

The distinctive HKU MArch Thesis

This week and this year presented a significant moment for the Faculty and Department of Architecture that will not have been noticed by many. At ARC's Degree Show opening, I made a not too well-researched comment that this year's MArch Thesis projects seem subtly but profoundly different to previous years. Struggling to express what was only an impression, I suggested that so many more than usual were focused on solving socially significant problems and with a simplicity, creative technicality and lack of hubris that was effective and refreshing. The range of problems addressed, too, was wider than usual. I picked out one that had particularly struck me: a Nepalese earthquake village structure that placed two massive rammed-earth retaining walls, presumably on a collapsed part of slope, with the space created in between, filled beautifully with a starkly contrasting complex and almost delicate wooden framed building. Other projects proposed equally clever architectural interventions into HK's decaying housing estates, ecologically fragile shorelines, traditional villages and so on. After me, Joshua Bolchover spoke, sharing an unrehearsed endorsement. To paraphrase: 'This year, HKU's MArch Thesis has eventually found its mark. These are not Berkeley, UCL, Yale, ETH, Cornell, Princeton or GSD theses. These are HKU theses.' And Joshua gave his own observations about how experiences from the thesis teaching experimentation of recent years and the scaled down activity imposed by the pandemic had yielded more from less. Then Cole Roskam spoke, stating that the walls of this year's MArch exhibition are 'filled with truth'. I understood Cole's comments to be responding to the same phenomenon. Truth, in the sense of observations and analysis of a problem. Truth, in the sense of rigour and honesty in testing for appropriate and efficacious solutions. Truth, perhaps (although I do not know if Cole's metaphysics extends to this) in equating artistic beauty with simplicity, naturalness, functionality and evolutionary performance.

A special moment, I think, in the life of FoA. Thank you ARC teachers and students. It's been a long slog and I share your excitement about where we can go from here.

Many congratulations to colleagues and teams featured below. More stunning work.

Chris Webster
Dean, FoA

Faculty of Architecture

Welcome to Dr Xiaohu Zhang, who has recently joined the Department of Urban Planning and Design in his new role as Assistant Professor, with effect from 10 May 2021. Xiaohu comes to us from MIT SENSEable City Lab.



Department of Architecture

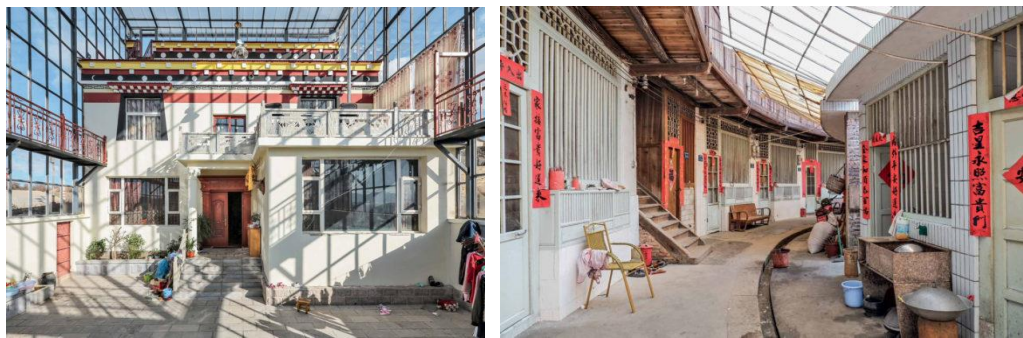
1. John Lin

- has received a [2021 Graham Foundation grant](#) for his project 'Renovation Toolbox: A Guided Tour of Innovative Houses by Self-builders in Rural China'.

Abstract: *'Renovation Toolbox: A guided tour of innovative houses by self-builders in rural China' develops a series of short movies to spread stories of vernacular adaptations. It has been over 50 years since Architecture Without Architects introduced vernacular or 'non-pedigreed' architecture to a wider audience. Revisiting Rudofsky's premise on vernacular architecture through the lens of contemporary China is to be confronted with abandonment, infrastructural collisions, mutations, adaptations, and contested territories. What we find today is a transitional life-style through a hybrid way of living. Stories of structural adaptation of traditional houses often happen alongside social and community transformation. The films act as 'guided tours' of these transformations, narrating the design responses that negotiate between traditional housing forms and the changing conditions of the rural village. The goal is to bring the research to life, actively demonstrating to governments and self-builders the culturally and environmentally sustainable benefit of adapting traditional houses as opposed to abandonment.*

Project statement: *The underpinning research uncovered examples of innovative, sustainable and efficient renovations of vernacular houses done by spontaneous builders in four remote locations in rural China. These renovated houses have already been represented through photographs and drawings in the previous research project, but in order to*

bring the research to life and to actively demonstrate the benefits of adapting traditional houses, a series of follow-up films will be developed. The films act as 'guided tours' of the renovations, making those remote houses virtually accessible. There will be four films, each one corresponding to a vernacular house typology that emerged from the previous research (underground houses in Sanmenxia, Shanxi; wooden houses in Guizhou, Guiyang; collective houses in Longyan, Fujian; and seasonal houses in Shangri-La, Yunnan). The aim is to encourage people to consider adaptation as alternative over cheaply available building methods that are currently transforming the rural landscape. The project will also potentially influence policy in vernacular houses preservation. The understanding of adaptation as a viable strategy can help to reduce the abandonment of traditional houses and ensure the longevity of vernacular structures. The films will have a greater impact on the actual production of the rural built environment – much of which is made without architects.



2. 'House Tales' Exhibition @PMQ

- BA(AS) Year 2 Students and Studio Instructors concluded a year-long collective research on contemporary postures of rural living with an exhibition at the HKU Architecture Gallery@PMQ – 'House Tales'.



By bringing together two worlds – the contemporary and the vernacular, the process of design looks both backwards and forwards, and the role of the architect is questioned. In the context of Hong Kong and Mainland China, the rural way of living is heavily influenced not just by ancestral knowledge of building, but also by cultural tendencies, such as multigenerational households, which leads to contrasting lifestyles brought together.

The question that rose from trying to understand the contemporary postures of rural living was a simple one: what defines a home, and how do we explore the relationship between design and the conditions of living. Therefore, how can one design a house which responds to shaping the qualities and functions of domestic living?

Through this analysis, it becomes natural to notice the beginning of a new design approach for rural households, which combines state-of-the-art techniques with vernacular craftsmanship, in a new functional dynamic, which is neither rural nor urban, neither contemporary nor traditional – but that captures the best of both worlds, signifying a novel approach towards sustainable living.

Date: 7 June 2021 (Monday) – 28 June 2021 (Monday)
Time: 10:00am – 8:00pm
Venue: S507, 5/F, Staunton (Block A), PMQ,
35 Aberdeen Street, Central, Hong Kong

Instructors:

John Lin, Lidia Ratoi, Haotian Zhang, Su Chang, Yi Sun, Chiara Oggioni, Tianying Li

Exhibition Assistants:

Chan Chun Ngok Osten, Chau Mei Yan, Cheung Wing See Kyo, Chick Kar Yi Priscilla, Choy Jan Yip Joseph, Fan Ka Mak Moses, Hong Sum Ho, Ming Rou Hon, Pak Hei Nam, Tse Yau Wai Fergal.

Participants:

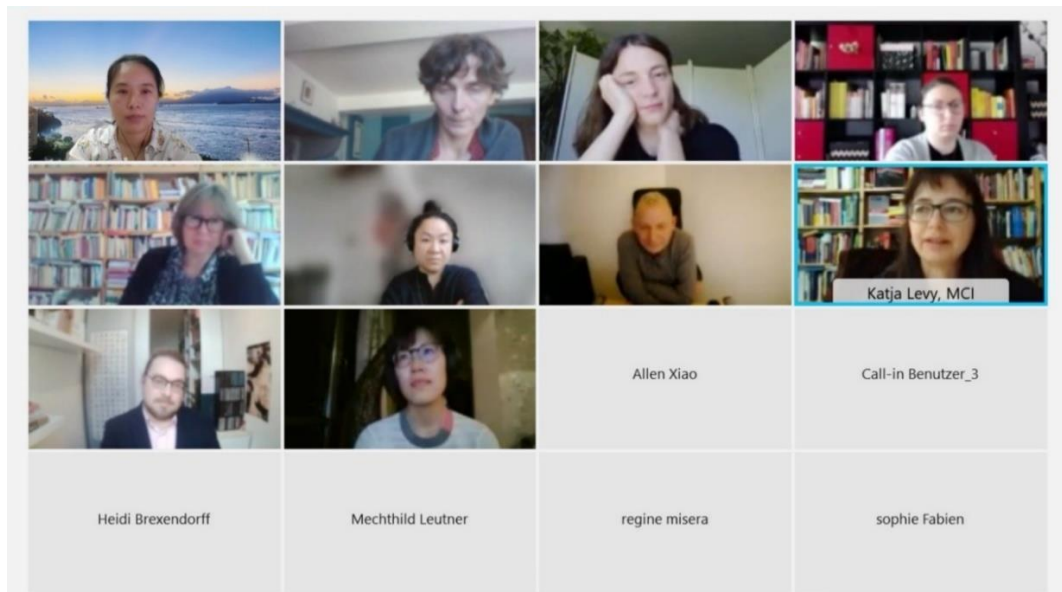
BA(AS) Year 2 Students (2020-21)

Please visit the [HKU Architecture Gallery Webpage](#) and Instagram [@house_tales](#) for more information.

