ZIXUN HUANG

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SUMMARY

I am a lead graduate researcher in FHL Vive Center, running the OpenARK team in EECS Dept @UC Berkeley, working closely with the Lab Director Dr. Allen Y. Yang. My research interests focus on robust perception, automation and autonomy with a strong emphasis on their integration into architectural construction. Prior to this, I obtained my Bachelor of Architecture from Zhejiang University, where I co-founded and led the Robotic Fabrication Lab. My ultimate objective is to advancing *Moon-to-Mars Planetary Autonomous Construction Technology* (MMPACT, *e.g.* 3D printed habitat).

EDUCATION

University of California, Berkeley

Master of Design, College of Engineering Dec. 2023

- **Research Focus:** Visual Computing. GPA: *4.0 (CS-related) / 4.0*
- **Thesis:** Universal AR-Enhanced Interface for ROS: Enabling Multi-Type Robot Navigation.
- **Relevant Courses:** Computer Vision; Deep Neural Network; Computational Photography; GenAI & LLM; Reinforcement Learning.

Zhejiang University

Bachelor of Architecture, School of Civil Engineering and Architecture Jun. 2020

- **Research Focus:** Robotic Construction and Design Computation. GPA: *3.99 (Math-related) / 4.0*
- **Relevant Courses:** Calculus (I, II, III); Linear Algebra; Ordinary Differential Equations; Wireless Network; Image Analysis and Processing; C Programming; Architectural Robotics.

PUBLICATIONS

1. **Huang, Z.***, Yao, K.*, Zhao, S. Z.*, Pan, C.*, Xu, T., Feng, W., & Yang, A. Y. (2023). "Robust Digital-Twin Localization via An RGBD-based Transformer Network and A Comprehensive Evaluation on a Mobile Dataset," *in submission to IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI).* [preprint]

2. **Huang, Z.**, Song, Y., Zhuang, K., Li, R., Zhou, Z., Situ, J., Gao, J., & Yang, A. Y. (2023). "Recalling the Robust Digital-Twin Localization on a Non-Rigid Moving Robot Dataset," *poster presented on 2023 Vive Center Gala.* [poster]

3. Zhuang, X.*, **Huang, Z.***, Zeng, W., & Caldas, L. (2023). "MARL: Multi-scale Archetype Representation Learning for Urban Building Energy Modeling," *in Proceedings of the IEEE/CVF International Conference on Computer Vision Workshops (ICCVW).* [paper]

4. Zhuang X.*, **Huang Z.***, Zeng W. and Caldas L. (2023) "Encoding Urban Ecologies: Automated Building Archetype Generation through Self-Supervised Learning for Energy Modeling," *in Conference on Association for Computer Aided Design in Architecture (ACADIA).* [paper]

5. Xu, W., & **Huang, Z.** (2020). "Robotic Fabrication of Sustainable Hybrid Formwork with Clay and Foam for Concrete Casting," *in XXIV International Conference of the Iberoamerican Society of Digital Graphics (SiGraDi).* [paper]

6. Wang, S., Huang, K., **Huang, Z.**, Sodano, M., Xu, W., & Raspall, F. (2019). "Fabrication of Topology Optimized Concrete Components Utilizing 3D Printed Clay Mould," *in Proceedings of International Association for Shell and Spatial Structures (IASS).* [paper]

AWARDS & RECOGNITION

Awards & Scholarships.

1. MIT Reality HACK 2023 Winner - Spatial Audio Track 2023
   Massachusetts Institute of Technology

2. MDes Distinguished Scholar Award ($ 8962) 2022, 2023
   Jacobs Institute of Design Innovation, University of California, Berkeley

3. Excellent in Student Research Training Project 2018
   School of Civil Engineering and Architecture, Zhejiang University

4. ZJU Merit-based Scholarship 2016
   School of Material Science and Engineering, Zhejiang University

5. Provincial Third Division of the National High School Mathematics League 2015
   Zhejiang Province, China

Invited Talks.

