing area, and overall permeability should be carefully considered. The use of appropriate sun-shading devices and glass can also effectively minimize heat gain and reduce glare from external sources. Adopting mechanical ventilation such as ceiling fans when possible.

Optimization of Outdoor Thermal Comfort

Suitable shading devices in outdoor area can enhance the outdoor microclimate and residents' relationship with greenery around the estate. The design factors may include visual permeability, air permeability, integrated with plants and adjacent planters. Measures to mitigate urban heat island effects should also be applied during the design, such as using light-coloured paving material, planting trees and vegetation to provide shade and cooling effects.

A diverse mix of landscape species and plant massing can also improve outdoor thermal comfort. Incorporating a layered vegetation structure - featured canopy trees, understory shrubs, perennials and groundcovers - provides natural shading and cooling effects from evapotranspiration.

These elements work collectively to moderate microclimates, improving overall comfort for residents while contributing to the ecological value of the site.

9:45 – 10:30 Invited Lecture #4

- Chair: Prof. B.S. TANG
- Presenter: Ms. Margaret CHAN
- Presentation title: Promoting a Liveable and Sustainable Urban Environment in Hong Kong

- Abstract: Hong Kong's hot, humid summers and varied wind environments across districts pose real challenges to achieving outdoor thermal comfort, especially when coupled with rising global temperatures and urban heat island effect. In Hong Kong, the Government has spearheaded various initiatives to promote a permeable city fabric. Our "Hong Kong 2030+" strategic planning framework has underscored enhancing liveability as a building block to champion sustainable development. We endeavour to foster quality and future-proof city development that integrates air ventilation consideration and innovative urban design solutions for permeable city fabric. Air ventilation consideration is also integral to the plan-making process, such as planning studies for major districts or new development areas and formulation of town plans. The Planning Department has commissioned studies to establish and refine the air ventilation assessment system and offering expert advice on air ventilation matters in relation to planning submissions. The Government is committed to including air ventilation assessments in the planning and urban design considerations of major projects. In addition, qualitative guidelines on air ventilation are set out in the "Hong Kong Planning Standards and Guidelines" to guide developments. Yet, government measures alone do not suffice in promoting a liveable and sustainable urban environment. Collective efforts of private developers, academic institutions and various stakeholder organisations are also pivotal. Through our collaborative initiatives, Hong Kong could showcase the world as both a global city and a comfort hub.

10:30 – 10:45 Morning Tea breaks

10:45 – 11:30 Invited Lecture #5

- Chair: Prof. B.S. Tang
- Presenter: Ms. Theresa W.S. YEUNG
- Presentation title: Pervasive Comfort Hubs for Resilient Cities: The Tung Chung Stream River Park as a Model for Ecological and Community Resilience
- Abstract: The Tung Chung Stream project exemplifies how urban resilience and ecological conservation can coexist through innovative design. Located near villages and public housing in Hong Kong, this Ecologically Important Stream is being transformed from a channelized waterway into a naturalized river park—the first of its kind in the city. By restoring the stream's natural state, the project enhances biodiversity with over 40 native plant species while integrating predictive flood-monitoring technology, upgrading flood protection from a 1-in-50-year to a 1-in-200-year resilience level. Beyond flood mitigation, the Tung Chung River Park fosters a water-friendly culture and deepens human-nature connections through an ecological trail, riverside boardwalks, and a sustainable visitor center for eco-education. As Hong Kong's first sustainable urban drainage system, it embodies the 'sponge city' concept, mitigating climate risks while serving as a pervasive comfort hub—a vibrant space for recreation, education, and ecological stewardship. This project sets a benchmark for healthy, resilient cities, demonstrating how nature-based solutions can harmonize urban development, climate adaptation, and community well-being.