Centre of Urban Studies and Urban Planning

1. Professor Shenjin He

- was invited to present a paper titled 'Negotiating the Right to a Decent Home and Beyond: Small Property Right Housing and Migrants' Upward Social Mobility in Urban China', at the 'Changing Places. Chinese Migrants in Cities – Migrants in Chinese Cities' International Workshop, hosted by Professor Dr Bettina Gransow, Freie Universität Berlin, and Dr Katja Levy, University of Manchester, at Confucius Institute of Freie Universität Berlin, on 28-29 May 2021.



- has published the following co-authored paper/book chapter:
 - (i) Wang, K., Qian, J., & **He, S.** (2021). Contested worldings of e-waste environmental justice: Nonhuman agency and e-waste scavaging in Guiyu, China. *Annals of the American Association of Geographers*, 1-20. DOI: <http://doi.org/10.1080/24694452.2021.1889353>

Abstract: Current environmental justice (EJ) research is moving beyond the distributional paradigm to embrace frameworks that emphasise the plurality of EJs. This study proposes that actor-network theory (ANT), which foregrounds nonhuman agency and heterogeneous associations, holds great potential for pushing forward this research agenda. It presents an ANT-informed analysis of the plural epistemologies of EJ by focusing on a global e-waste scavaging hub—Guiyu in China. E-waste is considered a fluid and emergent material actant. The multiplicity of e-waste materialities coconstitutes the disparate worldings of EJ, with a wide range of actors involved in the knowledge-making practices. Disparate EJ realities concerning e-

waste scavenging have been worlded and enacted through the heterogeneous associations among numerous nonhuman actors, including discarded electronic devices, environmental conditions, pollutants, toxic substances, artifacts, discourses, tools and techniques, and a variety of human stakeholders, ranging from non-governmental organisations, media, and academics to local scavengers relying on e-waste for livelihood and wealth. In tracing these heterogeneous associations, this study juxtaposes two competing EJ worldings related to the ontological indeterminacy of e-waste. It first problematises the worlding of North-to-South dumping that not only misrepresents the complex geographies of e-waste, but also epitomises a simplified distributional model of EJ. Then it ventures to theorise an often-neglected and underresearched dimension: EJ as situated capabilities and functionings concerned by the local community. This study thus adds to ongoing efforts to advance pluralist epistemologies of EJ.

- (ii) Qian, J., Ling, J., & **He, S.** (2021). Making cities and regions in globalising East Asia. In A. M. Orum, J. Ruiz-Tagle, & S. V. Haddock (Eds.), *Companion to Urban and Regional Studies* Oxford: Wiley Blackwell, pp 21-42. DOI: <https://doi.org/10.1002/9781119316916.ch2>

1. Mr Ziyu Peng (PhD candidate supervised by Professor Wilson Lu and Dean Webster)

- has his co-authored paper with Professor Wilson Lu and Dean Webster accepted for publication:

Quantifying the embodied carbon saving potential of recycling construction and demolition waste in the Greater Bay Area, China: Status quo and future scenarios. *Science of the Total Environment* (MS reference number: STOTEN-D-21-07316R1).

Abstract: *Comparing with the enduring efforts to reduce carbon emissions in design, construction, and operation stages of a construction project, less attention has been paid to emission abatement potential in the end-of-life stage, particularly by recycling waste generated by construction and demolition (C&D) activities. This research aims to cover this knowledge void by quantifying the embodied carbon saving potential of recycling C&D waste. It does so by adopting a Life Cycle Assessment (LCA) and choosing the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) in South China for a case study. The carbon emission is treated as embodied in construction materials, by recycling which the equivalent amount of carbon generated from the virgin materials can be saved. It is estimated that the GBA produced 128.49 Mt of C&D waste in 2018, which implies an embodied carbon saving potential of 92.26 Mt carbon emissions. The research goes further to understand the future C&D waste generation and their corresponding embodied carbon saving potential. A first-of-its-kind dynamic approach is developed to simulate the future 42-year saving potential under four construction development scenarios. Depending on different construction growth rates, the embodied carbon saving potential in 2060 can be up to 894.80 Mt and down to 166.34 Mt. This research can help achieve China's 2060 carbon neutral goal by focusing on a non-negligible sector in an economically important region. Methods proposed in this paper are also applicable to other regions worldwide, especially where C&D waste data is insufficient.*

2. Dr Frank Xue

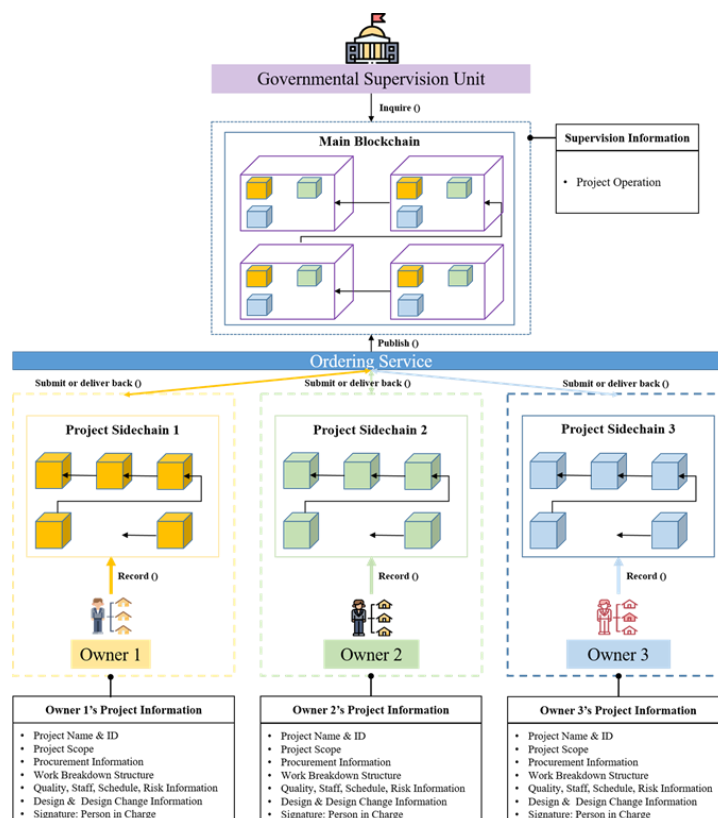
- has won a University's Seed Fund for Basic Research, for his project titled 'Automated Machine Learning (AutoML) for Processing Urban Big Data: A Derivative-free Optimization (DFO)'s Perspective', at the amount of HK\$120,000, for a project period of 18 months.

3. iLab researchers led by Professor Wilson Lu and/or Dr Frank Xue

- have the following papers accepted for publication:

- (i) **Lu, W.S., Wu, L., Zhao, R., Li, X., and Xue, F. (2021).** Blockchain technology for governmental supervision of construction work: Learning from digital currency electronic payment systems. *ASCE Journal of Construction Engineering and Management*. Forthcoming.

