Hongshan Guo

Assistant Professor · Department of Architecture · The University of Hong Kong
hongshan@hku.hk | ORCID: 0000-0002-8716-0343 | +852 9677 8596

Profile

- **Research**: Design science for human–building–climate systems—probabilistic modeling, physics-informed ML, co-simulation, and climate stress-testing for buildings, cities, and public institutions.
- **Flagship impact**: Published correction of century-old 120 W metabolic default in comfort standards (*Energy and Buildings*, 2025), prompting and winning ASHRAE 1959-TRP (PI, awarded Feb 2026).
- **Methods and media**: Digital twins, probabilistic simulation, scenario-conditioned weather generation, and computer vision; translated into teaching, open benchmarks, and cross-disciplinary design pedagogy.

Selected Design Science Contributions (2025–2026)

- **Standards intervention**: Demonstrated demographic bias in prevailing metabolic defaults used in global comfort standards; resulting ASHRAE 1959-TRP award positions this work for direct standards revision.
- **Playable performance models**: Built co-simulation workflows integrating data-driven comfort models with EnergyPlus, validated across 13 climates for robust stress-testing under climate uncertainty.
- **Design-facing AI infrastructure**: Led AI-enabled pedagogy platforms (Socratic Oracle; AI Design Coach) deployed across Architecture, Geography, and Computer Science to support evidence-based design reasoning.

Appointments

- Assistant Professor, Department of Architecture, The University of Hong Kong (Sep 2023–present)
- Principal Data Scientist, Bank of New York Mellon (2020–2023)—led end-to-end ML deployment and model governance for daily $29–43 billion Federal Reserve account-balance forecasting
- Postdoctoral Researcher, Princeton University (2019–2020)

Education

- Ph.D., Architecture (Architectural Technology & Computational Design), Princeton University, 2019
- M.Eng., Mechanical Engineering, Columbia University, 2013
- B.Eng., Architectural (HVAC) Engineering, Harbin Institute of Technology, 2012

Research Expertise

Design Science & Performance Simulation: Digital twins and co-simulation frameworks, physics-informed machine learning, probabilistic design exploration under uncertainty, building energy modeling (EnergyPlus, Modelica), reduced-order and surrogate models, post-occupancy evaluation, learning-enabled control.

AI & Computational Methods: Physics-informed neural networks (PINNs), uncertainty quantification (epistemic/aleatoric), Bayesian inference and calibration, ordinal regression, model predictive control, reinforcement learning, computer vision (thermal imagery segmentation), synthetic data generation, domain adaptation.

Environmental Systems & Building Science: Thermodynamics, heat and mass transfer, HVAC systems and control, thermal comfort prediction, sensor-driven analytics and IoT deployment, wearable sensing, building diagnostics.

Climate Science & Resilience: Synthetic weather generation (regime-switching models with CORDEX/CMIP), scenario-conditioned climate projections through 2100, infrastructure stress-testing, urban microclimate sensing, thermal equity and heat-wave vulnerability.

Tools & Implementation: Python/Julia/Matlab; EnergyPlus, Modelica, Grasshopper/Ladybug; PyMC/Stan for probabilistic programming; Git/Docker/cloud ML pipelines.

Mentorship & Supervision

Doctoral students

- Kanxuan He — PhD (HKU, 2025–) on probabilistic control; 1st Place, ICML 2025 CO-BUILD Smart Building Competition; leading manuscript in revision for *Energy and AI*.
- Yu Chang — PhD (HKU, 2024–) on cross-cultural thermal comfort; first-author review in *Renewable and Sustainable Energy Reviews* (2025) now informing ASHRAE/EN benchmarks.

MArch thesis advisees (completing 2026)

- Multi-agentic, physics-informed occupant modeling for environment evaluation in architectural design.
- Neuroarchitecture thesis using EEG to study occupant responses to spatial design conditions.

Funding & Honors

- ASHRAE Research Project 1959-TRP — PI, "Demographic-Aware Metabolic Rate Defaults for Thermal Comfort Standards," $55,000 (15 months; awarded Feb 2026, commencing Apr 2026). Sponsored by TC 4.1 Load Calculations Data and Procedures.
- Competitive internal startup package (HKU; substantial research funding, 2023)
- Teaching Development & Language Enhancement Grant (TDLEG), HKU — PI, "Socratic Oracle: Multimodal Voice-AI Tutor for Evidence-Based Learning," HK$1,000,000 (2025–2028; 31 months)
- Teaching Development Grant (TDG), HKU — PI, "AI Design Coach: A Conversational Design Narrative Builder," HK$300,000 (2026–2028). Cross-Faculty deployment across Architecture, Geography, and Computer Science.
- ICML 2025 CO-BUILD Smart Building Competition: 1st Place (faculty mentor/author)
- NeurIPS 2025 Urban AI Workshop (Buildings Challenge): 3rd Place (faculty mentor)
- Gartner "Eye on Innovation" Award (Advanced Solutions, BNY Mellon), 2021
- Lowry Methodology Award, International Conference of Urban Climate (AMS), 2018