6. A010125: From Robotic Fabrication to 3D Scene Understanding Oct. 2023
   (Online Talk) Dept. of Architecture, Xi'an University of Architecture and Technology

7. Design@Large Panel: Landing a Research Position Sep. 2023
   Jacobs Institute of Design Innovation, University of California, Berkeley

8. Architectural Robotics: From Design to Construction — Nov. 2019
College of Civil Engineering and Architecture, Zhejiang University

Featured in Press.

9. Shrine of Whatslove. *Domus* [link] — Jul. 2019

10. Red triangle robotically woven carbon-fiber structure. *ARCH20* [link] — May. 2019

11. Structure woven with a red triangle made entirely of carbon fiber. *metalocus* [link] — Mar. 2019

12. Shrine of Whatslove / Wutopia Lab. *ArchDaily* [link] — Mar. 2019

13. China's first all carbon-fiber structure designed architecture. *Gooood* [link] — Mar. 2019

RESEARCH EXPERIENCE

Robust Millimeter-Level Perception
Lead Graduate Researcher in Computer Vision (supervised by Dr. Allen Y. Yang) — Sep. 2022 - Present
FHL Vive Center, EECS Dept. — *University of California, Berkeley*

- Lead-Authored a novel 3D object localization algorithm, fusing RGB and LiDAR-depth data based on self-attention modules, for robust and accurate pose estimation in mobile AR scenarios involving real-world non-Gaussian depth noise.
- Introduced a Fourier-transform enhanced filtering module into 3D object tracking tasks, designed to rectify inherent sensor-level measurement errors in a learning-based manner.
- Developed a digital-twin tracking dataset featuring rigid daily objects and non-rigid moving robots (*e.g.* Leo Rover, DJI Drones, etc.) captured with a Optical Motion Capture System and multi-type depth sensors (*e.g.* ZED stereo sensing, iPhone LiDAR).

Efficient Building Energy Estimation
Student Researcher in Machine Learning (supervised by Prof. Luisa Caldas) — May. 2023 - Sep. 2023
Immersive Design Club, XR Lab — *University of California, Berkeley*

- Co-First authored an efficient VQAE-based method for energy modelling with residential buildings' latent embedding and clustering, reducing the computation time by 133.7 times for NYC's residential energy consumption estimation.

Cloud Design Computation
Research Assistant, Hybrid (supervised by Prof. Hao Zheng) — Jun. 2020 - Jul. 2022
Architectural Intelligence Group — *City University of Hong Kong*

- Developed a scalable and efficient backend server for the deployment of a learning-based bionic aerofoil 3D structure generation algorithm; the related work was published in *Advanced Science*[1].
- Hand-Crafted a cloud urban computing platform with GAN-based heatmap generation and automated urban data crawling for multiple city perception (*e.g.* vehicle travel demand) simulation.

Robotic Mass Customization
Lead Student Researcher in Robotic Manufacturing — Dec. 2018 - Dec. 2020
Robotic Fabrication Lab — *Zhejiang University*

- Authored a rapid additive manufacturing system using high-torque stepper motors, Arduino and KUKA Robots, designed for the 3D printed clay mould of topology optimized concrete components.
- Authored an efficient mass customization method, utilizing 3D clay printing and robotic hot-wire cutting, with a comprehensive efficiency evaluation; enabled robotic non-planar printing with KUKA prc;

Autonomous Resin Shaping
Summer 2019
2019 Digital Architecture Design Association International Summer Campus (with Dr. Dan Luo) — *Tsinghua University*

- Achieved 3D printing in the air where the resin dropping and solidifying under the force of gravity; automated image capturing and processing for real-world data exploration with OpenCV; trained an autonomy with imitation learning and offline reinforcement learning to predict robotic behaviors (*e.g.*, end-effector's extrusion speed, robotic arm's motion speed and dwell time, etc).

Automatic Discrete Construction with Drones
Summer 2019
2019 DigitalFUTURES Workshop (with Prof. Xiang Wang) — *Tongji University*

- Achieved discrete stacking utilizing a UAV gripping system crafted from Raspberry Pi, PX4 and 3D printed hardware, etc; seamlessly incorporated the tracking of drones (via MoCap) and their control (via ROS) into Grasshopper3D (via BENGESHT).

