

Yijiang Huang

Postdoctoral fellow at ETH Zurich

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Research interests

Computational planning methods that coordinate robots, humans, and resources to enable the efficient construction of sustainable structural solutions.

Education

- 9/2018 - 9/2022 Ph.D. in Building Technology Department of Architecture, MIT
Dissertation: *Algorithmic planning for robotic assembly of building structures*
Advised by Caitlin Mueller
MIT Presidential fellow (2018)
- 9/2016 - 5/2018 Master of Science in Building Technology Department of Architecture, MIT
Thesis: *Automated motion planning for robotic assembly of discrete architectural structures*
Advised by Caitlin Mueller
MIT Presidential fellow (2016)
- 9/2012 - 5/2016 Bachelor of Science in Applied Mathematics University of Science and Technology of China

Research Experience

- 1/2023 - Now Postdoctoral fellow Computational Robotics Lab, ETH Zurich
Developed a computational design framework for spatial bar structures with reusable swivel coupler joints; researched planning and control for cooperative mobile robotic assembly; contributed to cross-departmental research for NCCR DFAB. Supervised by Stelian Coros.
- 9/2016 - 8/2022 Graduate research assistant Digital Structures Group, MIT
Developed planning algorithms for robotic assembly and tested them on real-world robot systems in various physical scales; developed computational matching algorithms for circular design with reused materials; collaborated with researchers at MIT, Princeton, TU Delft and ETH Zurich; published results in journal and presented findings at academic conferences and seminars; led instructions and contributed to the developments of various courses and workshops. Advised by Caitlin Mueller.
- 6/2019 - 8/2019 Guest researcher Gramazio & Kohler Research Group, ETH Zurich
Integrated robotic planning algorithms to the open-source COMPAS-FAB framework; led hands-on workshops about the developed software.
- 2/2015 - 6/2016 Undergraduate research assistant Geometry and Graphics Computing Lab, USTC
Developed a sequence planning algorithm for robotic spatial extrusion; designed and built a customized extrusion hardware; led a collaboration with an architectural firm's R&D branch; published results at SIGGRAPH Asia. Advised by Juyong Zhang, Lei Yu, and Ligang Liu.

Professional Experience

- 9/2020 - 5/2021 **Remote technical consultant** Roboticplus Inc., virtual
Bi-weekly remote meetings with the R&D team to provide technical advice on geometric feature detection, point cloud registration, and path planning of wood-cutting and welding robots.
- 7/2015 - 8/2016 **Research intern** ArchiSolution Workshop, Beijing
Research stay to develop collaborated academic research project on robotic extrusion planning. Contributed to the assembly of large-scale 3D printers. Monitor the fabrication and shipping process of a commercial 3D printed facade. Developed a robotic layer-based printing demo for clients.

Fellowships and Funding

- 1/2023-1/2025 **ETH Zurich Postdoctoral Fellowship**
208,900 CHF in salary costs + 24,000 CHF for research and travel costs, awarded to 15 individuals each year (25% success rate).
- 9/2016, 9/2018 **MIT Presidential Fellowship**
Funding for tuition (50k USD each year) and living stipend of one academic year (48k USD), with additional guaranteed TA funding coverage throughout the entire duration of study if needed. Awarded to around 110 new graduate students each year (out of 7,200 grads), selected by the Deans and Heads of Departments at MIT.
- 9/2014 - 6/2016 **USTC Outstanding Undergraduate Student Scholarship (500 RMB/year)**

Publications

* indicates authors contributed equally.

JOURNAL ARTICLES

- 2023 SMO **M. Tarek and Y. Huang**
[General deflation for finding multiple local optima in non-convex optimization](#)
Structural and Multidisciplinary Optimization, 2023, in press
- 2023 Siggraph **Z. Wang, F. Kennel-Maushart, Y. Huang, B. Thomaszewski, S. Coros**
[A Temporal Coherent Topology Optimization Approach for Assembly Planning of Bespoke Frame Structures](#)
ACM Transactions on Graphics (TOG), 2023, 42.4, pp 1-13
- 2021 ConRob **Y. Huang, C. Garrett, I. Ting, S. Parascho, C. Mueller**
[Robotic additive construction of bar structures: Unified sequence and motion planning](#)
Construction Robotics, vol. 5, pp. 115-130
- 2018 ConRob **Y. Huang, C. Garrett, C. Mueller**
[Automated sequence and motion planning for robotic spatial extrusion of 3D trusses](#)
Construction Robotics, vol. 2, no. 1-4, pp. 15-39
- 2017 IJRM **K. Tam, D. Marshall, M. Gu, J. Kim, Y. Huang, J. Lavallee, C. Mueller**
[Fabrication-aware structural optimisation of lattice additive-manufactured with robot-arm](#)