11:30– 12:30 Presentation from the students

- Topic: computational platform for optimizing design
- Chair: Prof. Wilson W.S. LU, Prof. Jianxiang HUANG, Prof. Frank XUE

11:30-11:45	Xueqing LI , Wilson W.S. LU, Ziyu PENG, and Zihan XU	Cool down hot spots: Thermally responsive generative design for mixed-used urban blocks
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11:45-12: 00	Zihan XU , Wilson W.S. LU, Ziyu PENG, and Xueqing LI	How to buffer areas affects outdoor heat stress assessment? A case study in Kowloon East
12:00-12:15	Tongping HAO , Phil JO, Simon LANNON, Peter FROST, and Jianxiang HUANG	Modelling the Impact of Green Infrastructure on Urban Heat Mitigation

12:15 – 12:30 Discussions

12:30 – 14:00 Lunch Break

14:00 – 15:15 Presentation from the students

- Topic: Prototype designs, reformed professional practices, planning regulations and development control framework
- Chair: Prof. Tanya Zheng TAN

14:00-14:15	Anvar MUKHAMEDJANOV	Heat view factor: New framework for urban surface temperature assessment
14:15-14:30	Yilun LI and Chao REN	Assessing outdoor thermal experiences under future extreme heat: A case study in Hong Kong's public housing estates
14:30-14:45	Guancong REN	Evaluating dynamic thermal comfort during outdoor walking: A comparison of PET and mPET
14:45-15:00	Jiawei WANG , Jianong LI, and Jianlei NIU	Assessing urban pedestrian-level climate experience through small and big data in Hong Kong

15:00 – 15:15 Discussions

15:15 – 16:30 Panel discussion

- Moderator, Prof. B.S. TANG
- Panel members:
Prof. Naiping GAO, Prof. Jianlin LIU, Prof. Kenny KWOK, Ms. Elaine WONG , Ms. Margaret CHAN, Ms. Theresa W.S. YEUNG, Mr. William SIN, Ms. Kelly LIN,

16:30 End of Symposium

Postdoc/ Postgraduate students' presentation abstracts

following the sequence in the agenda above

August 7th 11:00 – 12:00

A Multiscale Modelling Framework for Calculating Pedestrian-Level Wind Distributions in Real Urban Environments

Jue WANG and Ruoyu YOU

Pedestrian-level wind, typically defined at a height of 1.5 to 2 meters, plays an important role in influencing residents' thermal comfort and exposure to air pollution in urban environments. Wind distributions at this level are affected by processes across different spatial scales. At the microscale (length scale < 2 km), local building configurations significantly affect near-ground airflow. At the mesoscale (length scale < 200 km), atmospheric processes such as diurnal alternatives and sea breeze, also affect pedestrian-level wind. To account for these multiscale factors, different modelling approaches are required. Computational fluid dynamics (CFD) is commonly used for microscale studies due to its ability to explicitly resolve building geometries. In contrast, the Weather Research and Forecasting (WRF) model is appropriate for mesoscale simulations, as it captures atmospheric phenomena that CFD cannot address. Therefore, combining WRF and CFD simulations provides a promising approach for accurately calculating pedestrian-level wind distributions. However, WRF simulations for wind profiles are not sufficiently precise in built-up areas, due to oversimplification of complex urban morphology. To address this issue, we previously introduced an analytical method combined WRF and a porosity model. Built-up areas were treated as porous media, and the porosity model estimated airflow resistance based on urban morphology. Wind profiles extracted from the urban edge in WRF simulations were adjusted by the analytical method to serve as inflow conditions for CFD. Consequently, a multiscale modelling framework integrating WRF, CFD and an analytical method was proposed to calculate pedestrian-level wind distributions in real urban environments. This framework was validated through a case study in a public housing estate (578 m × 560 m) in Kwun Tong District, Hong Kong, using field measurement data as benchmarks. Results showed that the proposed framework performed better in pedestrian-level wind simulations compared to CFD simulations with inflow conditions directly extracted from WRF.

Deep learning based surrogate models for fast prediction of urban wind environments

Houzhi WANG, Wei MA, Jianlei NIU, and Ruoyu YOU

Urban wind environment assessment is crucial for pedestrian comfort and pollutant management in urban design. While computational fluid dynamics (CFD) simulations provide accurate assessments, their computational intensity limits practical application in iterative design processes. Deep learning models offer promising alternatives with significantly accelerated prediction capabilities, yet their effectiveness across diverse building configurations and the impact of training data composition require further investigation. To this end, this study comprehensively evaluates a U-Net based deep learning surrogate model for fast urban wind assessment, using a substantial CFD-generated training dataset. The trained model demonstrated strong predictive performance for unseen building configurations, offering a speed-up of several orders of magnitude over traditional CFD methods. This acceleration enables near real-time wind assessments, making the approach highly suitable for interactive urban design applications. The model successfully learned transferable wind flow

patterns, showing effective generalization across diverse building configurations. From the model development perspective, integrating diverse building configurations into the training dataset proved effective in improving the model's robustness and generalization capabilities, with cases including multiple buildings yielding more substantial improvements in predictive performance. This study highlights the potential of deep learning-based surrogate models to accelerate urban wind assessment, greatly benefiting early-stage urban planning and design optimization.

