# Yijiang Huang

Junior Group Leader at ETH Zurich

Nationality: Chinese; Date of birth: 17-08-1994

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#### Research interests

My goal is to advance robotic intelligence to deepen our understanding of the relationship between design and construction processes.

Most of my work integrates *automated planning*, *physics simulation*, and *computational design*: I leverage planning algorithms to enable robots to autonomously construct architectural structures across scales, while simultaneously using insights gained from the planning and execution processes to inform and enhance design methodologies.

### 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

1/2025 - Now

SNSF Ambizione Junior Group Leader (Oberassistentin) Computational Robotics Lab, ETH Zurich

Supported by the SNSF Ambizione funding scheme, I develop computational methods to enhance assembly robots' intelligence in dexterous skills, workspace design, and collaborative behaviors. Advised by Stelian Coros.

### 1/23 - 12/24 Postdoctoral fellow

#### Computational Robotics Lab, ETH Zurich

Supported by an ETH postdoc fellowship, I 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. Advised 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 handson 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.

### **Funding**

#### 1/2025-12/2029 SNSF Ambizione Grant

Project title: Computational design of skills, environment, and collaborative intelligence for assembly robots

A four-year project grant, covering around 0.6 million CHF for my salary and project spending. One of the most prestigious funding instruments for early-career researchers from the Swiss National Science Foundation (18% success rate).

# **Fellowships**

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**

Google scholar profile. h-index: 12, citation count: 459 (as of 04-06-2025)

\* indicates authors contributed equally.

JOURNAL ARTICLES

[J<sub>7</sub>] K.J. Lee, Y. Huang, C. Mueller

2025 Str.

A differentiable structural analysis framework for high-performance design optimization

Structures, 2025, 78, p.109292

[J6] Y. Huang, C. Garrett, C. Mueller

2024 AIC Constructability-driven design of frame structures with state-space search methods

Automation In Construction, 2024, 167, p.105711

[J5] 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

[J4] Y. Huang, C. Garrett, I. Ting, S. Parascho, C. Mueller

2021 ConRob Robotic additive construction of bar structures: Unified sequence and motion planning

Construction Robotics, vol. 5, pp. 115-130

[J<sub>3</sub>] Y. Huang, C. Garrett, C. Mueller

<sup>2018</sup> ConRob Automated sequence and motion planning for robotic spatial extrusion of 3D trusses

Construction Robotics, vol. 2, no. 1-4, pp. 15-39

[J2] 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

[J1] 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

[C<sub>13</sub>] V.P.Y. Leung, Y. Huang

2024 CAAD Design Validation and Conflict Resolution for Robotic Fabrication: A Multi-Stage Framework for

Complex and Non-Repetitive Processes

Proceedings of CAAD Future, HongKong, 2025

[C12] C. Jiang, Y.H. Hung, Z. Wang, Y. Huang, A.L. Gheyselinck, P. Aejmelaeus-Lindström

<sup>2024</sup> IASS Computational Design and AR-assisted Assembly of Infinitely Reusable Temporary Structures

Proceedings of International Association for Shell and Spatial Structures (IASS), Zurich, 2024

[C11] V.P.Y. Leung, Y. Huang, C. Garrett, F. Gramazio, M. Kohler

<sup>2024 RobArch</sup> Planning Non-repetitive Robotic Assembly Processes with Task and Motion Planning (TAMP)

Proceedings of Robotic Fabrication in Architecture, Art and Design (RobArch), 2024

D. Tanadini, G. Boller, V.P.Y. Leung, Y. Huang, P. D'Acunto [C10] 2022 ACADIA

The CantiBox - Robotic Assembly of Interweaving Timber Linear Elements Using Bespoke Interlocking Timber-to-Timber Connections

Proceedings of the 42th Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA), Philadelphia, PA, USA, 27-29 October, 2022

