

Dr. Rui Zhu

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Working experience

[2021-current] The Hong Kong Polytechnic University, Hong Kong SAR

Research Assistant Professor

Department of Land Surveying and Geo-Informatics

Faculty of Construction and Environment

[2018-2020] Singapore-MIT Alliance for Research and Technology, Singapore

Postdoctoral Associate

MIT Senseable City Laboratory

Joint Researcher at MIT Senseable City Laboratory, MIT, USA

Websites: <https://smart.mit.edu/> & <http://senseable.mit.edu/>

Education

[2014-2017] The Hong Kong Polytechnic University, Hong Kong SAR

Ph.D. in Geo-Informatics

Department of Land Surveying and Geo-Informatics

Faculty of Construction and Environment

Dissertation: Spatiotemporal data modeling for the analysis of dynamic behaviors of urban heat island
([HKIS – Dissertation Awards for Postgraduate Students, 2 winners in Hong Kong in 2018](#))

[2015-2016] Université Laval, Canada

Ph.D. Exchange Study

Department of Geomatics

Faculty of Forestry, Geography and Geomatics

[2010-2013] KTH - Royal Institute of Technology, Sweden

M.Sc. in Geodesy and Geoinformation

Department of Urban Planning and Environment

School of Architecture and the Built Environment

Dissertation: Moving object trajectory based intelligent traffic information hub

[2006-2010] Nanjing Normal University, China

B.Sc. Geographic Information System

Department of Geographical Information System

School of Geography Science ([National “Double-First Class” Initiative](#))

Dissertation: Virtual-Reality based Railway Visualization with VC++ and OpenGL

Media reports

Solar Cities: [Interviewed by Singapore TV](#); [Interviewed by Portfolio Magazine](#); [Interview video](#); [MIT SCL Website](#); [MIT Newsletter](#); [SMART Newsletter](#); [Invited Article in Topos Magazine](#)

Urban Mobility: [Singapore Lianhe Zaobao](#); [MIT News](#); [SMART Newsletter](#); [Topic News](#); [USA News Hub](#); [Amazing4You](#); [ONRede](#); [News Break](#); [TechXplore](#); [Transport News](#); [UrAllNews](#)

Journal publications (* corresponding author)

[32] **Zhu, R.**, Kondor, D., Zhang, X., Santi, P., Ratti, C. (2020). Solar charging improves operational efficiency of shared electric scooters. [In submission](#)