Predicting and Mitigating Urban Overheating with Nature-Based Solutions: A Machine Learning Approach Supported by Field Measurement Data

Jiwei ZOU, Lin WANG, Senwen YANG, Liangzhu Leon WANG Michael LACASSE

Urban overheating, intensified by climate change, poses significant risks to public health and urban sustainability. While traditional approaches like numerical simulations and field measurements face challenges due to data uncertainties, this study leverages machine learning (ML) to enhance predictions of future urban overheating severity and duration, with a focus on urban greening's mitigation potential under varying global warming (GW) scenarios. Field measurements were conducted from June 15 to September 14, 2024, at an office campus in Ottawa (a cold climate zone), capturing microclimate data across four sites with distinct vegetation coverage: an open lawn (Lawn), a non-greened parking plot (Parking), a sparsely treed area (Tree), and a fully forested zone (Forest). Three ML models—Artificial Neural Networks (ANN), Recurrent Neural Networks (RNN), and Long Short-Term Memory (LSTM)—were trained on local climate data, with LSTM outperforming the others in accuracy. Projections under four GW scenarios (aligned with Shared Socioeconomic Pathways for 2050 and 2090) reveal that the Universal Thermal Climate Index (UTCI) at the Parking site could rise from ~27 °C (GW1.0) to 31 °C (GW3.5). While all sites show increased exposure to low health risk (UTCI > 26 °C), dense tree coverage effectively prevents extreme thermal stress (UTCI > 38.9 °C). These findings highlight urban greening as a critical strategy for mitigating heat risks and improving outdoor thermal comfort in future climates.

August 7th 14:00 – 15:00

Daytime radiative cooling technology driven thermal environment management in urban heat source buildings

Yunfei FU, Yunlong WANG and Tim K.T. TSE

Sharp increases in building heat loads, induced by the urban heat island effect, have necessitated the development of an effective multi-scenario thermal environment management system for buildings at the urban scale. The application of Radiative Cooling (RC) technology in regulating the surface temperatures of urban buildings is a promising solution. This study investigates the energy storage and heat transfer properties of the Daytime Radiative Cooling (DRC) metafilm, a type of RC material, from spring to summer by performing a field measurement on a heat source building of ~500 m² rooftop and corresponding Computational Fluid Dynamics (CFD) simulations. The results highlight that the DRC metafilm applied to the outer roof surface achieves a peak cooling rate of 38.3% under direct sunlight, which is a 50.6% improvement over the uncoated condition, providing effective heat dissipation and ensuring a continuous passive cooling process in hot environments. Under intense summer heat, roof surface temperatures clad with cooling films remain consistently below ambient levels, with

peak temperatures reduced by approximately 5°C. Compared to uncovered counterparts, temperatures decrease by around 30°C, daily thermal fluctuations are reduced by over 70%, and annual net air conditioning energy consumption is cut by one-third. Additionally, during the peak solar radiation intensity of summer, the DRC film acts as an efficient heat dissipator, facilitating negligible surface heat flux on the exterior roof, with localized areas exhibiting positive cooling effects. Consequently, using DRC material generates tangible economic and substantial environmental benefits for building thermal environment management.

Design and optimization of a horizontal windcatcher modified from LED video walls