International Journal of Rapid Manufacturing, vol. 7, no. 2-3, pp. 120-168

- 2016 Siggraph **Y. Huang**, J. Zhang, X. Hu, G. Song, Z. Liu, L. Yu, L. Liu
[Framefab: Robotic fabrication of frame shapes](#)
ACM Transactions on Graphics (TOG), 35(6), 224
- CONFERENCE ARTICLES
- 2024 RobArch V.P.Y. Leung, **Y. Huang**, C. Garrett, F. Gramazio, M. Kohler
[Planning Non-repetitive Robotic Assembly Processes with Task and Motion Planning \(TAMP\)](#)
Proceedings of Robotic Fabrication in Architecture, Art and Design (RobArch), 2024
- 2021 SCF **Y. Huang**, V.P.Y. Leung, C. Garrett, F. Gramazio, M. Kohler, C. Mueller
[The new analog: A protocol for linking design and construction intent with algorithmic planning for robotic assembly of complex structures](#)
Proceedings of ACM Symposium on Computational Fabrication, 2021
- 2021 SCDoS **Y. Huang**, L. Alkhayat, C. De Wolf, C. Mueller
[Algorithmic circular design with reused structural elements: Method and Tool](#)
Proceedings of the international FIB symposium of Conceptual Design of Structures, 2021
- 2020 RSS C. Garrett*, **Y. Huang***, T. Lozano-Pérez, C. Mueller
[Scalable and Probabilistically Complete Planning for Robotic Spatial Extrusion](#)
Proceedings of Robotics: Science and Systems (RSS), virtual, 2020
- 2020 AAG F. Amtsberg*, **Y. Huang***, D. Marshall, K. Gata, C. Mueller
[Structural upcycling: Matching digital and natural geometry](#)
Proceedings of Advances in Architectural Geometry, Champs-sur-Marne, France, 2020
- 2019 SCF R. Arora, A. Jacobson, T. Langlois, **Y. Huang**, C. Mueller, W. Matusik, A. Shamir, K. Singh, D. Levin
[Volumetric Michell trusses for parametric design & fabrication](#)
Proceedings of the ACM Symposium on Computational Fabrication, 2019
- 2019 ACADIA L. Tessmer, **Y. Huang**, C. Mueller
[Additive Casting of Mass-Customizable Bricks: Workflow for Design and Robotic Fabrication](#)
Proceedings of the 39th Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA), Austin, Texas, 21-26 October, 2019
- 2018 RobArch **Y. Huang**, J. Carstensen, L. Tessmer, C. Mueller
[Robotic extrusion of architectural structures with nonstandard topology](#)
Proceedings of Robotic Fabrication in Architecture, Art and Design (RobArch), 2018
- 2018 IASS **Y. Huang**, J. Carstensen, C. Mueller
[3D truss topology optimization for automated robotic spatial extrusion](#)
Proceedings of International Association for Shell and Spatial Structures (IASS), Boston, MA, 2018
- 2016 ACADIA L. Yu, **Y. Huang**, Z. Liu, S. Xiao, L. Liu, G. Song, Y. Wang
[Highly Informed Robotic 3D Printed Polygon Mesh: A Novel Strategy of 3D Spatial Printing](#)
Proceedings of the 36th Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA), Ann Arbor 27-29 October, 2016, pp. 298-307

WORKSHOP ARTICLES

- 2020 IROS C. Garrett*, Y. Huang*, T. Lozano-Pérez, C. Mueller
Scalable Planning for Robotic Spatial Extrusion
IROS Workshop on Building Construction and Architecture Robotics, online, 2020.

PREPRINTS

- 2023 K. Doshi, Y. Huang, S. Coros
[On Hand-Held Grippers and the Morphological Gap in Human Manipulation Demonstration](#)
- 2022 J. Chen, J. Li*, Y. Huang*, C. Garrett, D. Sun, C. Fan, A. Hofmann, C. Mueller, S. Koenig, B. Williams
[Cooperative Task and Motion Planning for Multi-Arm Assembly Systems](#)