- [31] **Zhu, R.**, Cheng, C., Santi, P., Chen, M., Zhang, X., Mazzarello, M., Ratti, C. (2020). Systematic optimization of equipping photovoltaic modules in three-dimensional cities for real-time electric demand. [In submission](#)
- [30] Meng, Y., Wong, M.S., Xing, H., **Zhu, R.**, Qin, K., Kwan, M.P., Lee, K.H., Kwok, C.Y.T., Li, H. (2020). Effects of Urban Functional Fragmentation on Nitrogen Dioxide (NO₂) Variation during the COVID-19 Outbreak in China. *Landscape and Urban Planning*. [Submitted](#)
- [29] Mamaru, B., Shi, W.Z., Wong, M.S., **Zhu, R.** (2020). Analysis of Urban Drivable Network and Socioeconomic Conditions in Emerging Cities of Africa Using Big Data Based Spatial Connectivity, Urban Form and GDP Attributes. *Cities*. [Submitted](#)
- [28] Fung, C.H., Wong, M.S., **Zhu, R.**, Chan, P.W. (2020). Time-series Heat Fluxes Modelling over Hong Kong based on Spatiotemporal Data Fusion on Satellite Images. *ISPRS International Journal of Geo-Information*. [Submitted](#)
- [27] Meng, Y., Wong, M.S., Xing, H., Kwan, M.P., **Zhu, R.** (2020). Association between Global Air Pollution and Confirmed Cases of COVID-19. *Annals of the American Association of Geographers*. [Submitted](#)
- [26] Wong, M.S., **Zhu, R.***, Kwok, Y.T., Kwan, M.P., Santi, P., Lee, K.H., Heo, J., Li, H., Ratti, C. (2020). Variation of NO₂ and its Association with Urban Mobility in the COVID-19 Pandemic. *Environmental Research Letters*. [Submitted](#)
- [25] Yang, Z., Hui, K. W., Abbas, S., **Zhu, R.**, Kwok, C. Y. T., Heo, J., Ju, S., Wong, W. S. (2020). A Review of Monitoring Methods on Tree Sway, Tilt and Root-plate Movement. *Journal of Geospatial Engineering*. [Submitted](#)
- [24] Yu, X., Wong, M.S., Kwan, M.P., Nichol, J., **Zhu, R.**, Heo, J., Chan, P.W., Chin, D.C.W., Kwok, C.Y.T., Kan, Z. (2020). COVID-19 infection and mortality: association with PM_{2.5} concentration and population distribution – an exploratory study. *ISPRS International Journal of Geo-Information*. [Major revision](#)
- [23] Zhong, T., Zhang, K., Chen, M., Wang, Y., **Zhu, R.**, Zhang, Z., Zhou, Z., Qian, Z., Lv, G., Yan, J. (2020). A City-scale Estimation of Rooftop Solar Photovoltaic Potential Based on Deep Learning. *Applied Energy*. [Major revision](#)
- [22] Cheng, C., **Zhu, R.***, Costa, A.M., Thompson, R.G., Huang, Y. (2020). Multi-Period Two-echelon Location Routing Problem for Disaster Waste Clean-up. *Transportmetrica A: Transport Science*. [Major revision](#)
- [21] Zhong, T., Zhang, K., Chen, M., Wang, Y., **Zhu, R.**, Zhang, Z., Zhou, Z., Qian, Z., Lv, G., Yan, J. (2020). Assessment of solar photovoltaic potentials on urban noise barriers using street-view imagery. *Renewable Energy*. [Minor revision](#)
- [20] Cheng, C., **Zhu, R.***, Thompson, R.G., Zhang, L. (2020). Reliability Analysis for Multiple-stage Solid Waste Management Systems. *Waste Management*. [Accepted](#)
- [19] Cheng, C., **Zhu, R.***, Costa, A.M., Thompson, R.G. (2021). Optimisation of Waste Clean-up after Large-Scale Disasters. *Waste Management*, 119, 1-10.
- [18] Yan, L., Luo, X., **Zhu, R.**, Paolo Santi, P., Wang, D., Ratti, C (2020). Quantifying and analyzing traffic emission reduction by ridesharing: a case study of Shanghai. *Transportation Research Part D*, 89, 102629.
- [17] **Zhu, R.**, Wong, W. S., You, L., Santi, P., Nichol, J., Ho, H. C., Lu, L., Ratti, C. (2020). The effect of urban morphology on the solar capacity of three-dimensional cities. *Renewable Energy*, 153, 1111–1126.
- [16] **Zhu, R.**, Zhang, X., Kondor, D., Santi, P., Ratti, C. (2020). Understanding spatio-temporal heterogeneity of bike-share and scooter-share mobility. *Computers, Environment and Urban Systems*, 81, 101483.
- [15] **Zhu, R.**, Guilbert, E., Wong, W. S. (2020). Object-oriented tracking of spatial and thematic dynamic behaviors of urban heat islands. *Transactions in GIS*, 24, 85–103.
- [14] Kan, Z., Wong, W. S., **Zhu, R.** (2020). Understanding space-time patterns of vehicular emission flows in urban areas using geospatial technique. *Computers, Environment and Urban Systems*, 79, 101399.
- [13] **Zhu, R.**, You, L., Santi, P., Wong, W. S., Ratti, C. (2019). Solar accessibility in reforming urban areas: A case study in Kowloon East, Hong Kong. *Sustainable Cities and Society*, 51, 101738.
- [12] You, L., Tuncer, B., **Zhu, R.**, Xing, H., Yuen, C. (2019). A Synergetic Orchestration of Objects, Data and Services to Enable Smart Cities. *IEEE Internet of Things Journal*, 6(6), 10496–10507.
- [11] Ho, H. C., Wong, W. S., Abbas, S., **Zhu, R.** (2019). Development of the Adjusted Wind Chill Equivalent Temperature (AWCET) for cold mortality assessment across a subtropical city: validation and comparison with a spatially-controlled time-stratified approach. *BMC Public Health*, 19, 1290.