Bingchao ZHANG, Cruz Y. LI, Yunfei FU and Tim K.T. TSE

Many densely populated cities, such as Hong Kong, adopt a gridiron plan, resulting in a large amount of high-rise buildings and narrow, perpendicularly-crossed streets in city centers. This urban layout can lead to ventilation challenges, particularly in streets that are perpendicular to the prevailing wind direction, causing poor air circulation and potential buildup of heat and pollutants. To address this issue, this study proposes an innovative solution: a horizontal windcatcher, which is modified from billboards typically mounted at building corners (e.g., outdoor corner LED video walls). These billboards are strategically suspended away from the building surfaces, creating a corridor that allows wind to pass through. Computational Fluid Dynamics (CFD) simulations have been conducted to verify the efficacy of this design, demonstrating that the horizontal windcatcher successfully redirects wind from one street to the perpendicular street, thereby improving the overall ventilation route and increasing airflow rates. Furthermore, the study delves into optimizing the shapes of these corridors by redesigning the building corners and billboards. Advanced topology optimization techniques are employed with the goal of minimizing pressure loss between the corridor's inlet and outlet. The results show that the optimized shapes significantly enhance the redirected flow rate, leading to better removal of heat and air pollutants, and ultimately contributing to a healthier urban environment.

Thermal environment in a street canyon with aerodynamic interference from dense billboards

Daniel Ziyue PENG, Bingchao ZHANG and Tim K.T. TSE

The urban landscapes of modern major cities are characterized by densely clustered buildings, forming distinctive street canyons. The widespread presence of billboards along these streets further complicates the urban microclimate, yet their impact on the thermal environment within street canyons remains underexplored. This study employs Reynolds-Averaged Navier-Stokes (RANS) simulations to investigate the influence of billboard arrangements—specifically, aligned side-by-side layout and centered layout—on the thermal environment of street canyons under varying wind attack angles (22.5°, 45°, 67.5°, and 90° relative to the billboards). The results reveal that both billboard layouts generate thermal hotspots between 0.6L (building length in the streamwise direction) and 0.9L downwind on pedestrian-level for all tested wind angles. This effect is attributed to the billboards accelerating pedestrian-level wind from the back-streamwise direction, which then leads to zones of stagnant air. Centered billboards have a stronger impact on the pedestrian-level thermal environment than aligned side-by-side billboards. The presence of billboards generally increases heat accumulation near both leeward and windward canyon walls due to the formation of wake regions behind billboards. Furthermore, higher billboard density leads to more severe heat buildup within the canyon. These findings underscore the critical importance of incorporating billboard configurations into urban thermal environment modeling in urban contexts.

August 7th 15:15 – 17:15

A modified k- ϵ turbulence model to better account for the buoyancy effect

Hao Wang, and John Zhang LIN

Buoyancy is one of the main forces driving flows, particularly when considering the thermal comfort of occupants in the indoor environment. As CFD has become an important and powerful tool for studying thermal comfort and indoor environments, its performance in predicting the buoyancy-driven flow is still far from being commonly satisfied. Most turbulence models have inherent weaknesses in dealing with the buoyancy, as these turbulence models are always established based on wind tunnel tests whereas the buoyancy effect is a significant similarity constraint in the wind tunnel. This work aims to refine existing turbulence models so to better account for the buoyancy effect. Based on theoretical derivations, a new description is proposed for the coefficient, which appears in the buoyancy term in the transport equation of the turbulence dissipation rate. This proposed solution is firstly validated by simulations at large scale where the standard k- ϵ turbulence model with the new coefficient can reproduce profiles quite identical to the analytic solution to the governing equations. The performance of the modified turbulence model is then evaluated by comparing the modelling results and the measurements in a thermally stratified indoor chamber.

Coupled simulation of CFD and human thermoregulation model in outdoor wind environment

Kumar DHARMASASTHA, and Jianlei NIU

The increasing frequency and intensity of global heatwaves necessitate the design of outdoor environments that ensure thermal comfort, safeguard human health, and support social interaction and recreational activities. A major challenge in creating comfortable outdoor environments is the inaccurate prediction of thermal comfort, due to the influence of asymmetrical and transient environmental factors and the limitations of existing thermal comfort models. Therefore, a method to evaluate outdoor thermal sensation is proposed, which accounts for human thermal interaction with the outdoor environment by incorporating human thermoregulation and ambient outdoor parameters. This approach involves modelling the outdoor environment with a computational thermal manikin (CTM) coupled with the human thermoregulation model (JOS-3) to assess both local and overall skin temperatures. The corresponding local and overall thermal sensations associated with these skin temperatures are then evaluated using the updated CBE thermal comfort model. A case study of an outdoor cooling spot employing a membrane-assisted radiant cooling system is used to demonstrate the proposed method. The resulting thermal sensations are compared with data from a human subject survey. Several coupling strategies were analysed and compared to simplify the process and reduce computation time and the complexity of meshing. The study concludes with two practical findings: 1) A one-way coupling strategy, which does not require skin temperature feedback to the CFD simulation, is sufficient for outdoor environments. 2) A simplified CTM-free approach using predefined convective heat transfer coefficients is also a viable and efficient alternative. These methods offer a practical pathway for designing thermally comfortable outdoor environments.