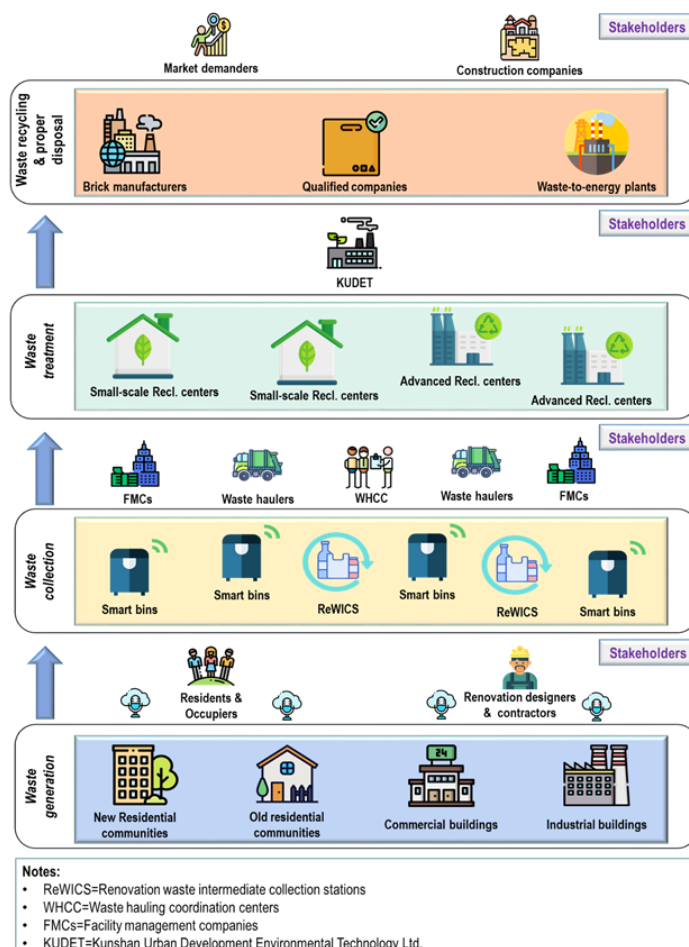
Abstract: Blockchain technology has been explored for governmental supervision of construction work (GSCW) due to its merits of traceability, immutability, and transparency. However, its decentralised nature is seemingly incompatible with GSCW, which is a type of centralised governance per se. This research aims to find a network topology with a proper level of (de)centralisation and, based on this topology, to develop a blockchain-based model for GSCW. Firstly, a literature review is conducted to identify problems in GSCW. Then, a cross-sectoral learning is performed between GSCW and digital currency electronic payment systems. Next, a design science research method is adopted to develop a dual-layer blockchain-based GSCW model integrated with an incentive mechanism. Finally, the model is illustrated in Hyperledger Fabric and evaluated its strengths and weaknesses. It is found that the model can enable an information-sharing, tamper-proof, and privacy-preserving mechanism without affecting the current status and routines of GSCW units and project teams. The model developed in our study can serve as a valuable reference for policymakers, practitioners, and researchers to develop governance policies or blockchain applications.



Graphical Abstract:
A dual-layer
blockchain-based
model for construction
supervision

- (ii) **Bao, Z. K., Lu, W. S., and Hao, J. L. (2021).** Tackling the “last mile” problem in renovation waste management: A case study in China. *Science of Total Environment*. Forthcoming.

Abstract: Solid waste generated from building renovation, called ‘renovation waste’ in this study, represents a major waste management problem. A particular difficulty is sourcing renovation waste arising sporadically from discrete sites for central processing. This can be characterised as a ‘last mile’ problem in renovation waste management (RWM). This study reports good practice for dealing with the RWM last mile problem in a city in China. We conduct qualitative research comprising site investigations and interviews, organised in an in-depth case study. We discover that the city effectively solved the last mile problem by developing a multi-layer, nested waste management system, empowered further by various smart technologies and concerted collaboration from multi-stakeholders coordinated by a determined government. Nevertheless, the longevity of the RWM is contingent on confronting several challenges, including (a) achieving cost and benefit balance, (b) defining clearer standards and policies, and (c) raising stakeholders’ awareness of waste management. A general RWM strategy is recommended to establish fluent channels through which to source and qualify renovation waste for central treatment. The study delves into the much neglected world of RWM and provides a valuable reference for tackling similar problems.



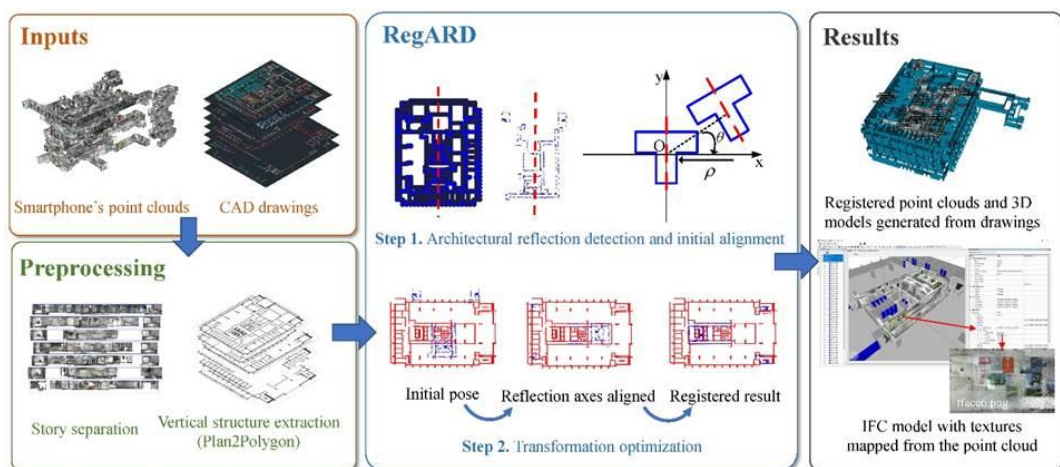
Graphic Abstract:
The renovation waste management system in Kunshan, China

- have published the following papers:

- (i) **Wu, Y.**, Shang, J., & **Xue, F.** (2021). RegARD: Symmetry-based coarse registration of smartphone's colorful point clouds with CAD drawings for low-cost digital twin buildings. *Remote Sensing*, 13(10):1882. DOI: <https://doi.org/10.3390/rs13101882>

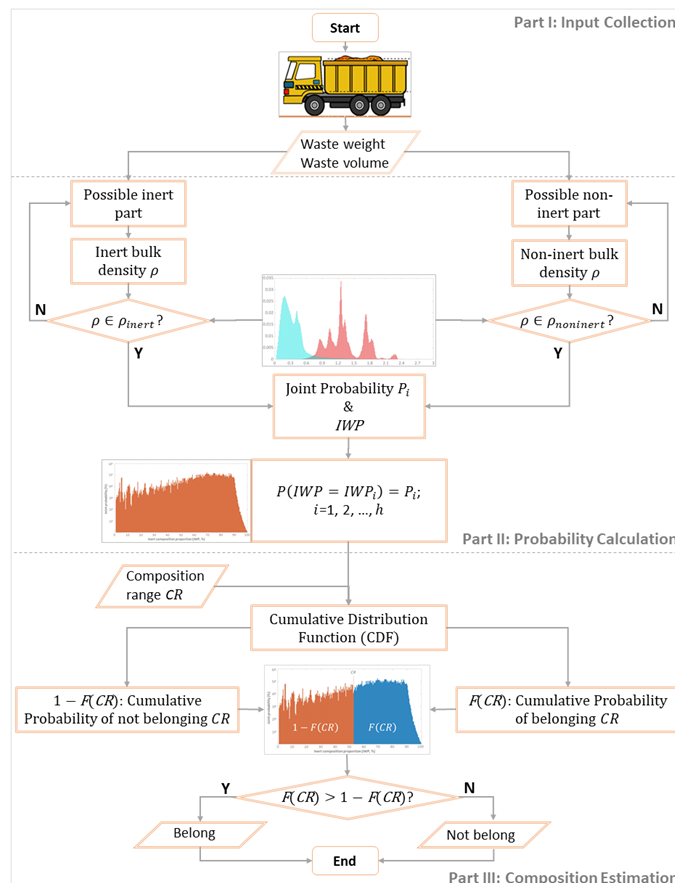
Abstract: Coarse registration of 3D point clouds plays an indispensable role for parametric, semantically rich, and realistic digital twin buildings (DTBs) in the practice of GIScience, manufacturing, robotics, architecture, engineering, and construction. However, the existing methods have prominently been challenged by (i) the high cost of data collection for numerous existing buildings and (ii) the computational complexity from self-similar layout patterns. This paper studies the registration of two low-cost data sets, i.e., colourful 3D point clouds captured by smartphones and 2D CAD drawings, for resolving the first challenge. We propose a novel method named 'Registration based on Architectural Reflection Detection' (RegARD) for transforming the self-symmetries in the second challenge from a barrier of coarse registration to a facilitator. First, RegARD detects the innate architectural reflection symmetries to constrain the rotations and reduce degrees of freedom. Then, a nonlinear optimisation formulation together with advanced optimisation algorithms can overcome the second challenge. As a result, high-quality coarse registration and subsequent low-cost DTBs can be created with semantic components and realistic appearances. Experiments showed that the proposed method outperformed existing methods considerably in both effectiveness and efficiency, i.e., 49.88% less error and 73.13% less time, on average. The RegARD presented in this paper first contributes to coarse registration theories and exploitation of symmetries and textures in 3D point clouds and 2D CAD drawings. For practitioners in the industries, RegARD offers a new automatic solution to utilise ubiquitous smartphone sensors for massive low-cost DTBs.