- [10] Lu, M., An, K., Hsu, S. C., **Zhu, R.** (2019). Considering user behavior in free-floating bike sharing system design: A data-informed spatial agent-based model. *Sustainable Cities and Society*, 49, 101567.
- [09] Ho, H. C., Abbs, S., Yang, J., **Zhu, R.**, Wong, W. S. (2019). Spatiotemporal prediction of increasing winter perceived temperature for climate change mitigation: A sustainable planning guideline for a sub-tropical city. *International Journal of Environment Research and Public Health*, 16, 497.
- [08] Na, J., Yang, X., Dai, W., Li, M., Xiong, L., **Zhu, R.**, Tang, G. (2018). Bidirectional DEM relief shading method for extraction of gully shoulder-line in loess tableland area. *Physical Geography*, 39(4), 368-386.
- [07] **Zhu, R.**, Guilbert, E., Wong, W. S. (2018). Object-core oriented data modelling for tracking of behaviors of urban heat islands. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 42(4), 763-770.
- [06] **Zhu, R.**, Wong, W. S., Guilbert, E., Chan, P. W. (2017). Understanding heat patterns produced by vehicular flows in urban areas. *Scientific Reports – Nature*, 7, 16309.
- [05] **Zhu, R.***, Guilbert, E., Wong, W. S. (2017). Object-oriented tracking of the dynamic behavior of urban heat islands. *International Journal of Geographical Information Science*, 31(2), 405-424.
- [04] **Zhu, R.**, Guilbert, E., Wong, W. S. (2016). Tracking the spatial evolution of urban heat islands. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 3(2), 3-8.
- [03] Wong, W. S., **Zhu, R.**, Liu, Z., Lu, L., Peng, J., Tang, Z., Lo, C. H., Chan, W. K. (2016). Estimation of Hong Kong's solar energy potential using GIS and remote sensing technologies. *Renewable Energy*, 99, 325-335.
- [02] Li, F., Tang, G., Wang, C., Cui, L., **Zhu, R.** (2016). Slope Spectrum Variation in a Simulated Loess Watershed. *Frontiers of Earth Science*, 10(2), 328-339.
- [01] Yang, Y., Tang, G., Cao, M., **Zhu, R.** (2013). An intelligent method to discover transition rules for cellular automata using bee colony optimization. *International Journal of Geographical Information Science*, 27 (10), 1849-1864.

Conference publications

- Zhu, R.**, Guilbert, E., Wong, W. S. (2016). Tracking the spatial evolution of urban heat islands, Commission II, WG II/1. *In Proceeding of the XXIII ISPRS Congress*. Prague, Czech Public, 12-19 July 2016.
- Zhu, R.**, Guilbert, E., Wong, W. S. (2015). Event-based tracking of the dynamic behavior of urban heat islands. *In Proceeding of the 2nd International Conference on Sustainable Urbanization*, 239. Hong Kong, China, 7-9 January 2015.
- Zhu, R.**, Gidófalvi, G. (2013). GPS-based crowd sourced intelligent traffic information hub. *In Proceeding of the 26th International Cartographic Conference*, 669-670. Dresden, Germany, 25-30 August 2013.
- Zhu, R.**, Alizadeh, A., Wu, W. (2011). A GIS based potential risk assessment for water body, *In Proceeding of the 1st Higher Technical Institution in Russia*, 168-171. St. Petersburg, Russia, 20-23 April 2011.
- Yang Tao, Guoan Tang, Shanshan Ge, Shijie Zhu, Xiangxi Dai, **Zhu, R.** (2009). Assessment of urban building layout based on spatial pattern analysis methods, *IEEE 2009 17th International Conference on Geoinformatics*, 1-5. Fairfax, VA, USA, 12-14 August 2009.

Presentation

- Zhu, R.** The effect of urban morphology on the solar capacity of three-dimensional solar cities. [CREATE Symposium 2019](#). SMART, Singapore, 06 December 2019. (Invited)
- Zhu, R.** The effect of urban morphology on the solar capacity of three-dimensional solar cities. The Second International Conference on Urban Informatics. HK PolyU, Hong Kong SAR, 24-26 June 2019.
- Zhu, R.** The effect of urban morphology on the solar capacity of three-dimensional solar cities. Applied Energy “A+B” Symposium. MIT, USA, 22-24 May 2019.

Zhu, R. Strong effect of urban geomorphology to solar capacity of three-dimensional cities (poster presentation). Future Urban Mobility Symposium 2019. Singapore, 28-29 January 2019.