CONFERENCE ABSTRACTS AND POSTERS

- 2024 ICRA Y. Huang*, P.Y.V. Leung*, C. Garrett, F. Gramazio, M. Kohler
[Planning Non-repetitive Robotic Assembly Processes with Task and Motion Planning \(TAMP\)](#)
3rd Workshop on Future of Construction: Lifelong Learning Robots in Changing Construction Sites (2024), ICRA, Yokohama, Japan, 2024
- 2023 FoC Y.H. Hung*, C. Jiang*, Z. Wang, Y. Huang, A.L. Gheyselinck, P. Aejmelaeus-Lindström
[Computational Design and Assembly of Infinitely Reusable Kit of Parts](#)
Future of Construction Symposium, Munich, Germany, 2023
- 2023 IRS K.J. Lee, Y. Huang, C. Mueller
[A differentiable assignment algorithm for high performance inventory-driven structural design](#)
(In)visible Reuse Symposium, Lausanne, Switzerland, 2023
- 2021 WCSMO Y. Huang and M. Tarek
[TopOpt.jl: Truss and Continuum Topology Optimization, Interactive Visualization, Automatic Differentiation and More](#)
In: *14th World Congress of Structural and Multidisciplinary Optimization (WCSMO-2021)*

Selected Software

Open-source code is available on [my website](#) for most of the publications above.

COMPAS-FAB	Contributor
A Python package for the COMPAS Framework that facilitates the planning and execution of robotic fabrication processes	
pybullet_planning	Contributor
A Python package based on the pybullet physics simulation engine to provide collision checking, kinematics, and motion planning for robotics research.	
ikfast_pybind	Author
A Python package for analytical robot kinematics.	
conmech	Author
A Python package for linear elastic analysis of spatial trusses and frames.	
TopOpt.jl	Contributor
A Julia package for flexible topology optimization on continuum and truss domains.	

Professional Service

EXTERNAL REVIEWING

Journal and Conferences

- 2024 Paper committee member: International Conference on Geometric Modeling and Processing
2018-2023 Reviewer: Construction Robotics
2019 Reviewer: ACM SIGGRPAH
2020 Reviewer: ACM SIGGRAPH Asia
2020-2021 Reviewer: ACM Symposium of Computational Fabrication

Grants

- 2023 Review Panel for ETH Zurich Career Seed Awards

Teaching

SEMESTER-LONG COURSES

- 2019-2021 Computational Structural Design and Optimization (4.450) MIT Architecture
Teaching assistant (~ 25 students per year)
Led weekly office hours and monitored student final projects; developed new assignments and lectures to reflect recent developments and tools in optimization and fabrication; guest lecture on optimization algorithms and discrete and combinatorial optimization. (with C. Mueller)
- Spring 2018 Design for Robotic Assembly (4.S48) MIT Architecture
Instructor (12 students)
Designed, organized, and presented a new project-based course on architectural design for robotic assembly. Students learned the basic principles of programming an industrial robotic arm and explored creative usage of the technology. Their final projects questioned the physical precision of robots, engaged in playful human-robot interactions, and produced bespoke geometries. (with C. Mueller and J. Lavallee)

WORKSHOPS

- 10/2023 Task and Motion Planning for Robotic Assembly ACADIA, hybrid
Co-instructor (17 students, three-day-long workshop)
Gave lectures and led tutorial sessions. Students used the robot planning tool developed in my research to generate robot assembly program for assemblies they designed. [Workshop summary](#). (with V.P.Y. Leung)
- 7/2020 Kintsugi, Upcycling, and Machine Learning (4.181) MIT Architecture
Co-instructor (12 students, three-week-long workshop)
Gave lectures and led tutorial sessions. Students used the optimal matching tool developed in my research to design new assemblies from recycled materials. (with C. Mueller, D. Marshall, D. White)
- 10/2019 Fabrication-informed design of robotically assembled structures Design Modeling Symposium, Berlin
Co-instructor (14 students, two-day-long workshop)
Gave lectures and tutorials. Students used the planning system developed in my research to compute robot trajectories to assemble structures they designed. (with S. Parascho, G. Wartinger, C.

Mueller)

- 9/2019 Structural Upcycling workshop MIT Architecture
Co-instructor (10 students, two-week-long workshop)
Developed computational design workflow for designing structures that reuse recycled tree branches.
(with F. Amtsberg, D. Marshall, K.M. Gata, C. Mueller)
- 7/2017 Parametric Architectural Design Workshop Tsinghua University, Beijing
Teaching Assistant (13 students, one-week-long workshop)
Mentored students on the design and construction of full-scale, load-bearing bridges, using generative computational design tools that link architectural expression with structural performance.
(with C. Mueller)
- 7/2016 Parametric Architectural Design Workshop Tsinghua University, Beijing
Teaching Assistant (12 students, one-week-long workshop)
Mentored students on the use of industrial robots to cut customized wood notches for the assembly of a human-scale reciprocal wood vault. (with L. Yu and Z. Liu)

