

FANGZHENG LIU

fzliu@mit.edu ◇ Fangzheng's github ◇ Portfolio

KEY PASSION

Wireless sensor system and miniature robotic design for Human-Computer Interaction and planetary exploration.

PROOF OF EXCELLENCE

One of my designed miniature robot (3 cm × 3 cm × 3 cm), which I named the “AstroAnt”, has been sent to the Moon in Mar 2025 in the Intuitive Machines IM-2 Lunar south pole mission. It is one of the smallest rover and the first Bluetooth device that has ever been sent to the Moon.

EDUCATION

Massachusetts Institute of Technology

Ph.D. in Media Arts and Sciences

September 2021 — May 2026 (expected)

Responsive Environments Group, MIT Media Lab

Massachusetts Institute of Technology

M.S. in Media Arts and Sciences

September 2019 — Aug 2021

Responsive Environments Group, MIT Media Lab

Beijing Institute of Technology

M.S. in Information and Communication Engineering

September 2015 — Apr 2018

Beijing Institute of Technology

B.S. in Information Engineering

September 2011 — Jun 2015

WORK EXPERIENCE

Engineer (supervisor: Prof. Samuel C.C. Ting (1976 Nobel laureate in physics))

CERN (the European Organization for Nuclear Research)

Apr 2018 — Apr 2019

- Designed the ground test monitor and control software for the UTTPS (Upgraded Tracker Thermal Pump System) of the AMS-02 (Alpha Magnetic Spectrometer, a high-energy particle Spectrometer operating on the International Space Station).
- The UTTPS has been installed to the AMS-02 by the end of Jan 2020 through four spacewalks.

ACADEMIC RESEARCH EXPERIENCE

AstroAnt - my designed robot is on the Moon!

MIT Media Lab

Jan 2021 — Mar 2023

- Lead engineer of the MIT Media Lab “AstroAnt” Lunar mission. The “AstroAnt” a miniature robot designed to work on the top panel of the Lunar rover MAPP-1 (developed by the Lunar Outpost) to collect temperature data. The data collected by the AstroAnt is used to monitor the health of the MAPP-1 rover’s thermal system.
- Developed the AstroAnt robot, responsibilities include: electrical hardware development, mechanical system development, firmware development, concept of operation design, and conducting all the tests.
- Delivered the AstroAnt flight hardware on Mar, 2023.
- The AstroAnt has been sent to the Lunar South Pole in the Intuitive Machines IM-2 mission in March 2025. Due to the failure of the Intuitive Machines’ IM-2 lander, the AstroAnt didn’t get power on the Moon.

HexSense

May 2023 — Present

MIT Media Lab

- The “HexSense” is a type of miniature wireless sensor node that can be ballistically deployed from rovers/landers or dropped from a fly-by satellite to the Lunar surface. After deployment, the HexSense can automatically stand upright and start collecting scientific data.
- Developed the “HexSense” sensor node, including electrical hardware design, mechanical system design, firmware development, and conducting all the tests.
- Finished two field expeditions on Earth: a 10-day field expedition in Svalbard (Arctic area) in July 2023. One HexSense was deployed to collect local environmental data; a 7-day field expedition in the lava tubes on the Canary Island in Feb 2024. Two HexSense were deployed to study the shielding protection of the lava tubes.
- Finished one parabolic flight in May 2024 and validated HexSense’s performance in Lunar gravity environment.

Lunar Tumbleweed

May 2025 — Present

MIT Media Lab

- The Lunar Tumbleweed is a movable wireless sensor node that is designed to work on the Moon. It enables a “power-free” mobility: it can continuously move without consuming any electrical power. Instead, it leverages the heat from the sunlight and custom-designed actuators driven by lab-made shape memory alloy springs.
- Finished the Lunar Tumbleweed prototype development, including mechanical design, actuator design, simulation, and fabrication.
- Finished all tests in a lab environment. The tests validated the continuous “power-free” mobility in a Lunar gravity environment.

LunarDeltaT

Feb 2023 — Jun 2023

MIT Media Lab

- The “LunarDeltaT” is an energy harvesting module for the HexSense wireless sensor node working on the Moon. It can harvest energy through the temperature gradient naturally formed across the surface of the sensor node through a custom-designed thermopile.
- Developed the LunarDeltaT module, including thermopile design and fabrication.
- Finished all tests in a lab environment. LunarDeltaT shows an advantage over solar cells in a dusty environment (e.g., the lunar surface).

LunarWSN (Master thesis at MIT)

Nov 2020 — Aug 2021

MIT Media Lab

- The “LunarWSN” is a miniature cubic shape wireless sensor node that can be ballistically deployed from rovers/landers or dropped from a fly-by satellite to the Lunar surface. It is designed to study the electrical property of Lunar regolith and detect the presence of water ice in-situ.
- Developed the LunarWSN node, including electrical hardware design, mechanical system design, firmware development.
- Finished all the system function tests in a lab environment, and the LunarWSN shows the capability to detect different water content in Lunar regolith simulant.

