Zhaoyi Xu

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About Me

I am currently a PhD student in Mechanical Engineering at the University of Michigan, Ann Arbor, under the supervision of Professor Jianping Fu. My research lies at the intersection of biology and engineering, with a focus on understanding human development and health. Specifically, I employ human pluripotent stem cell (hPSC)–based organoids to model early human developmental processes. In addition, I am interested in inverse problems and medical image analysis, with an emphasis on developing interpretable AI models for healthcare applications.

Research Interests

- Human developmental biology
- Human pluripotent stem cell (hPSC) models and therapies
- Interpretable/Reliable AI models for health

Education

PhD, Mechanical Engineering, University of Michigan 2021 - 2026 (expected)
- GPA: 4.0 / 4.0
- Advisor: Prof. Jianping Fu
- Thesis committee: Cheri X. Deng, Qiong Yang, and Chengzhi Shi

MASc, Mechanical Engineering, University of Toronto 2021
- GPA: 3.9 / 4.0
- Advisor: Prof. Xinyu Liu
- Thesis: An Improved Approach for Optogenetic Locomotion Control of Caenorhabditis Elegans

BEng, Mechanical Engineering, Hong Kong University of Science and Technology 2019
- The Dean's List, First Class Honours

Exchange student in Mechanical Engineering, National University of Singapore 2018

Selected Research Experience

Synthetic 3D hPSC Models on Peri-Implantation Development 2021 - present
University of Michigan, Supervisor: Professor Jianping Fu
- Developed biomimetic implantation-like niches for 3D hPSC organoid culture using microfluidics and microfabrication, replicating maternal tissue properties to study early human embryo development events.
- Independently initiated and executed three sub-projects, leading to publications [1] [8] [10].

Neural Differentiation of hPSCs via Acoustic Tweezing Cytometry 2022 - 2024

University of Michigan, Supervised by Professor Jianping Fu, Professor Cheri X. Deng

- Utilized the Acoustic Tweezing Cytometry (ATC) technology to study hPSCs' mechanosensitive properties, for large-scale production of functional motor neurons for medical applications.
- Supported by *NIH R01 GM143297* and participated as a core member, as main contributor to two annual progress reports, resulting in publications [4] [9].

An Improved Approach for Optogenetic Locomotion Control of Caenorhabditis Elegans 2019 - 2021

University of Toronto, Supervised by Professor Xinyu Liu

- Collaborated on developing the living soft microrobot, RoboWorm, using optogenetic control of C. elegans with microfluidic tools; resulted in a notable Science Robotics publication [5].
- My work improved RoboWorm technology, elevating the success rate from 7.1% to 80.77%, by creating a new transgenic C. elegans strain and enhancing the control system's robustness.
- Collaborated closely with the renowned molecular biology team at Mount Sinai Hospital (Zhen lab) on a daily basis, gaining valuable bio-laboratory expertise.

Gecko-Inspired Symbiosis Robotics End-Effector 2018 – 2019

HKUST Robotics Institute, Supervised by Professor Michael Yu Wang

- This is my undergraduate Final-Year Project, where I utilized 3D-printing and Finite Element Method, designed and microfabricated a gecko-inspired gripper for delicate object handling in industrial production.
- Devoted 300+ hours, led a group of 4 students and awarded the HKUST President's Cup for the most outstanding final-year projects of the year.

3D-Printed Devices with Negative Poisson's Ratio 2018 – 2019

NUS Centre for Additive Manufacturing (AM.NUS), Supervised by Professor Wen Feng Lu

- Worked with Dr. Lu, director of AM.NUS and his team, we developed medical protective equipment and soft robots with auxetic structures using 3D-Bioprinting (publication [6] [11]).

Publications

Journals

[1] **Zhaoyi Xu**, Weiping Li, Xufeng Xue, Nicholas G. Schott, Ruxin Yang, Shiyu Sun, Jeyoon Bok, Jan P. Stegemann, Jianping Fu, and Cheri X. Deng, "Acoustic cell patterning reveals geometry- and substrate-dependent vasculogenesis and human embryo model development," *Nature Communications*, under revision, 2026.

[2] Tao Hong, **Zhaoyi Xu**, Se Young Chun, Luis Hernandez-Garcia, and Jeffrey A. Fessler*, "Convergent complex quasi-Newton proximal methods for gradient-driven denoisers in compressed sensing MRI reconstruction," *IEEE Trans. on Computational Imaging*, vol. 11, pp. 1534–1547, 2025. DOI: 10.1109/TCI.2025.3625052.

[3] Tao Hong, **Zhaoyi Xu**, Jason Hu, and Jeffrey A. Fessler*, "Using randomized Nyström preconditioners to accelerate variational image reconstruction," *IEEE Trans. on Computational Imaging*, vol. 11, pp. 1630–1643, 2025. DOI: 10.1109/TCI.2025.3622903.

[4] **Zhaoyi Xu**, Shiying Liu, Xufeng Xue, Weiping Li, Jianping Fu*, and Cheri X Deng*, "Microbubble behaviors in acoustic tweezing cytometry regulates embryonic stem cell differentiation," *Scientific Reports*, vol. 13, no. 18030, 2023. DOI: 10.1038/s41598-023-45397-5.

