Zain Karsan

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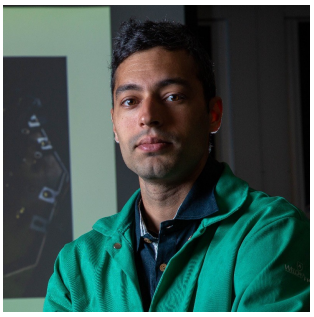
Summary

Mechanical Engineer, Architect and Technical Instructor with 6+ years designing machines, tools and robots for digital fabrication, additive manufacturing, and construction automation.
Cross disciplinary expertise, design and engineering software, machine learning, numerical simulation, fabrication experience across materials, wood, metals, plastics, stone, composites.
Interested in leveraging my expertise to increase the efficiency of the building sector and make construction more sustainable.
Currently developing a semi-autonomous multi-robotic system for the disassembly of steel structures.



Professional Experience

Research Scientist, Self Assembly Lab – Cambridge, MA — September 2021 – June 2023

- Lead researcher developing novel metal additive process, Liquid Metal Printing, high speed large format aluminum printing, together with industry partners AMADA and AISIN.
- Designed, fabricated and tested experimental nozzle and furnace assemblies to maintain 700°C and corrosion resistance with crucibles carrying 3L of molten aluminum.
- Developed experimental rigs for Addidas Wet Suit Prototypes, where robotically applied adhesive bonds were subject to fatigue test-bench involving multiple cycle counts and frequencies.

Technical Instructor, MIT – Cambridge, MA — June 2018 – September 2021

- Supported graduate courses How to Make (almost) Anything, Fine Furniture Making, How to Design, Aluminum Casting Workshop, Robotic Fabrication, taught roughly 350 students
- Authored syllabi and coordinated graduate level digital fabrication course during pandemic featuring self-developed $200 desktop CNC machine kit, supported students to build and modify their machines.

Technologies

Python, C++, KRL, Matlab, ROS2, Git, Rhinoceros, Grasshopper, Solidworks, Fusion360, Blender, KiCAD, Mastercam, Robotmaster, Powermill, Revit, AutoCAD, Adobe Suite

Education

ETH Zurich
Doctoral Studies in Civil Engineering and Architecture — Sept 2023 – Current,

- **Coursework:** Planning and Decision Making for Autonomous Robots, Programming for Robotics, Computational Structural Design, Physically Based Simulation, Advanced Model Predictive Control, Embedded Systems, System Identification

Massachusetts Institute of Technology
Master in Architecture — Sept 2014 – June 2018, GPA: 4.8/5.0

- **Coursework:** How to Make (almost) Anything, Quarra Matter Fellowship, Computational Design, Structural Optimization

MSc in Mechanical Engineering — Sept 2021 – May 2023
MSc in Computational Design — GPA: 4.8/5.0

- **Coursework:** Precision Machine Design, Manufacturing Processes, Elements of Mechanical, Numerical Simulation, Computational Science and Engineering,

Machine Learning Models & Applications, Measurement and Instrumentation

Publications

- **Karsan Zain**, Dillenburger, B. & De Wolf, C. (2025) **Graph Based Disassembly Sequencing with Structural and Stability Constraints** 2025 EC3, proceedings of the 42nd European Conference on Computing in Construction, Porto, 14-17 July 2025
- **Karsan Zain**, Dillenburger, B. & De Wolf, C. (2025) **Multi-Robotic System for Welded Steel Disassembly** CAADRIA 2025: Architectural Informatics; proceedings of the 30th CAADRIA conference, Tokyo, 22-29 March 2025
- **Karsan Zain**, K. Kaiser, J. Laucks, S. Tibbits, **Liquid Metal Printing** ACADIA 2023: Habits of the Anthropocene; proceedings of the 43rd annual conference of the Association for Computer Aided Design in Architecture, ACADIA, Colorado 2023.
- **Karsan Zain**, **Desk Mate: A Collaborative Drawing Platform** CAADRIA 2023: Human Centric; proceedings of the 28th CAADRIA conference, Ahmedabad, 18-24 March 2023, pp. 521–530, https://doi.org/10.52842/conf.caadria.2023.2.521
- **Karsan Zain**, **TinyZ: A Desktop CNC Machine to Enable Remote Digital Fabrication** ACADIA 2021: Realignments; proceeding of the 41st annual conference of the Association for Computer Aided Design in Architecture, ACADIA, Online and Global. 3-6 November 2021. https://doi.org/10.52842/conf.acadia.2021.058

Projects

Desk Mate: Machine Learning Enabled Drawing Machine MIT Spring 2022

- Built synthetic dataset of 10k sketches and trained several models, VAE and GAN models, CNNs & RNNs taking user sketch as input, and returning an embellished sketch, used PyTorch
- Developed a hardware interface, pen plotter which unrolls and draws on trace paper potentially producing 50 yard long drawings.

Desktop Lathe MIT Spring 2022

- Design in Solidworks and fabricated using CNC mill, lathe, waterjet. Validated with 0.002” Accuracy and 0.001” Precision.
- In a team of 5, led the manufacturing process planning, generated functional requirements, and coordinated with team members validation tests using MEMS, thermal cameras, and cutting tests.

Multi-Axis Flexure Testing Machine MIT Spring 2021

- In a team of 4, designed and built a machine to measure the 2D stiffness matrix of a flexure specimen, between 10^{-2} and 10 N/μm.
- Developed transmission design and machined parts to interface worm gear and acme lead screw assembly to impart up to 10kN vertical load from horizontal crank with only 5Nm torque.

Additional Experience And Awards

Vanguard Award Runner Up, ACADIA 2023: Liquid Metal Printing

Emeco House, L.A., Exhibition 2022: Metal Printed Chairs, Self Assembly Lab

Vanguard Award, ACADIA 2021: TinyZ: A Desktop CNC Machine to Enable Remote Digital Fabrication

Rotch Design Award, MIT 2018: Awarded for Thesis entitled: "Taking Stock"

Quarra Matter Fellowship, MIT 2017: Design Research at Robotic Stone Carving Facility Madison, WI

Winning Design, MIT 2016: Design Build Workshop with Wang Shu & Nanjing University in Zheizhang Province

IPAF 1a,1b,3a,3b: Mobile and Stationary Boom and Scissor Lift International Certification

Kuka College, Shelby, MI: Basic and Advanced Programming, Commissioning and Maintenance