Enhancements of whole-body thermal sensation model for non-uniform and transient environments

Junwei LIN, Ying JIANG, Yongxin XIE, and Jianlei NIU

The demand for predicting human responses in non-uniform and transient environments reflecting real-world indoor and outdoor conditions is increasing. To address these needs, the Center for the Built Environment at the University of California, Berkeley has developed a series of thermal sensation and comfort models. These models predict local and whole-body (overall) thermal sensations and comfort based on physiological data using logistic regression and pieced modelling techniques. However, discontinuities occur during pieced model transitions. Additionally, when the whole-body feels quite warm, the dominant effect on the whole-body thermal sensations from local cooling of back, chest, and pelvis was over-estimated. This study enhances the overall thermal sensation models through systematic experimental validation and algorithmic refinement. A total of 792 valid thermal sensation surveys were collected from 42 human subjects in seven cases featuring spatial-temporal variations from indoors and outdoors. By analysing their transition patterns, pieced models are refined to improve accuracy, smoothness, and interpretability, including adjustments of a few pieced calculation models, corrections to two original smoothing functions, and mitigation of the overcooling bias in the “dominated cold” condition. The revised models achieved smoother overall sensation predictions from local thermal sensation, aligning closely with surveyed data. Combined with a multi-nodal human body, these models improve the predictive accuracy and applicability of the overall thermal sensation in dynamic and non-uniform environments and providing a foundation for further refinements in physiology-based thermal sensation and comfort models.

Explore health risks that the elderly face during heatwaves due to their degraded perceptual responses

Peiyang DU, Yongxin XIE, and Jianlei NIU

Elderly people are more likely to face heat-related health conditions when exposed to hot weather due to their low sensitivity. However, there is a lack of research in real environments to show the actual heat risks that low sensitivity brings to the elderly. In this study, subjects were asked to exercise on an outdoor treadmill for at a moderate intensity, during which physiological parameters and questionnaire surveys were adopted. Results showed that both of the thermal sensation votes and thermal comfort votes of the elderly were higher than the young group, at the same time, the core temperature of the elderly gradually increased over 38°C, indicating that the elderly felt hot but were still comfortable, which means that the elderly had poor thermal sensitivity. The dehydration of the elderly reached 3%, but the thirst votes were lower than 4, indicating that they were not sensitive to their own dehydration status. The autonomic nervous system of the elderly is poorly regulated and they cannot activate sympathetic nervous system activity in time when faced with heat stress and exercise stress, which may increase cardiovascular risk and reduce exercise performance.

Human body convective heat transfer coefficient under non-stationary turbulent wind

Siqi ZHOU, Yichen YU, and Jianlei NIU

In recent decades, extensive research has focused on the role of dynamic airflow in improving thermal comfort from both physiological and psychological perspectives. However, the specific mechanism by which dynamic airflow affects convective heat transfer from the human body remains unclear. This study utilizes an active shutter and a passive grid to simulate non-stationary turbulent flows in a wind tunnel, and employs a thermal manikin to determine the convective heat transfer coefficient (h_c) over the human body. Considering the physical constraints posed by a wind tunnel, the simulated wind conditions were considered to be reasonably representative of pedestrian-level wind environment. The findings indicate that

while high-frequency turbulence intensity significantly increases h_c , h_c does not change notably with fluctuation amplitude in the low-frequency range. In outdoor settings, turbulence intensity can be overestimated by more than half if the synoptic trend is not removed. Therefore, detrending dynamic flow is critical for accurately calculating turbulence intensity; otherwise, the whole body's h_c could be overestimated by up to 40%. Furthermore, when the integral length scale is smaller than half the manikin's characteristic length, the impact on h_c is limited. A reduction in wavelength of low-frequency fluctuation component in dynamic flow contributes to enhancing h_c , while no more than 4% in typical outdoor pedestrian-level wind conditions. To improve the accuracy of the predicted h_c in prototype pedestrian-level urban environment, an equivalent wind speed which accounts for the effects of turbulence has been proposed to adjust the wind speed input in current thermal comfort models.