[5] Xianke Dong, Sina Kheiri, Yangning Lu, **Zhaoyi Xu**, Mei Zhen, and Xinyu Liu*, "Towards a living soft microrobot: Optogenetic locomotion control of caenorhabditis elegans," *Science Robotics*, vol. 6, no. 55, eabe3950, 2021. DOI: 10.1126/scirobotics.abe3950.

[6] Mingcan Liu, **Zhaoyi Xu**, Jing Jie Ong, Jian Zhu, and Wen Feng Lu*, "An earthworm-like soft robot with integration of single pneumatic actuator and cellular structures for peristaltic motion," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 7840–7845, 2020. DOI: 10.1109/IROS45743.2020.9341166.

[7] Sihan Huang, **Zhaoyi Xu**, Guoxin Wang*, Cong Zeng, and Yan Yan, "Reconfigurable machine tools design for multi-part families," *The International Journal of Advanced Manufacturing Technology*, vol. 105, no. 1, pp. 813–829, 2019. DOI: 10.1007/s00170-019-04236-6.

Conferences

[8] **Zhaoyi Xu**, Weiping Li, Jianping Fu*, and Cheri X Deng*, "Controlled development of a human epiblast model using acoustic patterning," 8th Bioengineering and Translational Medicine Conference by AIChE, San Diego, US, 2024.

[9] **Zhaoyi Xu**, Weiping Li, Jianping Fu*, and Cheri X Deng*, "Formation and development of a human epiblast model in biomimetic implantation-like niche through acoustic hpscs patterning," The Great Lakes Developmental Biology Meeting, Toronto, Canada, 2023.

[10] **Zhaoyi Xu**, Xufeng Xue, and Jianping Fu*, "Probing mechanobiology of human neural crest cell development using a patterned microfluidic neural tube model," Keystone Symposia on Molecular and Cellular Biology, Keystone, CO, United States, 2022.

[11] Yafeng Han, **Zhaoyi Xu**, and Wen Feng Lu*, "Design of conforming surface for human skin at highly-stretched joint areas with additive manufacturing," 5th International Conference on Additive Manufacturing and Bio-Manufacturing (ICAM-BM), Beijing, China, 2018.

Honors and Awards

2024	8th Bioengineering and Translational Medicine Conference	Young Investigator Award
2021-23	UMich Rackham Travel Grant	USD 2,150
2021	UMich ME Department Fellowship	USD 89,775
2019-21	UofT MIE Department Fellowship	Full Scholarship
2021	UofT Barbara and Frank Milligan Fellowships	CAD 10,000
2020	UofT MIE Endowed Fellowship	CAD 3,000
2019	HKUST President's Cup	Gold Award
2018	HKSAR Government Talent Development Scholarship	HKD 10,000
2016	HKUST Robot Design Contest	Champion
2013	China National Awarding Program of Future Scientists	Top 100
2009	China Arts Grade Examination - Piano, Grade 10	Top Level

Teaching Experience

ME 335 Heat Transfer University of Michigan, Winter 2026
Graduate Student Instructor (Teaching Assistant) (20 hrs/week)

- Led instruction for 93 students; designed/delivered recitation lectures and held office hours.
- Developed experience in large-class teaching and course coordination.

ME 495 Laboratory II University of Michigan, Fall 2025
Graduate Student Instructor (Teaching Assistant) (20 hrs/week)

- Designed and taught two lab sections (24 students) for senior-level laboratory course.
- Broad topics included heat transfer, mechanical dynamics, and AFM-based nanoscale metrology.
- Gained extensive self-directed learning and close student mentorship.

MIE 342 Circuits with Applications to Mechanical Engineering Systems University of Toronto, Fall 2020
Teaching Assistant (15 hrs/week)

- Supported a lab course of ˜130 students in a four-TA team.
- Co-developed online laboratory tools for remote instruction during COVID-19, enabling virtual circuit assembly and experimental data acquisition.

Student Mentoring

- **Linyuan Li** (Jun. 2025 – Sep. 2025), B.S. student, Biochemistry, University of Michigan. Topic: Mechanical regulation of zebrafish PSM cells using geometrically modulated elastomeric substrates.
- **Ruxin Yang** (Aug. 2024 – Sep. 2025), M.S. student, Biomedical Engineering, University of Michigan. Topic: Acoustic cell patterning.

Skills

Laboratory

Cell biology: Human Pluripotent Stem Cell • Imaging and Microscopy • Immunostaining • qPCR • Single-cell RNA Sequencing

Engineering: Microfluidics • Nanofabrication • 3D Printing/Bioprinting

Quantitative Analysis: Python • R • Matlab • C/C++

Illustration: ImageJ • Adobe Photoshop • Adobe Illustrator • Procreate

Office: Office Suite • Google Workspace • LaTeX

Teamwork: Multi-tasking • Interpersonal skills

Languages: English • Mandarin • Cantonese