CircuitScout (side project)

Jun 2023 — Oct 2023

MIT Media Lab

- Developed a small bench-top machine tool to streamline the in-circuit debugging. With the help of the PCBPT, when debugging PCB, all the users need to do are selecting signals and checking the output without the need to do anything else.

IO-Touch (side project)

Oct 2023 — Nov 2023

MIT Media Lab

- Developed a pure software approach that can turn almost every GPIO into a capacitive sensor.

MindCube (side project)

Jul 2024 — Aug 2024

MIT Media Lab

- Developed a miniature (3 cm x 3 cm x 3 cm) fidget cube toy that can collect data from all the sensors when it is played in a hand. The data collected can be used to study one's real-time emotion. The Mind Cube can also be used as a music/game controller.

SELECTED MEDIA REPORTS

- **Fast Company** - "MIT designed these tiny R2-D2 robots to help keep spaceships safe" [LINK]
- **Forbes** - "MIT Will Return To The Moon For The First Time Since Apollo, Thanks To This Space Startup" [LINK]
- **MIT News** - "MIT engineers prepare to send three payloads to the moon" [LINK]
- **Create the Future 2024 Design Contest** - **Category winner (Robotics)** "Astroant: a Miniature Symbiotic Robotic Serving on the Outside Surfaces of Spacecraft, Rovers, and Landers for Inspection and Diagnostic Tasks" [LINK]
- **Castrol** - "Castrol membership supports the astroant payload program" [LINK]
- **MIT Media Lab** - "Media Lab + Castrol Collaboration: Meet HexSense" [LINK]
- **hackster.io** - "IoT Shoots for the Moon" [LINK]
- **Create the Future 2023 Design Contest** - **Top 100 Entry (Electronics)** "PCB Probe Tester (PCBPT) - a Compact Desktop System that Helps with Automatic PCB Debugging" [LINK]
- **Hackaday** - "Hackaday Prize 2023: Circuit Scout Lends A Hand (Or Two) For Troubleshooting" [LINK]
- **hackster.io** - "CircuitScout Aims to Automate the Painful Process of Probing Test Pads on Your PCBs" [LINK]

PUBLICATIONS

- **Fangzheng Liu**, Nicolas STAS, Ariel Ekblaw, and Joseph A Paradiso. "HexSense Lunar Mapping: Deployable 360 Cameras for Panoramic Inspection & 3D Reconstruction". In The 47th International IEEE Aerospace Conference (2026, submitted).
- Leonie Bensch, Cody Paige, Don D. Haddad, **Fangzheng Liu**, Nathan Perry, Gerrit Olivier, Jessica Todd, Joseph A. Paradiso "Creating Immersive Digital Twins of Terrestrial Planetary Analogs with Multimodal Sensing and Game Engines for Virtual Exploration. In The IEEE Pervasive Computing Special Issue - Defining A New Cross Reality: Digital Twins and Mixed Reality Worlds (2025, accepted).
- **Fangzheng Liu**, Kerri Cahoy, Ariel Ekblaw, and Joseph A Paradiso. "A Wireless Lunar Sensor Node Powered by Temperature Gradients across the Device's Surface". In The 45th International IEEE Aerospace Conference (2024).
- **Fangzheng Liu**, Nathan Perry, Ariel Ekblaw, and Joseph A Paradiso, 2025. "A Field Expedition and Parabolic Flight Experiment for the HexSense: A Type of Ballistic Deployed Self-Oriented Wireless Sensor Nodes for Future Lunar Exploration". In AIAA Scitech 2025 Forum.
- **Fangzheng Liu**, Cody Paige, Ariel Ekblaw, and Joseph A Paradiso. "HexSense: Self-Oriented Ballistic Deployed Wireless Sensor Nodes for Lunar Exploration". In Accelerating Space Commerce, Exploration, and New Discovery (ASCEND) 2024.
- **Fangzheng Liu**, Ariel Ekblaw, Joseph Paradiso. "LunarWSN node - a Wireless Sensor Network node designed for In-Situ lunar water ice detection." SmallSat conference 2022 (Aug 2022).