ANONYMOUS TEACHING FEEDBACK

- Fall 2019-2021 Computational Structural Design and Optimization (4.450) MIT Architecture
A sample of anonymous feedback about my teaching assistantship is gathered below, where each quotation corresponds to a different student:
"Yijiang has been the best TA I have had at MIT. He's thoughtful and thorough in his responses and feedback and seems to have a true passion for the material. Couldn't have succeeded in this course without him."
"Yijiang had a very challenging job as a (sole) TA to ~31 students! He was always responsive over email and Piazza. It's nice to know that no matter what, I could count on getting an answer to any question that came up. Yijiang is also very kind and thoughtful, and I was never worried to ask him questions in class. Great TA."
"Yijiang is the best TA that I've ever had. He is so helpful and so passionate about the subject. He is so approachable and he answers questions so quickly and in such an understandable manner."
"Amazing TA. I've learnt a lot from Yijiang and he definitely goes out of his way to help us, be it during or out of class. Really fortunate to have him as the teaching assistant for the class."

Mentoring

MASTER'S THESIS ADVISOR

- 11/2023 - Peiyu Zeng ETH Zurich
7/2024 Master in Robotics, Systems, and Control (ME). Thesis: Computational design of automated logistic factories (with S. Huber and S. Coros)
- 5/2023 - 9/2024 Yi Hsiu Hung, Chenming Jiang ETH Zurich
Master in Digital Fabrication (Architecture). Thesis: Computational Design and Assembly of Infinitely Reusable Kit of Parts (with Z. Wang, A. Gheyselinck, P. Aejmelaesus-Lindström)

MASTER'S SEMESTER PROJECT ADVISOR

- 2/2024 - 6/2024 Emre Altan ETH Zurich
Master in Robotics, Systems, and Control (ME). Semester project: Realzsim MoCap calibration for mobile robotic assembly.

ACADEMIC YEAR UNDERGRADUATE RESEARCHERS

2017	Thomas Cook Industrial robot's planning and simulation	MIT EECS Senior
2017	Kodiak Brush Thermal hotend design for robotic printing	MIT ME Senior
2017	Khanh Nguyen Portable 3D printing control system design	MIT ME Sophomore

EXTERNAL COMMITTEE MEMBER

2/2023	Gabriel Vallat Master thesis: Multi-agent Reinforcement Learning for Assembly of a Spanning Structure (with M. Kamgarpour and S. Parascho)	EPFL
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SUMMER UNDERGRADUATE AND HIGH SCHOOL RESEARCHERS

8/2021	Research mentor, Summer Geometry Institute Bonnie Magland, Cynthia Fan, Lily Kimble, Marcus Vidaurri Planned, prepared, and mentored a week-long research project for four undergraduate students (1 ME, 2 CS, 1 Math) on design optimization via shape morphing. (with C. Mueller)	Virtual, MIT
8/2020	Mentor, HerCodeCamp Mentored four female-identified high-school students on a two-week-long code camp to build a ping-pong game in Python. (with N. Sultanum)	Virtual, UToronto

Press

5/2022	MIT engineers build load-bearing structures using tree forks instead of steel joints	Dezeen
3/2022	Using nature's structures in wooden buildings	MIT News

Invited Seminar Talks

5/2024	Suzumori Laboratory	Tokyo Inst. of Tech.
10/2023	AsiaGraphics Webinar	Online
7/2023	USTC computer graphics summer school	USTC
6/2023	Applied R&D at Foster + Partners	London
5/2023	Design++ seminar series	ETH Zurich
10/2022	Mark Pauly's group	EPFL
11/2021	Justin Solomon's group	MIT
11/2021	Stefanie Mueller's group	MIT
10/2020	Young series: Robotic Fabrication 3	DigitalFUTURES
6/2020	Intelligent Autonomous Systems Seminar	TU Darmstadt
9/2019	Guest lecture at Modeling and Analysis of Structures (1.571)	MIT
4/2019	AIR Seminar of the Hariri Institute of Computing	Boston University
3/2018	Disney Research Zurich	Disney
3/2018	Institute of Technology in Architecture	ETH Zurich
11/2017	Simple Person's Applied Math Seminar (SPAMS)	MIT
11/2017	Computer Graphics Seminar	MIT
4/2017	Brian Williams's group	MIT

Athletics Program Involvement

2022-present	Member of Nestlé FC	Vevey, CH
2022-2023	Member of Vevey Sport FC 3rd team	Vevey, CH
2017-2022	Member of BKP FC	Boston
2016-2022	Member and captain (2019) of Chinese Scholar and Student Association (CSSA) Soccer Team	MIT