Patents

- Methods and Systems for Generating Predictions Based on Time Series Data Using an Ensemble Model. US 2022/0300860 A1 (published 2022). Co-inventor.
- Wearable Metabolics: Human Heat Dissipation Sensor via Non-Intrusive Core and Skin Temperature Measurement with Custom-Fitting Wearables. US Provisional 63/300,130 (filed 2022). Co-inventor.

Selected Publications

Journal articles (published/accepted)

1. Guo H., Aviv D. *From Seven Points to Probabilities: Ordinal Learning for Risk-Aware Thermal Comfort Prediction.* Building and Environment, accepted 2026. [Ordinal learning, risk-aware prediction]

2. Guo H., Pigliautile I., Chang Y., Qiao Q., Li Y. *Toward Smarter HVAC Control: Machine Learning Reveals Hidden Drivers in Thermal Comfort Databases.* Energy and AI, accepted 2026. [Sensitivity analysis, MRT, data quality]

3. Guo H., Chang Y., Li Y., Zhou Y., Qiao Q., Lai C.Y., Schuldenfrei E. *Ventilation–Energy Trade-offs in Retrofitted Hong Kong Wet Markets.* Energy and Buildings, 116918, 2026. [Field measurement, retrofit, IEQ–energy trade-offs]

4. Guo H., Sun R., Xu Y. *Correcting the 120-Watt Assumption: Demographic-Aware Metabolic Rates for Energy*

Savings and Thermal Comfort Equity in Buildings. Energy and Buildings, 2025. [Standards impact, equity; prompted ASHRAE 1959-TRP]

5. Guo H., He K., Xu Y., Lei Y. *A Co-Simulation Methodology for Integrating Data-Driven Thermal Sensation Models with Building Energy Control.* Energy and Buildings, accepted Nov 18, 2025. [Digital twins, co-simulation, 13 climates]

6. Guo H., He K., Luo Y., Chang Y. *Physics-Informed Neural Networks for Robust Thermal Comfort Prediction: Overcoming Data Quality Limitations Through Physiological Constraints.* Building and Environment, 2025. [PINNs, physiological constraints]

7. Chang Y., Guo H., Li Y., Chi B., Pigliautile I. *A Data-Driven Qualitative Review of Thermal Comfort Studies: Bridging the Gap Between Western and Eastern Perspectives.* Renewable and Sustainable Energy Reviews, 2025. [Data harmonization, benchmarks]

8. Guo H., Ferrara M., Coleman J., Loyola M., Meggers F. *Simulation and Measurement of Air and Mean Radiant Temperatures in a Radiantly Heated Indoor Space.* Energy, 193:116369, 2020.

9. Guo H., Aviv D., Loyola M., Teitelbaum E., Houchois N., Meggers F. *On the Understanding of Mean Radiant Temperature Within Indoor and Outdoor Environments: A Critical Review.* Renewable and Sustainable Energy Reviews, 2019.

Book chapters

- Guo H., Li Y., Zhou Y., Chang Y., Lai C.Y. *From Open Air to Air-Tight: Analyzing the Ventilation Overhaul in Hong Kong's Wet Markets and Its Implications.* In *Multiphysics and Multiscale Building Physics*, Springer, 2025.
- Guo H., Coleman J., Gullapalli I. *Accelerating NZEB Design Optimization Through LLM-Based Standardization and Compliance Checking.* In *Multiphysics and Multiscale Building Physics*, Springer, 2024.