Zhu, R. The development of senseable cities. Urban Planning, Land & Resources Commission of Shenzhen Municipality. Shenzhen, China, 09 November 2018. ([Invited](#)).

Zhu, R. Mapping of three-dimensional solar cities. SMART FM Seminar. Singapore, 23 October 2018.

Zhu, R. Challenges of Drive-By IoT Sensing for Smart Cities: City Scanner Case Study. PURBA 2018, The 7th International Workshop on Pervasive Urban Applications. Singapore, 12 October 2018.

Zhu, R. A prototype of Vibour AR smart glasses. SMART-REMIX Event. Singapore, 25 July 2018.

Zhu, R. Modelling of urban mobility for sustainable cities. Workshops of Future Urban Mobility Summer Research. Singapore, 6 & 9 July 2018.

Zhu, R. Modelling of urban mobility to solve environmental and transportation problems. Location: SMART at CREATE Tower. Singapore, 15 May 2018.

Zhu, R. My studying experience during the past ten years. Location: Nanjing Normal University. Nanjing, China, 24 November 2017.

Zhu, R. Understanding heat patterns produced by vehicular flows in urban areas. The 38th Research Salon of HK PolyU. Hong Kong, China, 17 February 2017.

Zhu, R. Understanding spatiotemporal heat patterns of vehicular flows in urban areas. Conference of the 2016 Cartographic Visualization of Big Data for Early Warning and Disaster/Crisis Management (EW&CM)-Methodology, Techniques and Applications. Nanjing, China, 27-29 November 2016.

Zhu, R. Going abroad to see the world. Location: Nanjing Normal University. Nanjing, China, 26 October 2016.

Zhu, R. Object-oriented tracking of dynamic behaviors of urban heat islands. The 7th Nationwide PhD-students Forum in Geo-Information, China. Nanjing, China, 26-28 November 2016.

Zhu, R. Tracking thematic and spatiotemporal dynamic behaviors of urban heat islands. Location: Laval University. Quebec City, Canada, 30 November 2015. ([Invited](#))

Lectures and supervisions

[2013] KTH - Course of Spatial Database (Course code: AG2425)

Teaching Assistant. Created the tutorial, gave lectures, and marked homework. It contained spatial database development, geometry definition, spatial queries and spatial indices with PostgreSQL and PostGIS. ([Link](#); [Tutorial](#))

[2012] KTH - Course of Web and Mobile GIS (Course code: AG2417)

Teaching Assistant. Created the tutorial, gave lectures, and marked homework. It contained GIS computer solutions, such as web maps based on GeoServer, ArcGIS Server, and ArcGIS API for JavaScript, mobile maps based on OpenStreetMap, Google Map, and ArcGIS SDK for Android. ([Link](#); [Tutorial](#))

[2011] KTH - MapReduce-based Spatial Data Mining with Eclipse and Hadoop

Research Assistant. Developed a spatial-data generator to create billions of points with x-dimensional attributions in normal spatial distribution patterns, and discovered frequent item sets in MapReduce and Hadoop.

[05/2017] Detection of tree health with multispectral remote sensing data

Co-Supervisor for bachelor's final-year project. Student: Christy Lui; HK PolyU.

[05/2017] Electricity Usage of Different Land Use in Hong Kong

Co-Supervisor for bachelor's final-year project. Students: Chan Wai Yan, Ngan Hui Yee, and Yim Cheuk Yuet; HK PolyU.

[04/2016] **Advance solar photovoltaic system on building facets for supporting individual households**

Co-Supervisor for bachelor's final-year project. Student: Chan Wai Ki; HK PolyU.

[04/2016] **Estimation of land surface temperature from satellite images**

Co-Supervisor for bachelor's final-year project. Student: Kong Cheuk Lam; HK PolyU.

[05/2015] **Impacts of the anthropogenic heat flux to the urban heat islands**

Co-Supervisor for master's dissertation. Student: Xiaoyuan Zhi; HK PolyU.

[05/2015] **Map matching for smartphone-based vehicle's navigation**

Co-Supervisor for master's dissertation. Student: Zhefu Li; HK PolyU.