Graphical Abstract:



- (ii) Yuan, L., Lu, W. S., & Xue, F. (2021). Estimation of construction waste composition based on bulk density: A big data-probability (BD-P) model. *Journal of Environmental Management*, 292, 112822. DOI: <https://doi.org/10.1016/j.jenvman.2021.112822>

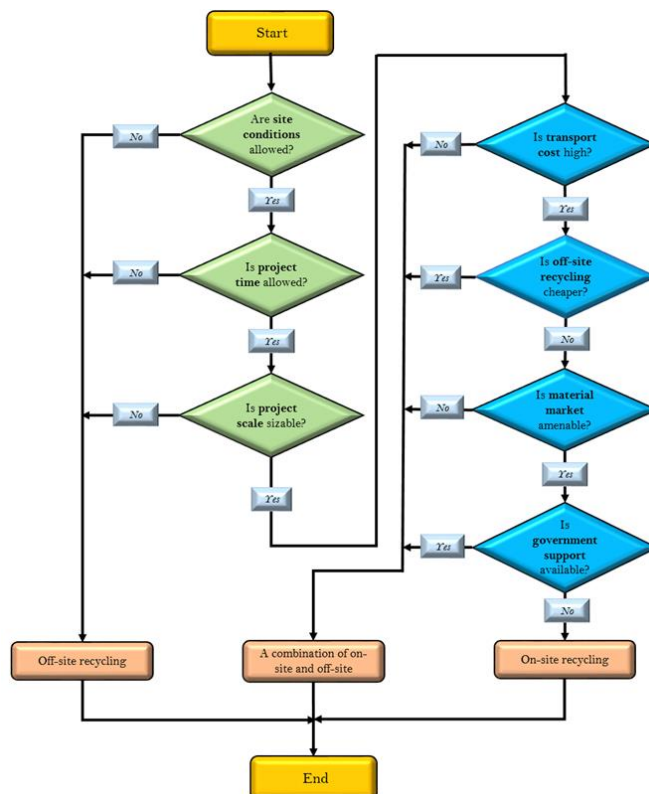
Abstract: Estimating the composition of construction waste is crucial to the efficient operation of various waste management facilities, such as landfills, public fills, and sorting plants. However, this estimating task is often challenged by the desire of quickness and accuracy in real-life scenarios. By harnessing a valuable data set in Hong Kong, this research develops a big data-probability (BD-P) model to estimate construction waste composition based on bulk density. Using a saturated data set of 4.27 million truckloads of construction waste, the probability distribution of construction waste bulk density is derived, and then, based on the Law of Joint Probability, the BD-P model is developed. A validation experiment using 604 ground truth data entries indicates a model accuracy of 90.2%, Area Under Curve (AUC) of 0.8775, and speed of around 52 seconds per load in estimating the composition of each incoming construction waste load. The BD-P model also informed a linear model which can perform the estimation with an accuracy of 88.8% but consuming 0.4 seconds per case. The major novelty of this research is to harmonise big data analytics and traditional probability theories in improving the classic challenge of predictive analyses. In the practical sphere, it satisfactorily solves the construction waste estimation problem faced by many waste management facility operators. In the academic sphere, this research provides a vivid example that big data and theories are not adversaries, but allies.



Graphic Abstract:
The architecture of the construction waste composition estimation model (BD-P model)

- (iii) **Bao, Z. K. & Lu, W. S.** (2021). A decision-support framework for planning construction waste recycling: A case study of Shenzhen, China. *Journal of Cleaner Production*, 309, 127449. DOI: <https://doi.org/10.1016/j.jclepro.2021.127449>

Abstract: Construction waste recycling is to turn construction waste materials into new resources for use. It is often considered in waste management plans, in which a central dilemma is to ponder the on-site and off-site options. Both recycling options have their respective strengths and weaknesses in dealing with internal and external factors related to site, time, cost, market, and government. However, no previous study has consciously considered the two options by putting them together with the factors in a structured model to support managers in devising their waste management plans. This study aims to develop a decision-support framework to help plan on-site and off-site construction waste recycling. It does so by adopting the qualitative research methods of case study, site visits and semi-structured interviews in Shenzhen, China. Two generic factors, namely (a) project characteristics (e.g., site constraints, time allowed, and project scale), and (b) industrial and governmental supports (e.g., transportation, recycling technology, the material market, regulations, and government subsidies), are found to determine the technical and economic viability of a particular recycling option. The two factors interact with each other and evolve over time and context to effect. This paper further articulated and organised their dynamics in a construction waste recycling decision-support framework. The research can help maximise the practicality of waste management plans. It is also of value to enhance construction waste management in the long run.



Graphic Abstract:
The decision-support framework for planning construction waste recycling

4. Professor Wilson Lu

- delivered a keynote speech titled 'Developing a Construction Waste Trade Organisation (WTO) in the Greater Bay Area, China: A Dream to Green', on the International Urban Building E&C Eco Summit, Suzhou, on 30 May 2021.



- delivered an invited talk titled 'Innovation and Education in Architecture, Engineering, and Construction' on the 2nd Forum of 'The Advancement of Smart Construction Pedagogy and Practices', organised by North China University of Technology, Beijing, on 30 May 2021.



THE UNIVERSITY OF HONG KONG 香港大學
faculty of architecture 建築學院
Department of Real Estate and Construction



iLab | @HKURBAN
The urban big data lab

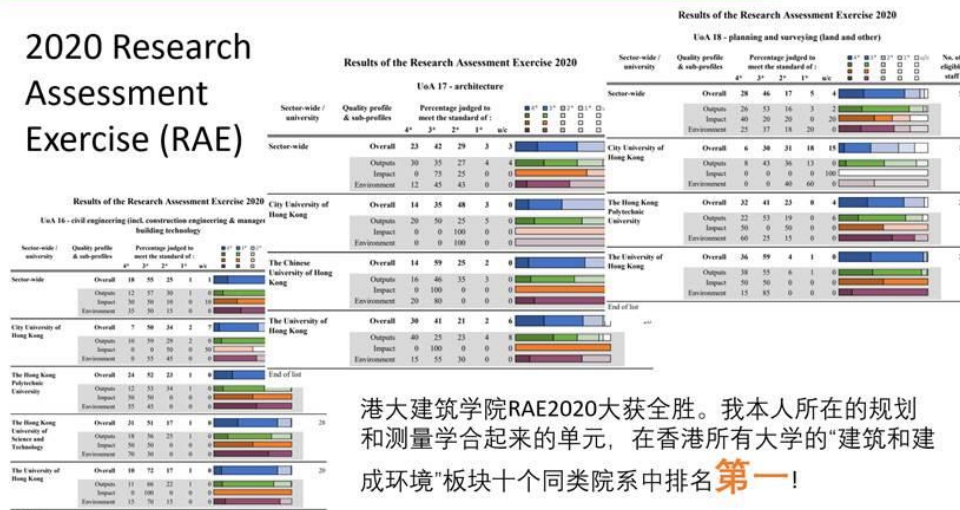
Innovation and Education in Architecture, Engineering, and Construction