Refereed conference and workshop papers (selected)

- He K., Guo H. *A Temporal Features-Enhanced Mixture-of-Experts Approach for Indoor Temperature Prediction.* ICML 2025 CO-BUILD Workshop (Oral); **1st Place, Smart Building Competition**. [MoE, temporal modeling, control]
- Niu S., Guo H., Ferrara M., Anselmo S. *Thermal-SAM: Adversarial Prompt-Based Unsupervised Building Segmentation in Thermal Aerial Imagery.* ICML 2025 CO-BUILD Workshop (Poster); **3rd Place, NeurIPS 2025 Urban AI Workshop (Buildings Challenge)**. [Computer vision, envelope diagnostics]
- Guo H., Chang Y., Hu D. *ML-Driven Sensitivity Analysis for Lean HVAC: New Insights from Large-Scale Comfort Data.* ICML 2025 CO-BUILD Workshop (Poster).
- Guo H., Zhou Y., Lai C.Y., Ren C. *From Open Air to Air-Tight: Ventilation Overhaul in Hong Kong Wet Markets.* IBPC 2024 (International Building Physics Conference), Toronto.
- Guo H., Coleman J., Gullapalli I. *Accelerating NZEB Design Optimization Through LLM-Based Standardization and Compliance Checking.* IBPC 2024.

Manuscripts under review (selected)

Climate & resilience:

- Guo H., He K. *Scenario-Conditioned Actual Meteorological Years (sAMY): A Stochastic Weather Generator Using Multi-Decadal Observations.* Under review, Energy and Buildings, 2026. [Synthetic weather, scenario-conditioned]
- Guo H., He K. *Input Quality, Not Statistical Complexity, Determines Climate-Adapted Weather File Fidelity: A Causal Decomposition of Degree-Day Errors.* Under review, Energy, 2026. [Weather file validation, causal analysis]
- Guo H., He K. *Controller-Agnostic Benchmarking Across Five Climates: Comfort, Energy, and Peak Trade-offs to*

2100. Under review, Engineering Applications of Artificial Intelligence (special issue), 2025.

Control & learning:

- Guo H., He K., Xu Y., Shi Z., Aviv D. *Probabilistic Thermal Comfort for Energy-Efficient Building Control: A Risk-Aware Framework.* Under review, Energy Conversion and Management, 2026.

Teaching & Mentorship

Courses designed and taught (HKU):

- ARCH7476: Evidence-Based Generative Design — Data-driven decision making in architecture; students frame design problems as testable claims, collect evidence, and produce reproducible analyses with visual communication artifacts. Dual pathways: low-code tools for accessibility, Python/Colab for depth. Mixed MArch/UG/PhD (2025–).
- DESN2003: Research for Innovation — Research methodology from question framing through evidence gathering to communication; parallel tracks for frontier research and applied/buildable outputs. UG (2023–).
- CCGL9065: Our Response to Climate Change | Hong Kong 2100 — Climate action through critique, debate, and speculative design; culminates in a public interactive art & science exhibition envisioning Hong Kong's 2100 landscape. UG (2024–).

Prior teaching: Princeton mini-courses on IoT sensing (deploying custom thermal/humidity sensors in campus buildings) and thermodynamics labs (hands-on measurement of radiant environments), 2015–2018.

Prepared to teach: MDes/MDE design science seminars (digital twins, probabilistic modeling, climate futures); core and advanced architecture studios integrating time-based environmental media; building performance and environmental systems; design engineering methods.

Pedagogy: Evidence-based design workflows combining low-code tools with Python/Colab notebooks; emphasis on reproducibility, uncertainty quantification, and visual communication; typical outputs include scenario videos, interactive dashboards, and spatial equity narratives.

Professional Service & Collaboration

Standards engagement: ASHRAE Research Project 1959-TRP (metabolic rate standards revision)—PI, awarded Feb 2026; published research directly prompted the RFP.

Reviewing: CVPR, ICML, NeurIPS workshops; journals including *Energy and Buildings*, *Building and Environment*, *Applied Energy*, *Energy*, *Journal of Building Engineering*, *Sustainable Cities and Society*, *Urban Climate*.

Leadership: Co-Chair, Technical Development & Proceedings Integration, CAAD Futures 2025.

Industry engagement: Hong Kong Green Building Council (HKGBC), Electrical and Mechanical Services Department (EMSD); prior industry role leading ML productization at Bank of New York Mellon (2020–2023).

Interdisciplinary collaborations: Climate scientists, control theorists, computer vision researchers, urban planners, public health scholars; architecture schools including UPenn, Princeton, Politecnico di Torino, University of Perugia, National University of Singapore, University of Tokyo.

Creative Practice & Public Scholarship

- Exhibitor (co-author), *Social Condenser Extraordinaire: Hong Kong's Municipal Services Buildings*, T1-02, *Projecting Future Heritage: A Hong Kong Archive* (Collateral Event of the 19th International Architecture Exhibition — La Biennale di Venezia), Campo della Tana, Venice, May–Nov 2025.

- Lead instructor, *Our Response to Climate Change | Hong Kong 2100*: public student exhibition combining speculative design with climate narratives and interactive media (HKU, 2024–).