The influence of clothing moisture content on heat and moisture transfer between the human body and the environment

Cheng ZHAO, Yichen YU, and Jianlei NIU

Evaporative heat loss is crucial to the human body's energy balance. Various thermal comfort models have been established to analyze the heat and mass transfer between the body and the environment during human sweating, yet the effects of sweat-soaked clothing on heat and moisture transfer remain insufficiently evaluated. This study investigates the thermal and moisture properties of different summer clothing and compares the heat loss of the human body in different sweating states using a sweating thermal manikin. It was found that the evaporative cooling efficiency of the body was suppressed by the soaked clothing as the sweating rate increased, which implies that sweat-soaked garments contribute additional resistance to moisture transfer. Consequently, we observed the dynamic variations in thermal and evaporative resistance of clothing ensembles at different moisture contents. A dynamic heat and moisture transfer model was established by incorporating clothing nodes in the thermal comfort model in detail.

Improved human heat storage model for dynamic conditions incorporating the time-lag relationship between weighted mean skin temperature and metabolic rate

Yuchun ZHANG and John Zhang LIN

Human thermal comfort and heat balance are critical factors in environmental control and health research. Traditional thermal comfort models often rely on steady-state assumptions, which fail to accurately capture the dynamic interactions between metabolic rate (M) and skin temperature (T_{sk}) under fluctuating activity levels and environmental conditions. This study proposes a novel dynamic human heat storage model that simultaneously integrates three key innovations: (1) real-time infrared thermography-based measurement of spatially representative weighted mean skin temperature (WMST), (2) estimation of time-resolved metabolic rate using heart rate surrogates, and (3) introduction of a time-lag function to capture the physiological delay between metabolic rate and skin temperature response. Unlike traditional models such as Fanger's PMV or Gagge's two-node model which rely on steady-state assumptions, or computationally intensive models like Fiala that require core temperature inputs, our proposed model is designed for practical, non-invasive applications in dynamic semi-open urban environments. The results demonstrate that WMST is a robust indicator of thermal comfort, showing strong correlations with subjective mean thermal sensation votes (MTSV) and thermal pleasure levels (T_p). Additionally, a significant time-lag effect between WMST and metabolic rate was observed, highlighting the need for dynamic modeling. The improved model, which accounts for transient variations in WMST and M , which has the

potential to reduce the thermal storage calculation error by up to 88.2%, enhancing its applicability in non-steady-state conditions. This study provides a theoretical foundation for adaptive thermal comfort models and real-time environmental control strategies, with potential applications in personalized HVAC systems, wearable technologies, and urban thermal safety monitoring.

August 8th 11:30– 12:30

Cool down hot spots: Thermally responsive generative design for mixed-used urban blocks

Xueqing LI, Wilson W.S. LU, Ziyu PENG, and Zihan XU

With the acceleration of urbanization leading to increased urban spatial density, the urban heat island effect is becoming increasingly severe. This exacerbates outdoor pedestrian-level thermal comfort in urban areas, and urban heatwaves may induce adverse health effects for residents and even life-threatening situations. Urban building forms significantly impact thermal comfort, while urban land use planning plays a major role in shaping areas of high pedestrian density. Different land use attributes need different pedestrian accessibilities. When planning and designing cities, enhancing outdoor thermal comfort (OTC) for pedestrians in the urban environment is vital for mitigating the thermal risks caused by global warming. This study introduces a novel concept called Cool Urban Hot Spots (CUHS). It integrates the pedestrian density influenced by land use into the planning and design of thermally comfortable urban blocks. The methodology combines OTC simulation, urban hot spots analysis of land use planning, and surrogate models based on integrated generative adversarial networks (GAN)-enhanced genetic generative design (GGD) approach. The GAN model is employed to quickly simulate OTC. Then, the design metrics of CUHS are optimized through the multi-objective optimization algorithm in GGD. This method was tested in a real urban area in Hong Kong. Results demonstrate that it can efficiently identify high-performing CUHS design solutions. This study provides an efficient land use planning tool for improving pedestrian-level OTC in high urban density areas.