建筑创新和人才培养

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带好建筑学院的科研创新，再创新高

2020 Research Assessment Exercise (RAE)

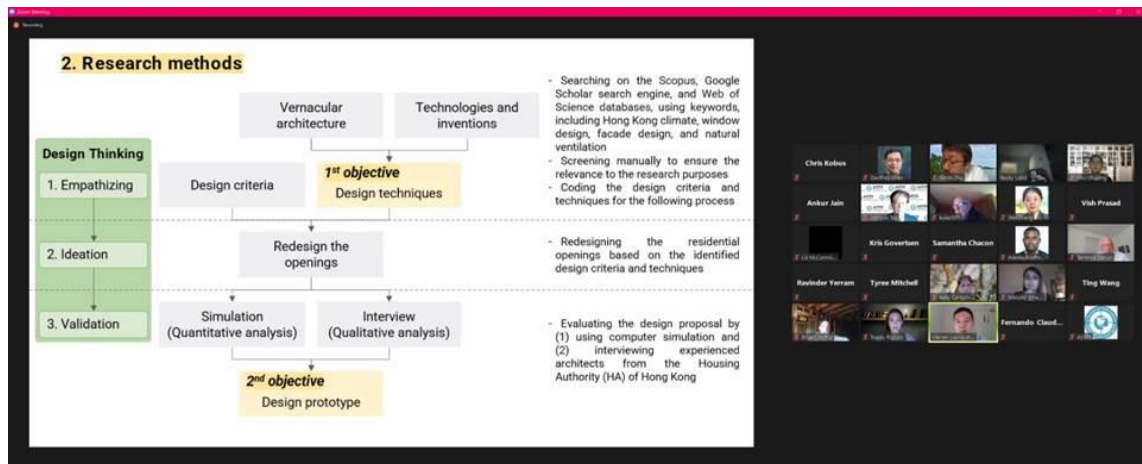


5. Mr Vikrom Laovisutthichai, a Hong Kong PhD Fellowship Scheme student with iLab, and Mr Stephen Grotz of the University of North Carolina at Charlotte
- won the only award of ‘Sustainability Tank Challenge: Leadership and Innovation in a Sustainable Built Environment’ on 28 May 2021, with the topic of ‘Rethinking the Residential Opening: A Case Study of Hong Kong’.

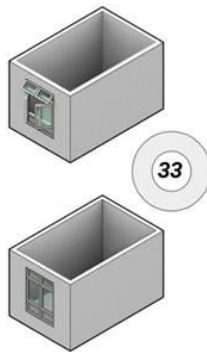
This is the final competition of a year-long programme called ‘Leadership Development in Built Environment Sustainability’ supported by the US National Science Foundation (NSF) and hosted by Louisiana State University, the American Society of Thermal and Fluids Engineers (ASTFE), and Hong Kong Polytechnic University. The programme put 10 graduate students from the US and Hong Kong to receive research and professional training over the year to develop their leadership in architecture, engineering, and construction. Vikrom was teamed up with Stephen. Another PhD student from the Faculty, Ms Yuwen Yang, also joined the programme.

Research topic: Rethinking the Residential Opening: A Case Study of Hong Kong

Abstract: *In a high-density city like Hong Kong, an opening in a residential unit has a massive impact on the microscale indoor environment, living conditions, and habitants’ satisfaction. Presently, numerous vernacular techniques and rapid development in design, construction, computation, and material technologies provide a prodigious opportunity to rethink this architectural component and maximise its advantages. This project, therefore, aims to review vernacular and new technologies, and redesign the residential opening in the context of Hong Kong. It is achieved by adopting 5-stage design thinking: empathising context, defining real-life challenge, brainstorming resolution, redesigning opening, and validating through simulation and interview with a practitioner. Finally, the design proposal is generated from the concept of ‘flexibility’ in responding to subtropical climate and seasonal changes. It is a sum of several architectural elements and techniques to serve various functions, facilitate manufacturing and assembly processes in Hong Kong’s modular off-shore construction, and ultimately improve living quality. This proposal can be regarded as a preliminary version for further research and practice development.*

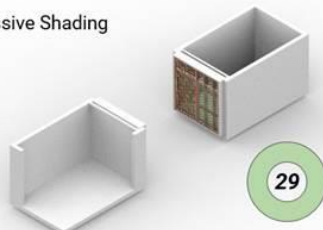


Existing Apartment

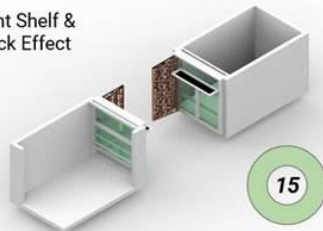


Base EUI based on average Hong Kong apartment

Passive Shading

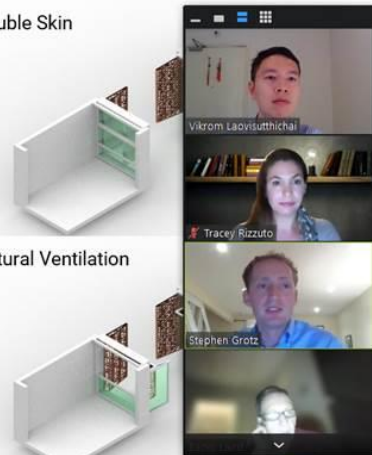


Light Shelf & Stack Effect



Sustainability data derived from Climate Studio modeling software and measured by Energy Use Intensity (EUI kWh/yr/sqm)

Double Skin



Natural Ventilation



Sustainable High Density Cities Lab

1. Dr Ren Chao

- has the following papers accepted for publication:

- (i) **Ren, C.**, Wang, K. *, Shi, Y., Kwok, Y.T., Morakinyo, T. E., Lee, T.-c., & Li, Y. (2021). Investigating the urban heat and cool island effects during extreme heat events in high-density cities: A case study of Hong Kong from 2000 to 2018. *International Journal of Climatology*, 1-19. Accepted author manuscript. DOI: <https://doi.org/10.1002/joc.7222>

Abstract: *Urban heat island (UHI) and cool island (UCI) effects are well-known and prevalent in cities worldwide. An increasing trend of extreme heat events has been observed over the last few decades and is expected to continue in the foreseeable future. In this study, warm periods (May to September) of 2000-2018 were examined to acquire a comprehensive understanding of the UHI and UCI characteristics for the case study of Hong Kong, China. 22 weather stations in Hong Kong were classified into four categories, namely urban, urban oasis, suburban, and rural, with reference to the local climate zone (LCZ) scheme, to analyse UHI and UCI phenomena during extreme heat and non-extreme heat situations. One representative type of extreme heat events was considered in this study: three consecutive hot nights with two very hot days in between (2D3N). Results show that both the UHI and UCI effects are exacerbated during extreme heat events. Using the concept of the UHI degree hours (UHIdh) and UCI degree hours (UCIdh), their spatial patterns in Hong Kong during extreme heat and non-extreme heat situations were mapped based on multiple linear regression models. It is found that the predictor variable – windward/leeward index is a significant influential factor of both UHIdh and UCIdh during extreme heat events. The resulting UHIdh and UCIdh maps not only enhance our understanding of the spatial pattern and characteristics of the UHI and UCI during extreme heat events, but could also serve as a useful reference in climate change adaptation, heat-health risk detection, cooling-energy estimation and policy making.*

- has published the following papers:

- (i) Cai, W., Zhang, C., Sun, K., Ai, S., Bai, Y., Bao, J., Chen, B., Cheng, L., Cui, X., Dai, H., Di, Q., Dong, W., Dou, D., Fan, W., Fan, X., Gao, T., Geng, Y., Guan, D., Guo, Y., Hu, Y., **Hua, J.**, Huang, C., Huang, H., Huang, J., Jiao, K., Jiang, T., Kieseewetter, G., Klimont, Z., Lampard, P., Li, C., Li, Q., Li, T., Li, R., Lin, B., Lin, H., Liu, H., Liu, Q., Liu, X., Liu, Y., Liu, Z., Liu, Z., Liu, Z., Lou, S., Lu, C., Luo, Y., Ma, W., Mcgushin, A., Niu, Y., **Ren, C.**, Ren, Z., Ruan, Z., Schöpp, W., Su, J., Tu, Y., Wang, J., Wang, Q., Wang, Y., Wang, Y., Watts, N., Xiao, C., Xie, Y., Xiong, H., Xu, M., Xu, B., Xu, L., Yang, J., Yang, L., Yu, L., Yue, Y., Zhang, S., Zhang, Z., Zhao, J., Zhao, L., Zhao, M., Zhao, Z., Zhou, J., & Gong, P*. (2021). 因地而异的气候变化

健康影响需要因地制宜的应对措施 [Location-specific health impacts of climate change require location-specific responses]. *Chinese Science Bulletin*. DOI: <https://doi.org/10.1360/TB-2021-0140>