Projects

[09/2020–08/2023] **Urban thermal environment**

Co-PI for the project entitled with “*An integrated knowledge-based Remote Sensing and GIS dynamic model for the urban thermal environment*”, Funded by Hong Kong GRF, HKD 1,581,600 (ranked the 5th highest of the year in HK), 36 months.

[09/2019–08/2022] **Solar energy potential on 3D urban envelops**

Co-PI for the project entitled with “*Development of an integrated model for estimating 3D solar energy potential using GIS, Remote Sensing and Deep learning techniques*”, Funded by Hong Kong GRF, HKD 1,210,980, 36 months.

[09/2015–08/2017] **Augmented Reality based vehicular navigation**

PI for the project entitled with “*Augmented Reality based vehicular navigation based on smart glasses*”, Funded by HK PolyU, CNY 200,000, 48 months.

[06/2018–06/2019] **Smart City Tree Management**

Participate for the project entitled with “*Jockey Club Smart City Tree Management Project*” for monitoring and detection of tree rotation and tilt angles using Smart Sensing Technologies, funded by the Hong Kong Jockey Club Charities Trust, HKD \$32.28 million.

[05/2008–09/2009] **The analysis of the Criminal Spatio-temporal Distribution Patterns**

PI for the project entitled with “*The Analysis of the criminal spatio-temporal distribution patterns*”, Funded by Nanjing Normal University, 48 months. The project obtained two awards and one published paper.

Selected awards

[04/2019] The Hong Kong Institute of Surveyors – Dissertation Awards for Postgraduate Students (**2 winners in 2019 in Hong Kong**)

[10/2016] The best oral representation and conference paper for the 7th Nationwide PhD-students Forum in Geo-Information, China (**5% Selection**)

[05/2015] Innovation and Seed Fund for Augmented Reality-based Vehicle's Navigation Development, HK PolyU

[04/2014] PhD Scholarship of General Research Fund provided by University Grants Committee of Hong Kong

[04/2011] Diploma for participating in the International Forum-Competition of Young Researchers, Russia

[05/2010] Outstanding Graduate in School of Geographic Science, Nanjing Normal University

[12/2009] First Prize for Comprehensive Ability Scholarship (**5% Selection**)

[03/2009] Second Prize of Outstanding Academic Report Spatio-temporal Distribution Pattern Prediction of Motor Stolen Cases in Urban Areas

[05/2007] Leadership award in May the fourth Recognition

[06/2006] Outstanding University Student Union Member

Services

Members

- Member of the International Society for Photogrammetry and Remote Sensing (ISPRS)
- Member of the International Association of Chinese Professionals in Geographic Information Sciences
- Editorial board member in the Journal of Geospatial Engineering
- ISPRS Scientific Committee 1-5 October 2018, Delft, The Netherlands

Serve as guest editors

- *International Journal of Environmental Research and Public Health* – Special Issue “The 2nd Edition of Urban Environmental Quality” (Impact factor: 2.849)
- *Climate* – Special Issue “Understanding and Mitigating Urban Heat Island-Remote Sensing and GIS Technologies”
- *Climate* – Special Issue “The Interaction of Climate Change with Landscape and Environment”
- *International Journal of Chinese Culture and Management* – Special Issue “Holistic Evaluation and Management of Urban Systems Before, During and After Major Emergencies”

Serve as reviewers

- *Scientific Reports*
- *International Journal of Geographical Information Science*
- *International Journal of Sustainable Transportation*
- *Transactions in GIS*
- *IEEE Transactions on Cognitive and Developmental Systems*
- *Remote Sensing* ([Reviewer Board](#))
- *Climate*
- *Complexity*
- *Atmosphere*
- *Urban Climate*
- *Remote Sensing Applications: Society and Environment*
- *the 19th COTA ICTP 6-8 July 2019, Nanjing, China*

Computer skills

9 years

PostgreSQL, PostGIS, and pgRouting, Java in Eclipse (J2EE), ArcGIS, and Quantum GIS

3 years

Web GIS (JSP + Servlet + JavaBeans, GeoServer, OpenLayers, WMS and WFS)

Mobile GIS (GPS + OpenStreetMap SDK / Google Map SDK + Android)

ArcGIS solutions (ArcMap, ArcGIS Server)

2 years

Visual C#, Visual C++ (MFC), OpenGL, Oracle, MATLAB

Apache Spark, HTML, JavaScript, CSS