How to buffer areas affects outdoor heat stress assessment? A case study in Kowloon East

Zihan XU, Wilson W.S. LU, Ziyu PENG, and Xueqing LI

Global warming exacerbates the urban heat island effect that intensifies outdoor heat stress. Without proper understanding, these could lead to significantly negative impact on human health and urban livability in densely populated cities. Despite advances in urban thermal comfort research, gaps persist in understanding the impact of buffer radii on the relationship between urban morphology and outdoor heat stress, particularly across diverse Local Climate Zones (LCZs). This study investigates how buffer areas (radii ranging from 10m to 50m) influence the assessment of outdoor heat stress. Several representative urban areas in Kowloon East, Hong Kong are selected as the investigation zones. We select eight different LCZs, ranging from compact high-rise to large low-rise, to investigate how form parameters drive different thermal impacts. As a result, we choose 11 spatial design indicators to measure urban morphology design across different buffer radii, including Rhino-based indicators (e.g., Average Height Index) and DepthmapX-based indicators (e.g., Connectivity). Furthermore, we train a XGBoost model with UTCI inputs and SHAP analysis to assess impacts on strong heat stress (UTCI > 38°C). Findings indicate that buffer radii affect outdoor heat stress differently across LCZ-specific urban morphologies. Spatial design factors also show influences on heat stress, emphasizing the role of urban morphology design in shaping urban microclimates. This

study provides recommendations for urban designers to reduce strong heat stress and enhance thermal resilience in urban environments amid global warming.

Modelling the Impact of Green Infrastructure on Urban Heat Mitigation

Tongping HAO, Phil JO, Simon LANNON, Peter FROST, and Jianxiang HUANG

Abstract Green infrastructure, particularly urban trees, has emerged as a critical strategy for mitigating urban heat by providing shade, enhancing evapotranspiration, and modifying microclimatic conditions. However, inconsistent cooling outcomes reported in the literature may result from scale-dependent implementation and tools applied across different contexts. Additionally, the current research community lacks models to assess the cooling effects of green infrastructure at the street scale in urban environments. This study presents a novel simulation model developed to quantify the cooling effectiveness of green infrastructure at the street scale in urban areas. The model was implemented in Grangetown, Cardiff, Wales, as part of the 'Greener Grangetown' initiative, and used to simulate urban surface temperature and air temperature distribution under varying green coverage scenarios. Results indicate that an extensive planting scenario (38% coverage) could reduce air temperature by 1.5°C compared to the current situation (1% green coverage). The findings emphasize the importance of site-specific considerations and provide valuable insights for policymakers and urban planners in Wales and other cities experiencing similar climatic conditions. This study offers a robust tool to assist designers and policymakers in achieving effective urban cooling strategies while considering practical implementation challenges.

August 8th 14:00– 15:00

Heat view factor: New framework for urban surface temperature assessment

Anvar MUKHAMEDJANOV

In the wake of climate change, urban heat is a growing threat, yet urban surface temperature heterogeneity remains poorly quantified due to uncertainties in urban climate simulations, systematic biases in analysing infrared data and high equipment costs. In the face of increasing heat extremes, do cities need to wait for perfect evidence or act on the current insights?

Here I introduce the Heat view factor (Hvf), a pedestrian-level metric that quantifies heat distribution on urban surfaces using binarized 360° thermal imagery. Line graph analyses are used to determine the microclimatic covariation of the Hvf. The linear regression shows that the Hvf complements the Sky View Factor (Svf), by incorporating data on urban surface temperature, thus enabling a more comprehensive assessment of microclimatic dynamics in fast-growing cities. Crucially, the Hvf enables: (1) the classification of urban surfaces into thermally active (requiring a cooling intervention) and passive urban surfaces and (2) the resolution of 3D radiative edge effects in thermal analyses. In combination with AI-powered urban diagnostics, it provides cities with an actionable, cost-effective framework for urban heat mitigation.