TEACHING & LEADERSHIP

Graduate Student Research Mentor
Sep. 2023 - Present
FHL Vive Center for Enhanced Reality — *University of California, Berkeley*

- Conducted regular tutorials, weekly work sessions, and weekly meetings. Led regular timeline updates and reviews to move research projects forward.

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[1] Zheng, Hao, et al. "Dragonfly-Inspired Wing Design Enabled by Machine Learning and Maxwell's Reciprocal Diagrams." Advanced Science 10.18 (2023): 2370111.

- Mentored Yukun S., Kathy Z., Zoe Z. and Rui L. (Master of Engineering students) on MoCap system and RGBD camera calibration, 3D scanning and CAD model reconstruction; mentored Jackson G. (5th-year M.S. in CS) in understanding and designing 6DoF pose estimators; supervised Helena S. and Aaron Z. (EECS undergraduates) on AR-enhanced interface for Mars navigation, preparing for *2024 NASA SUITS* competition.

Academic Workshop Teaching Assistant   Summer 2021

The 3rd International Conference on Computational Design and Robotic Fabrication (with Prof. Hao Zheng)   *Tongji University*

- Instructed over 100 designers (about 50 in on-site sessions and 50 online) in multi-modal urban data crawling and GAN-based network training; responsibilities include: delivering talks on learning-based urban computing, conducting tutorials, and developing starter codes, etc.

Head Undergraduate Teaching Assistant   Spring 2019, Spring 2020

Course: 12195900 Computational Design & Robotic Fabrication   *Zhejiang University*

- Responsibilities include: leading work sessions, reviewing reading material, grading presentation and homework sets, and holding weekly office hours to assist students in mastery of material.

Undergraduate Student Lecturer   Fall 2019

Course: 12122800 Architectural Robotics   *Zhejiang University*

- Designed and taught a seminar course on the intersection of robotics and architectural construction; topics include the non-planar 3D clay printing and robotic hot-wire cutting, etc; course approved by the Dean of Architecture Department.

WORKING EXPERIENCE

Robotics Engineer Intern   Jan. 2019 - May. 2019

RoboticPlus.AI   *Shanghai, China*

- Designed and fabricated the China's first all-carbon fiber pavilion; achieved the 4 meters high and 3.8 meters wide entire structure weaved with a continuous line of carbon-fiber. Density of the structure is controlled at 18KG per cubic meter and the bearing capacity of 400KG is achieved.
- Developed a carbon-fiber weaving and a resin curing system using a KUKA Robot KR90 R3100 and 3D printed hardware, etc.
- Parameterized the robotic weaving path and generated the simulation for the robotic construction process on all woven modules.
- Applied computer vision using YOLO and OpenCV to reduce robot's collisions caused by flexure and deformation of woven anchors subjected to significant stress.

3D Software Engineer, Server-end Development Lead   Jun. 2021 - Apr. 2022

INSOME Technology Co. Ltd   *Shenzhen, China*

- Developed a modular building information management (BIM) system from 0 to 1; enabled efficient and scalable structure customization with real-time 3D visualization; achieved an immersive user experience built on Android using Unreal Engine and Blueprints.

Product & Technology Development Lead   Jan. 2021 - May. 2021

Hezhu Digital Technology Co. Ltd   *Shanghai, China*

- Led and prototyped an urban sustainability mapping system from 0 to 1; enabled cost management and carbon emission optimization for urban design evaluation; specified application into launched urban planning projects.

APPENDIX

Supplementary Materials.

- Robotic Carbon-Fiber Weaving System: https://youtu.be/bJ-8Ytwos4I/ (RECOMMEND)
- Automatic Discrete Construction with Drones: https://youtu.be/d-jheGgC-4k/ (RECOMMEND)
- Robotic Mass Customization: https://youtu.be/WWiFGQ9dVF4/
- Autonomous Resin Shaping: https://youtu.be/sSoAwbiJ7dw/ (real-world data exploration)

Portfolio Website.

- https://huangzixun.com/