- (ii) Chen, X., Yang, J.*, **Ren, C.**, Jeong, S., & Shi, Y. (2021). Standardizing thermal contrast among local climate zones at a continental scale: Implications for cool neighborhoods. *Building and Environment*, 197, 107878. DOI: <https://doi.org/10.1016/j.buildenv.2021.107878>

Abstract: The Local Climate Zone (LCZ) classification system provides a standardised framework to differentiate neighbourhoods for intra-city heat island studies. Yet the thermal contrast of air temperatures over different LCZs has not been examined at a continental scale. Using ground-based meteorological observations in 2016, here we investigated the seasonal thermal behaviours of various LCZs over China. Measured air temperatures over studied LCZs are found to have strong relations with latitude, altitude, and the distance to coastline. Thermal contrasts reduce to less than 1 °C in all seasons after removing the signal of background mean air temperature determined by geographical conditions. Despite the air temperature variation within individual LCZs, results reveal consistent characteristic air temperature regimes of LCZs exist at a continental scale. The warmth of built type LCZs is more evident at night, with an annual mean air temperature difference of 0.51 °C compared to the low plant LCZ. Among the studied LCZs, compact mid-rise neighbourhoods have consistently high air temperatures throughout the year. Comparative analysis suggests that open high-rise neighbourhoods are preferred over compact mid-rise and low-rise neighbourhoods for sustainable city development. Our results provide useful guidance for landscape design and planning to create cool cities and neighbourhoods.

- (iii) **Chung, L. C. H., Xie, J.* & Ren, C.** (2021). Improved machine-learning mapping of local climate zones in metropolitan areas using composite Earth observation data in Google Earth Engine. *Building and Environment*, VSI: Urban Morphology, 199, 107879. DOI: <https://doi.org/10.1016/j.buildenv.2021.107879>.

Abstract: Accurate, large-scale local climate zone (LCZ) maps with data consistency are crucial for urban environmental studies globally. However, current approaches using Earth observation data and machine learning (ML) algorithms with local computation power are limited by low accuracy, coverage, and efficiency. Here, we present an improved workflow for generating consistent large-scale LCZ maps based on optimal data and ML algorithm selection using the Google Earth Engine (GEE) platform. Twelve data-composition scenarios and one optimised scenario were designed to explore the effects and synergetic use of nine Earth observation datasets, based on their reported potential in pixel-based classification. Our results show that depending on the intended use of the map, the random forest (RF) classifier and support vector machine (SVM) classifier are by far the most appropriate ML algorithms for pixel-based LCZ classification. While the RF classifier achieves a significantly higher

overall accuracy and shows advantages in most of the individual classes, the SVM classifier exhibits significantly less variability with regard to accuracy. In addition, the competitive accuracy of the optimised scenario shows that using 'elite variables' in the RF classifier can significantly improve classification accuracy while also reducing computational burden. Furthermore, thermal-infrared variables are far more influential than other variables in LCZ classification. Our study is the first attempt to make a cross-comparison of various remote sensing datasets and ML algorithms for LCZ classification using the GEE platform. As such, our results provide valuable new insights, workflows, and future directions for large-scale LCZ classification to support urban environmental studies globally.

- (iv) Liu, S.*, Zeng, A., Lau, K., **Ren, C.**, Chan, P.-W., & Ng, E. (2021). Predicting long-term monthly electricity demand under future climatic and socioeconomic changes using data-driven methods: A case study of Hong Kong. *Sustainable Cities and Society*, 70, 102936. DOI: <https://doi.org/10.1016/j.scs.2021.102936>

Abstract: Data-driven methods, such as artificial neural networks (ANNs), support vector regression (SVM), Gaussian process regression (GPR), multiple linear regression (MLR), decision trees (DTs), and gradient boosting decision trees (GBDTs), are the most popular and advanced methods for energy demand prediction. However, these methods have not been cross compared to analyse their performances for long-term energy demand predictions. Therefore, this paper aims to identify the best method among these data-driven methods for quantifying the impacts of climatic and socioeconomic changes on future long-term monthly electricity demand in Hong Kong. First, historical 40-year climatic, socioeconomic, and electricity consumption data are used to train and validate these models. Second, different representation concentration pathway (RCP) scenarios and three percentiles of 24 global circulation model outputs are adopted as future climatic changes, while five shared socioeconomic pathways are considered for future socioeconomic uncertainties. The results show that the GBDT method provides the best accuracy, generalisation ability, and time-series stability, while ANN method exhibits the lowest accuracy and lower generalisation ability. The monthly electricity demands in Hong Kong under the RCP8.5–2090 s scenario are predicted to increase by up to 89.40 % and 54.34 % in the residential and commercial sectors, respectively, when compared with 2018 levels.

- (v) Yang, H., He, D., Lu, Y.*, **Ren, C.**, & Huang, X. (2021). Disentangling residential self-selection from the influence of built environment characteristics on adiposity outcomes among undergraduate students in China. *Cities*, 113, 103165. DOI: <https://doi.org/10.1016/j.cities.2021.103165>

Abstract: Although many studies have confirmed the effects of the built environment on adiposity outcomes in the general population, evidence for young adults is scarce. Furthermore, most prior studies are prone to residential self-selection bias due to the nature of cross-sectional research design, which makes the built environment–adiposity relationship spurious.

In this study, we explored the associations between the built environment and three objectively measured adiposity outcomes for a large representative sample of 20,227 undergraduate students from 89 university campuses in China. The adiposity outcomes were measured by body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR). The residential self-selection bias was largely mitigated because these students are required to live in campus dormitories. As shown by multilevel models, street connectivity, population density, and Normalised Difference Vegetation Index (NDVI) within and around the campus environment were negatively associated with the odds of adiposity to different extents. Furthermore, the adiposity outcomes of male and low cost-of-living undergraduates were more likely to be affected by built environment characteristics compared to female and high cost-of-living undergraduates. Hence, to deliver effective environment interventions to curb the prevalence of adiposity among undergraduate students, policymakers and university managers are advised to create a more carefully conceived campus environment.

- (vi) Wang, P., Goggins, W. B.*, Shi, Y., Zhang, X., **Ren, C.**, & Ka-Lun Lau, K. (2021). Long-term association between urban air ventilation and mortality in Hong Kong. *Environmental Research*, 197, 111000. DOI: <https://doi.org/10.1016/j.envres.2021.111000>

Abstract: *While associations between population health outcomes and some urban design characteristics, such as green space, urban heat islands (UHI), and walkability, have been well studied, no prior studies have examined the association of urban air ventilation and health outcomes. This study used data from Hong Kong, a densely populated city, to explore the association between urban air ventilation and mortality during 2008–2014. Frontal area density (FAD) was used to measure urban ventilation, with higher FAD indicating poorer ventilation, due to structures blocking wind penetration. Negative binomial regression models were constructed to regress mortality counts for each five-year age group, gender, and small area group, on small area level variables including green space density, population density and socioeconomic indicators. An interquartile range increase in FAD was significantly associated with a 10% (95% confidence interval (CI) 2%–19%, $p = 0.019$) increase in all-cause mortality and a 21% (95% CI: 2%–45%, $p = 0.030$) increase in asthma mortality, and non-significantly associated with a 9% (95% CI: 1%–19%, $p = 0.073$) in cardio-respiratory mortality. Better urban ventilation can help disperse vehicle-related pollutants and allow moderation of UHIs, and for a coastal city may allow moderation of cold temperatures. Urban planning should take ventilation into account. Further studies on urban ventilation and health outcomes from different settings are needed.*

- (vii) Ouyang, W.*, Morakinyo, T. E., **Ren, C.**, Liu, S., & Ng, E. (2021). Thermal-irradiant performance of green infrastructure typologies: Field measurement study in a subtropical climate city. *Science of The Total Environment*, 764, 144635. DOI: <https://doi.org/10.1016/j.scitotenv.2020.144635>

Abstract: Greenery infrastructure (GI) is an important design strategy for sustainable cities and communities' development, as it brings multiple benefits including mitigating urban heat island. Based on the implementation locations, three typical GI typologies, namely green roof, green wall, and ground tree, are widely adopted in urban communities. As previous studies focused on one single GI and mainly studied their thermal features, this study aims to fill the gap by investigating three GI typologies within one site; their thermal-irradiant performance was compared for four typical summer days in a subtropical city. Firstly, stationary and transect measurements were taken for six points (three greenery and three bare points); two typical measuring methods, i.e., the globe thermometer and the six-directional methods, were employed to collect irradiant variables. Secondly, the thermal-irradiant differences were revealed among GI typologies and temporal periods; two measuring methods were compared for their capabilities in detecting the irradiant variations near three GI typologies. Results showed that: 1) the ground tree experienced the smallest thermal-irradiant average and variation among three GI typologies; 2) the morning session (09:00–12:00) had the largest thermal-irradiant reduction and variations for three GI typologies; and 3) the six-directional method showed higher sensitivity towards the irradiant variations near three GI typologies; the globe thermometer method is not suitable for tree-shaded areas. This study provides a comprehensive understanding of proper selection of Mean radiant temperature (MRT) measuring methods and GI implementation for thermal comfort, especially for the subtropical cities. Practically, this study shows designers and policymakers on how to implement GI typologies for climate-resilient design.