Y. Huang, V.P.Y. Leung, C. Garrett, F. Gramazio, M. Kohler, C. Mueller [C<sub>9</sub>]

2021 SCF 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

Y. Huang, L. Alkhayat, C. De Wolf, C. Mueller [C8]

2021 SCDoS Algorithmic circular design with reused structural elements: Method and Tool

Proceedings of the international FIB symposium of Conceptual Design of Structures, 2021

C. Garrett\*, Y. Huang\*, T. Lozano-Pérez, C. Mueller [C<sub>7</sub>]

2020 RSS Scalable and Probabilistically Complete Planning for Robotic Spatial Extrusion

Proceedings of Robotics: Science and Systems (RSS), virtual, 2020

F. Amtsberg\*, Y. Huang\*, D. Marshall, K. Gata, C. Mueller [C6] 2020 AAG Structural upcycling: Matching digital and natural geometry

Proceedings of Advances in Architectural Geometry, Champs-sur-Marne, France, 2020

R. Arora, A. Jacobson, T. Langlois, Y. Huang, C. Mueller, W. Matusik, A. Shamir, K. Singh, D. Levin  $[C_5]$ 

Volumetric Michell trusses for parametric design & fabrication

Proceedings of the ACM Symposium on Computational Fabrication, 2019

L. Tessmer, Y. Huang, C. Mueller  $[C_4]$ 

2019 SCF

[C<sub>1</sub>]

2019 ACADIA 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 Architec-

ture (ACADIA), Austin, Texas, 21-26 October, 2019

Y. Huang, J. Carstensen, L. Tessmer, C. Mueller [C<sub>3</sub>]

2018 RobArch Robotic extrusion of architectural structures with nonstandard topology

Proceedings of Robotic Fabrication in Architecture, Art and Design (RobArch), 2018

Y. Huang, J. Carstensen, C. Mueller [C<sub>2</sub>]

2018 IASS 3D truss topology optimization for automated robotic spatial extrusion

Proceedings of International Association for Shell and Spatial Structures (IASS), Boston, MA, 2018

L. Yu, Y. Huang, Z. Liu, S. Xiao, L. Liu, G. Song, Y. Wang 2016 ACADIA

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 Architec-

ture (ACADIA), Ann Arbor 27-29 October, 2016, pp. 298-307

**PREPRINTS** 

Y. Tian, J. Jacob, Y. Huang, J. Zhao, E. Gu, P. Ma, A. Zhang, F. Javid, B. Romero, S. Chitta, S. Sueda, [P6] 2025

H. Li, W. Matusik

Fabrica: Dual-Arm Assembly of General Multi-Part Objects via Integrated Planning and Learning

[P <sub>5</sub> ] 2025	Y. Huang*, Z. Wang*, Y.H. Hung, C. Jiang, A.L. Gheyselinck, S. Coros Computational design and fabrication of reusable multi-tangent bar structures Final revision for the Journal of Computer-Aided Design, 2025
[P <sub>4</sub> ] 2023	P. Zeng*, Y. Huang*, S. Huber, S. Coros Budget-optimal multi-robot layout design for box sorting
[P <sub>3</sub> ] 2023	K. Doshi, Y. Huang, S. Coros On Hand-Held Grippers and the Morphological Gap in Human Manipulation Demonstration
[P2] 2023	M. Tarek and Y. Huang General deflation for finding multiple local optima in non-convex optimization
[P1] 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
[W1] 2020 IROS	Workshop Articles  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.
[A4] 2024 ICRA	Conference abstracts and Posters  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
[A <sub>3</sub> ] 2023 FoC	Y.H. Hung*, C. Jiang*, Z. Wang, <u>Y. Huang</u> , A.L. Gheyselinck, P. Aejmelaeus-Lindström Computational Design and Assembly of Infinitely Reusable Kit of Parts <i>Future of Construction Symposium</i> , Munich, Germany, 2023
[A2] 2023 IRS	K.J. Lee, <u>Y. Huang</u> , C. Mueller A differentiable assignment algorithm for high performance inventory-driven structural design ( <i>In</i> )visible Reuse Symposium, Lausanne, Switzerland, 2023
[A1] 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