Assessing outdoor thermal experiences under future extreme heat: A case study in Hong Kong's public housing estates

Yilun LI and Chao REN

Rising extreme heat events challenge the provision of healthy outdoor public spaces, particularly in dense urban environments. While transient thermal comfort in outdoor environments is well-documented, tools to assess the dynamic outdoor thermal experiences during design stages or under future extreme heat scenarios are still needed to assist the design of future-heat-resilient public spaces. This study demonstrates an integrated assessment workflow combining ENVI-met microclimate modeling, shortest path generation, and JOS-3 human physiological response modeling, using a Hong Kong public housing estate as a case

study. The analysis compares static and dynamic thermal experiences across baseline (2014), current (2023), and future (2040) scenarios under SSP2-4.5 and SSP5-8.5 climate projections. Analyses under static perspective reveal moderate increases in modified physiological equivalent temperature (mPET) under future scenarios, with median values of 36.8°C (SSP2-4.5) and 37.0°C (SSP5-8.5) compared to current 35.6°C during 9:00-18:00. Duration of thermal stress varies significantly by space type, with open squares, vegetated areas, and semi-outdoor spaces exceeding local thermal acceptability thresholds for 5.43, 3.3, and 0.55 hours respectively under future scenarios. Analyses under dynamic perspective reveal marginally higher changes in thermal stress in future scenarios compared to current scenarios, and no harmful heat stress occurred along the shortest daily commute paths under all extreme heat scenarios, with a maximum core temperature at chest of 37.21°C. Under future extreme heat, stronger simulated skin temperature changes exist during the hottest hours, indicating stronger thermal alliesthesia. This workflow combining the dynamic perspective to understand the influence of future extreme heat stress serves as a promising tool to assess dynamic thermal experiences in design proposals and future scenarios, assisting climate-responsive landscape design.

Evaluating dynamic thermal comfort during outdoor walking: A comparison of PET and mPET
Guancong REN

This is an abstract for TRS session. Outdoor walking in hot-humid climates poses growing health risks due to rising global temperatures. This study compares two widely used models—Physiologically Equivalent Temperature (PET) and its modified version (mPET)—in their ability to predict core and skin temperatures of individuals walking in subtropical urban settings. Field experiments were conducted in Hong Kong, involving 29 participants of varying ages walking through open, naturally shaded, and artificially shaded routes. Physiological responses were measured and compared to model estimates using several statistical metrics. Results show that mPET consistently outperformed PET, providing more accurate estimates of both core and skin temperatures across all environments, walking stages, and participant groups. While PET often overestimated temperatures, mPET produced lower prediction errors and better alignment with measured values. Sensitivity analyses further revealed that age, sex, body size, and clothing levels significantly influenced model performance. These findings suggest that mPET is better suited for dynamic outdoor conditions and can support more informed design of thermally comfortable and health-conscious urban spaces. This study highlights the need for continued refinement of thermal models, especially in accounting for demographic diversity and walking-related thermal stress.

Assessing urban pedestrian-level climate experience through small and big data in Hong Kong
Jiawei WANG, Jianong LI, and Jianlei NIU

The assessment of how urban pedestrian-level climates affect people's experience in outdoor spaces is essential for informing the urban planning aimed at improving the thermal comfort. This subject, however, remains a topic of debate. Most literature relies on "intervention experiment", which involving recruiting limited number of subjects and interviewing about their perceptions regarding a specific real-world microclimate or mimetic ones in chambers during short duration assessments. The method is grounded on 'small data' and struggles to reflect the actual experiences associated with outdoor activities, resulting in inconsistent findings across studies and constraining the generalization of conclusions. The emergence of social media has led to an increased willingness to share people's experiences in outdoor spaces on various platforms. The user-generated content represents a valuable source of "big data" for reflecting the real responses of people regarding urban pedestrian-level climates while people actively engaging in outdoor activities. This study combines both "small data" and "big data"

methods to understand users' outdoor experiences in Hong Kong and to identify the thermal environments that people comprehensively find satisfying. First, using the "small data" method, participant comments when conducting intervention experiments were analyzed using the sentiment analysis tool "VADER" to generate emotion factors ranging from -1 to 1 against measured microclimate data. Secondly, from a "big data" perspective, 1,300 pieces of social media content containing outdoor space experiences were collected and analyzed. These social media contents were converted into emotion factors and matched with the corresponding simulated microclimate conditions at the time of posting. The findings show that when mPET is below 36.5°C, the emotion factor consistently exceeds 0.05, indicating a positive emotional response. This research offers a new perspective and methodology for understanding how urban pedestrian-level climates affect people's experience when conducting outdoor activities.