- (viii) Shi, Y., **Ren, C.**, Luo, M., Ching, J., **Li, X.**, Bilal, M., Fang, X.*, & Ren, Z. (2021). Utilizing world urban database and access portal tools (WUDAPT) and machine learning to facilitate spatial estimation of heatwave patterns. *Urban Climate*, 36, 100797. DOI: <https://doi.org/10.1016/j.uclim.2021.100797>

Abstract: Climate change leads to more intense, higher, frequent and prolonged heat extremes. Understanding the spatial pattern of heatwave is vital for providing the corresponding weather services, making climate change adaptation strategies and heat-health actions. In this study, we present an approach to estimate the heatwave spatial patterns by utilising the World Urban Database and Access Portal Tools (WUDAPT) Level 0 data and machine learning. The analysis is based on two years (2009 and 2016) of air temperature data from 86 meteorological monitoring stations in Guangdong province of China, a subtropical region with frequent hot and sultry weather in summer. First, heatwave conditions were quantified by calculating the number of hot days and frequency of heatwave events in each year and used as the response variables. Then, random forest models were built by using a geospatial dataset consisting of WUDAPT and urban canopy parameters (UCP) as predictor variables. Based on the resultant models, spatial patterns of heatwave were estimated and mapped at 100 m spatial-resolution. The results show that this approach is able to estimate heatwave spatial patterns using open data and inform urban

policy and decision-making. The study is also a new perspective and a feasible pathway of utilising WUDPAT Level 0 product to facilitate urban environment applications.

- (ix) Huang, K.*, Leng, J., Xu, Y., **Li, X.**, Cai, M., Wang, R., & **Ren, C.** (2021). Facilitating urban climate forecasts in rapidly urbanizing regions with land-use change modeling. *Urban Climate*, 36, 100806. DOI: <https://doi.org/10.1016/j.uclim.2021.100806>

Abstract: *The local climate zone (LCZ) mapping scheme classifies urban lands into multiple types according to their climate-relevant surface properties, enabling forecasts of changes in urban climate. However, stationary LCZ maps are insufficient for forecasts in the rapidly urbanising regions, where there are frequent transitions among multiple urban lands and thus changing surface properties. To facilitate climate forecasts with these changing properties, we propose a new methodological framework to predict future LCZ maps using the Cellular Automata (CA) land-cover/land-use change (LCLUC) model. Different from most existing LCLUC studies that treat the urban area as homogeneous, our work is the first attempt to simulate the complex conversions among low-, mid- and high-rise urban lands defined in LCZ. To validate our method, we apply it in the Pearl River Delta (PRD) metropolitan area, China, a rapidly urbanising region with more than 50 million residents. First, we use the World Urban Database and Portal Tool (WUDAPT) method to generate LCZ maps of the PRD region in 2009 and 2014, with satellite images. Then, we apply the CA model on the 2009 LCZ map to forecast the 2014 one based on the LCLUC rules discovered by the data mining technique. The comparison between the forecasted and observed 2014 LCZ maps yields a kappa coefficient of 0.77 and an overall accuracy of 82%. Our method achieves satisfactory accuracies on the high- (84%) and low-rise (82%) urban lands while performing relatively poorly on the mid-rise (40%) lands. Our results demonstrate that the combination of the LCZ scheme and LCLUC modeling has the potential of capturing the structural changes within cities and providing the necessary input datasets for urban climate forecasts.*

- (x) Pesaresi, M.*, Corbane, C., **Ren, C.**, & Ng, E., (2021). Generalized vertical components of built-up areas from global digital elevation models by multi-scale linear regression modelling, *PLOS ONE*, 16(2), e0244478. DOI: <https://doi.org/10.1371/journal.pone.0244478>

Abstract: *The estimation of the vertical components of built-up areas from free Digital Elevation Model (DEM) global data filtered by multi-scale convolutional, morphological and textural transforms are generalised at the spatial resolution of 250 metres using linear least-squares regression techniques. Six test cases were selected: Hong Kong, London, New York, San Francisco, Sao Paulo, and Toronto. Five global DEM and two DEM composites are evaluated in terms of 60 combinations of linear, morphological and textural filtering and different generalisation techniques. Four generalised vertical components (GVC) estimates of built-up areas*

are introduced: the Average Gross Building Height (AGBH), the Average Net Building Height (ANBH), the Standard Deviation of Gross Building Height (SGBH), and the Standard Deviation of Net Building Height (SNBH). The study shows that the best estimation of the net GVC of built-up areas given by the ANBH and SNBH, always contains a greater error than their corresponding gross GVC estimation given by the AGBH and SGBH, both in terms of mean and standard deviation. Among the sources evaluated in this study, the best DEM source for estimating the GVC of built-up areas with univariate linear regression techniques is a composite of the 1-arcsec Shuttle Radar Topography Mission (SRTM30) and the Advanced Land Observing Satellite (ALOS) World 3D–30 m (AW3D30) using the union operator (CMP_SRTM30-AW3D30_U). A multivariate linear model was developed using 16 satellite features extracted from the CMP_SRTM30-AW3D30_U enriched by other land cover sources, to estimate the gross GVC. A Root Mean Square Error (RMSE) of 2.40 m and 3.25 m was obtained for the AGBH and the SGBH, respectively. A similar multivariate linear model was developed to estimate the net GVC. A RMSE of 6.63 m and 4.38 m was obtained for the ANBH and the SNBH, respectively. The main limiting factors on the use of the available global DEMs for estimating the GVC of built-up areas are two. First, the horizontal resolution of these sources (circa 30 and 90 metres) corresponds to a sampling size that is larger than the expected average horizontal size of built-up structures as detected from nadir-angle Earth Observation (EO) data, producing more reliable estimates for gross vertical components than for net vertical component of built-up areas. Second, post-production processing targeting Digital Terrain Model specifications may purposely filter out the information on the vertical component of built-up areas that are contained in the global DEMs. Under the limitations of the study presented here, these results show a potential for using global DEM sources in order to derive statistically generalised parameters describing the vertical characteristics of built-up areas, at the scale of 250x250 metres. However, estimates need to be evaluated in terms of the specific requirements of target applications such as spatial population modelling, urban morphology, climate studies and so on.

- (xi) Cai, W., Zhang, C., Suen, H. P., Ai, S., Bai, Y., Bao, J., Chen, B., Cheng, L., Cui, X., Dai, H., Di, Q., Dong, W., Dou, D., Fan, W., Fan, X., Gao, T., Geng, Y., Guan, D., Guo, Y., Hu, Y., **Hua, J.**, Huang, C., Huang, H., Huang, J., Jiang, T., Jiao, K., Kiesewetter, G., Klimont, Z., Lampard, P., Li, C., Li, Q., Li, R., Li, T., Lin, B., Lin, H., Liu, H., Liu, Q., Liu, X., Liu, Y., Liu, Z., Liu, Z., Liu, Z., Lou, S., Lu, C., Luo, Y., Ma, W., McGushin, A., Niu, Y., **Ren, C.**, Ren, Z., Ruan, Z., Schöpp, W., Su, J., Tu, Y., Wang, J., Wang, Q., Wang, Y., Wang, Y., Watts, N., Xiao, C., Xie, Y., Xiong, H., Xu, M., Xu, B., Xu, L., Yang, J., Yang, L., Yu, L., Yue, Y., Zhang, S., Zhang, Z., Zhao, J., Zhao, L., Zhao, M., Zhao, Z., Zhou, J., & Gong, P.* (2021). The 2020 China report of the Lancet Countdown on health and climate change, *The Lancet Public Health*, 6(1), e64-e81, DOI: [https://doi.org/10.1016/S2468-2667\(20\)30256-5](https://doi.org/10.1016/S2468-2667(20)30256-5)

Abstract: Left unmitigated, climate change poses a catastrophic risk to human health, requiring an urgent and concerted response from every country. As the home to one fifth of the world's population and the largest emitter of carbon dioxide globally, China's interventions in climate change are of pivotal importance, both to human health and to the planet. Similar to other countries, climate change mitigation and adaptation would bring immense health benefits for China's 1.4 billion people, and building these considerations into any COVID-19 recovery strategy and the detailed pathway to fulfil the 2060 carbon neutrality pledge will ensure it improves human wellbeing, both now and in the future. Decisions made over the coming months and years will establish the course of climate change policy for decades to come. To meet this challenge, Tsinghua University (Beijing, China), partnering with University College London (London, UK) and 17 Chinese and international institutions, has produced the Lancet Countdown China report, focusing at the national level and building on the work of the global Lancet Countdown. Drawing on international methods and frameworks, this report aims to understand and track the links between public health and climate change at the national level. This paper is one part of the Lancet Countdown's broader efforts to develop regional expertise and understanding. Uniquely, the data and results in this report are presented at the provincial level where possible, to facilitate the targeted response strategies for local decision makers.