2024-2025 IEEE Transactions on Robotics

Paper committee member: International Conference on Geometric Modeling and Processing

Reviewer: Construction Robotics Reviewer: ACM SIGGRPAH Reviewer: ACM SIGGRAPH Asia

2020-2021 Reviewer: ACM Symposium of Computational Fabrication

Grants

Review Panel for ETH Zurich Career Seed Awards

Workshop Organizing Committees

2024 CORL Workshop on Learning Robotic Assembly of Industrial and Everyday Objects

Co-organizers: Yunsheng Tian, Xiang Zhang, Hui Li, Wojciech Matusik, Sachin Chitta

### **Teaching**

SEMESTER-LONG COURSES

Spring 2025 Computational Models of Motion

ETH Zurich, CS

*Head TA* (led a three-TA team,  $\sim$  70 students per year)

Gave two lectures on reinforcement learning foundamentals. Led a TA team to design project-based assignments, gave tutorials, and design the exam.

Fall 2024 Advanced Machine Learning

ETH Zurich, CS

*Teaching assistant* (1 of 10 TAs,  $\sim$  300 students per year)

Developed and monitored student projects. Contributed to exam questions and testing.

Spring 2024 Stochasticity and Machine Learning

ETH Zurich, MAVT

*Teaching assistant* (1 of 10 TAs,  $\sim$  500 students per year)

Developed tutorials for generative model and reinforcement learning. Contributed to exam questions and testing.

2019-2021 Computational Structural Design and Optimization (4.450)

MIT Architecture

*Teaching assistant* ( $\sim$  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) Instructor (12 students)

MIT Architecture

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

7/2020

### 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)

### 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)

# 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  $\sim$ 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

11/23 - 7/24 Peiyu Zeng ETH Zurich

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. Aejmelaeus-Lindström)

#### MASTER'S SEMESTER PROJECT ADVISOR

2/2024 - 6/2024 Emre Altan ETH Zurich

Master in Robotics, Systems, and Control (ME). Semester project: Real2sim MoCap calibration for mobile robotic assembly.

#### ACADEMIC YEAR UNDERGRADUATE RESEARCHERS

2017 Thomas Cook MIT EECS Senior

Industrial robot's planning and simulation

2017 Kodiak Brush MIT ME Senior

Thermal hotend design for robotic printing

Khanh Nguyen MIT ME Sophomore

Portable 3D printing control system design

#### EXTERNAL COMMITTEE MEMBER

2/2023 Gabriel Vallat EPFL

Master thesis: Multi-agent Reinforcement Learning for Assembly of a Spanning Structure (with M. Kamgarpour and S. Parascho)

### SUMMER UNDERGRADUATE AND HIGH SCHOOL RESEARCHERS

Research mentor, Summer Geometry Institute Virtual, MIT

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)

8/2020

8/2021

2017

### Mentor, HerCodeCamp

Virtual, UToronto

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)

### Press

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

### **Invited Seminar Talks**

01/2025	Graphics And Mixed Environment Symposium Webinar	Online
11/2024	Kathrin Dörfler's Lab	TU Munich
7/2024	Chen Feng's Lab	New York University
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

2022-2023	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 Studen	t Association (CSSA) Soccer Team MIT

### Reference

#### Caitlin Mueller

Associate Professor of Architecture, Massachusetts Institute of Technology Ph.D. thesis advisor caitlinm@mit.edu

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#### **Stelian Coros**

Professor of Computer Science, ETH Zurich Postdoctoral research supervisor scoros@inf.ethz.ch

#### Catherine De Wolf

Assistant Professor of Circular Engineering for Architecture, ETH Zurich Research collaborator dewolf@ibi.baug.ethz.ch

### Tomás Lozano-Pérez

Professor of Computer Science and Engineering, Massachusetts Institute of Technology Ph.D. thesis committee member tlp@csail.mit.edu