- (xii) **Hua, J. Y., Zhang, X. Y., Ren, C.***, Shi, Y., Lee, T. C. (2021). Spatiotemporal assessment of extreme heat risk for high-density cities: A case study of Hong Kong from 2006 to 2016, *Sustainable Cities and Society*, 64, 102507. DOI: <https://doi.org/10.1016/j.scs.2020.102507>

Abstract: High-density cities are faced with growing extreme hot weather driven by climate change and local urbanisation, but localised heat risk detection is still at an early stage for most cities (Watts et al., 2019). This study developed a spatiotemporal hazard-exposure-vulnerability assessment of the extreme heat risk in Hong Kong for 2006, 2011, and 2016 integrating cumulative very hot day hours and hot night hours in summer, population density and a principal component analysis (PCA) of demo-socioeconomic characteristics. The risk was found spatially variant, and high-risk spots were identified at the community scale for both daytime and nighttime with underlying determinants behind. In both the daytime and the nighttime, high risk mainly occurred in the core urban areas. Nearly 10 more hot-spots were found in the nighttime than those in the daytime. Several old communities in Kowloon stayed at high risk from 2006 to 2016. Some new towns in the New Territories turned to be at higher risk in 2016 compared to 2006 and 2011, and this result showed signs to be emerging hot-spots in the near future. This study would be a useful reference for community-scale heat risk assessment and mitigation for the development of healthy and sustainable high-density cities.

Urban Analytics and Interventions Research Lab

1. Dr Guibo Sun

- organised the HKU-Cambridge Joint Seminar Series with Dr Christina Li of the University of Cambridge:

Event 1:

21 May 2021 (Friday), 5:00-7:00pm

Speakers and topics:

Dr Christina Li, Lecturer, Department of Land Economy, University of Cambridge, on **'The Heightened "Security Zone" Function of Gated Communities: Natural Experiment Evidence from the COVID-19 Pandemic'**.

Dr Eun Yeong Choe, Postdoctoral Fellow, Department of Urban Planning and Design & Urban Analytics and Interventions Research Lab, The University of Hong Kong, on **'Does a Natural Environment Enhance the Efficacy of Mindfulness-based Stress Reduction (MBSR)?'**

Discussant:

Professor Chris Webster, Chair Professor and Dean, Faculty of Architecture, The University of Hong Kong.

Event 2:

Date: 26 May 2021 (Wednesday), 7:30-9:30 pm

Speakers and topics:

Professor Andreas Kontoleon, Department of Land Economy, University of Cambridge, on **'An Artefactual Experiment on the Performance of Agglomeration Bonuses in Conservation Auctions: Lessons from the Field'**

Dr Guibo Sun, Assistant Professor, Department of Urban Planning and Design & Urban Analytics and Interventions Research Lab, The University of Hong Kong, on **'Natural Experiments in Built Environment and Health Studies: Enhancing the Design-based Approach by Urban Planning and Design Knowledge'**

Discussant:

Dr Zhaoyang Liu, Lecturer, Department of Land Economy, University of Cambridge

HKU-CAMBRIDGE JOINT SEMINAR SERIES:



FIELD AND NATURAL EXPERIMENTS

PLANNING, PROPERTY, HEALTH

FOR ABSTRACTS, PLEASE CHECK OUT EVENT WEBSITE:
[HTTPS://URBAN-INTERVENTION.HKU.COM/SEMINARS](https://urban-intervention.hku.com/seminars)



■ 21 MAY, 2021 FRIDAY

10:00AM - 12:00PM UK TIME/
5:00PM - 7:00PM HK TIME

THE HEIGHTENED 'SECURITY ZONE' FUNCTION OF
GATED COMMUNITIES: NATURAL EXPERIMENT
EVIDENCE FROM THE COVID-19 PANDEMIC

DR. CHRISTINA LI

LECTURER IN REAL ESTATE FINANCE,
DEPARTMENT OF LAND ECONOMY,
UNIVERSITY OF CAMBRIDGE



DISCUSSANT:

PROF. CHRIS WEBSTER

DEAN AND CHAIR PROFESSOR,
FACULTY OF ARCHITECTURE,
THE UNIVERSITY OF HONG KONG

DOES A NATURAL ENVIRONMENT ENHANCE
THE EFFICACY OF MINDFULNESS-BASED
STRESS REDUCTION (MBSR)?

DR. EUN YEONG CHOE

POSTDOC FELLOW,
DEPARTMENT OF URBAN PLANNING AND DESIGN,
THE UNIVERSITY OF HONG KONG



SCAN QR CODE TO REGISTER FOR THE EVENT ON 21 MAY



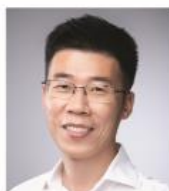
AN ARTEFACTUAL EXPERIMENT ON THE
PERFORMANCE OF AGGLOMERATION
BONUSES IN CONSERVATION AUCTIONS:
LESSONS FROM THE FIELD

PROF. ANDREAS KONTOLEON

PROFESSOR OF ENVIRONMENTAL ECONOMICS AND PUBLIC POLICY,
DEPARTMENT OF LAND ECONOMY, UNIVERSITY OF CAMBRIDGE

■ 26 MAY, 2021 WEDNESDAY

12:30PM - 2:30PM UK TIME/
7:30PM - 9:30PM HK TIME



NATURAL EXPERIMENTS IN BUILT ENVIRONMENT
AND HEALTH STUDIES: ENHANCING THE
DESIGN-BASED APPROACH BY URBAN PLANNING
AND DESIGN KNOWLEDGE

DR. GUIBO SUN

ASSISTANT PROFESSOR, DEPARTMENT OF URBAN PLANNING AND DESIGN,
DIRECTOR OF URBAN ANALYTICS AND INTERVENTIONS RESEARCH LAB,
THE UNIVERSITY OF HONG KONG



DISCUSSANT:

DR. ZHAOYANG LIU

UNIVERSITY LECTURER IN APPLIED ECONOMICS,
DEPARTMENT OF LAND ECONOMY,
UNIVERSITY OF CAMBRIDGE



SCAN QR CODE TO REGISTER FOR THE EVENT ON 26 MAY

ENQUIRIES:
EUN-YEONG CHOE, EYCHOE@HKU.HK

- was invited by the [Hong Kong Institute of Surveyors](#) to give a talk on 20 May 2021, on the topic of '[The Making of Hong Kong: 3D Pedestrian Network as the Critical Urban Infrastructure](#)'.



- has published the following article:

Sun, G., & Lau, C. Y. (2021). Go-along with older people to public transport in high-density cities: Understanding the concerns and walking barriers through their lens. *Journal of Transport & Health*, 21, 101072. DOI: <https://doi.org/10.1016/j.jth.2021.101072>

Abstract: *We applied a go-along interview, a mobile method that enhances the contextual basis of qualitative research, to understand how older people interact with walking environments when approaching public transport in high-density cities. We collected concerns, walking barriers and areas of improvement from older people's views by walking along with 72 participants on pre-designed walking paths towards public transport stations and stops in Hong Kong. The findings can help to address the mismatch between public transport supply and demand for older people in achieving healthy ageing in the high-density city of Hong Kong and elsewhere.*