- **Fangzheng Liu**, Blanchard, L., Haddad, D.D. and Paradiso, J.A., 2025. “Two Sonification Methods for the MindCube.” arXiv preprint arXiv:2506.18196.
- **Fangzheng Liu** and Joseph A Paradiso. 2023. PrintedCircuit Board (PCB) Probe Tester (PCBPT) - a Compact Desktop system that Helps with Automatic PCB Debugging. In The 36th Annual ACM Symposium on User Interface Software and Technology (UIST '23 Adjunct), October 29–November 01, 2023, San Francisco, CA, USA. ACM, New York, NY, USA 3 Pages. <https://doi.org/10.1145/3586182.3615800>.
- **Fangzheng Liu**, Dementyev, A., Wicaksono, I. and Paradiso, J.A., 2025, September. Experiencing EmbedNet: Embedding self-sensing to 3D casting objects. In Adjunct Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (pp. 1-4).
- Ariel Ekblaw, Juliana Cherston, **Fangzheng Liu**, Irmandy Wicaksono, Don Derek Haddad, Valentina Sumini, Joseph A. Paradiso. “From UbiComp to Universe - Moving Pervasive Computing Research Into Space Applications.” IEEE Pervasive Computing 2022.
- B Haghighat, J Boghaert, Z Minsky-Primus, J Ebert, **Fangzheng Liu**, M Nisser, A Ekblaw, and R Nagpal. “An Approach Based on Particle Swarm Optimization for Inspection of Spacecraft Hulls by a Swarm of Miniaturized Robots.” In 13th International Conference on Swarm Intelligence (ANTS 2022).
- **Fangzheng Liu**, Haddad, D.D. and Paradiso, J., 2024, October. MindCube: an Interactive Device for Gauging Emotions. In Adjunct Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology (pp. 1-2).
- LUO Qing-sheng, ZHOU Chen-yang, JIA Yan, GAO Jian-feng, **Fangzheng Liu**: “CPG-Based Control Scheme for Quadruped Robot to Withstand the Lateral Impact.” 2015. Journal of Beijing Institute of Technology, 35(4), pp.384-390.

PATENTS

- CUI Wei, HOU Jian-gang, **Fangzheng Liu**, SHEN Qing, XIANG Jing-zhi, WU Si-liang: “A Radar Echo Delay Coherent Simulation Method Based on Digital Radio Frequency Signal Storage.” Chinese patent: 2017104551967 (G01S7/40). Filed on Jun 16, 2017, and issued on Dec 18, 2018. [LINK]
(Advisors: CUI Wei, HOU Jian-gang)
- CUI Wei, SHEN Qing, HOU Jian-gang, **Fangzheng Liu**, XIANG Jing-zhi, WU Si-liang: “A Doppler Frequency Coherent Simulation Method for Radar Echoes Based on Real-time Frequency Measurement.” Chinese patent: 2017104552014 (G01S7/40). Filed on Jun 16, 2017, and issued on Oct 9, 2018. [LINK]
(Advisors: CUI Wei, HOU Jian-gang)

AWARDS

- **Amazon Robotics PhD communication competition (3rd place)** (2025)
- **The Create the Future Design Contest category winner (Robotics and Automation)** (2024-2025 academic year)
- **Harold Horowitz (1951) Student Research Fund award** (2023-2024 academic year)
- **Angela Leong Fund Fellowship** (2022-2023 academic year) - 1 student/year in MIT
- **Intel Cup Undergraduate Electronic Design Contest - Embedded System Design Invitation Contest** (2014) - Second prize
- **China National Scholarship** (2011) - Top 0.2%

TECHNICAL SKILLS

- **Electronics** - Embedded system (nRF52, STM32, Atmel ATSAMD, Atmel AVR, ESP32), FPGA (Xilinx 7 series), analog circuit
- **Programming languages and related** - C, C++, VHDL, Python, JavaScript, Git, LabVIEW, Arduino
- **Computer-aided design/engineering** - Altium Designer, KiCAD, EasyEDA, Mentor Graphics PADS, SolidWorks, Fusion 360, Inventor, Onshape.
- **Manufacturing skills** - 3D modeling/printing (FDM, SLA, SLS), Molding & Casting, CNC machining, PCB milling, PCB soldering, Laser cutting, water jet cutting.
- **Space grade tests** - thermal vacuum test.
- **Others** - Parabolic flight certificates !!! :]

TEACHINGS

- **Head Teaching Assistant** (MIT course MAS.836 “Sensing Technologies for Interact Environments”, 2022 Spring) — Responsible for origination of the course, including weekly problem sets, labs, weekly talk sessions with researchers in the different sensing areas. Most of the students are from non-electrical engineering background.
- **Teaching Assistant** (MIT course MAS.863/4.140/6.9020 “How To Make (almost) Anything”, 2024 Fall) — Responsible for electronics recitation for the students, and lots of them are from non-electrical engineering background.
- **Teaching Assistant** (MIT course MAS.863/4.140/6.9020 “How To Make (almost) Anything”, 2023 Fall) — Responsible for electronics recitation for the students, and lots of them are from non-electrical engineering background.
- **Teaching Assistant** (MIT course MAS.S76 “Adventures in Sensing”, 2021 Spring) — Responsible for the space sensing section talk selection.

FUN FACT ABOUT ME

A printmaking I made when I was ten years old was collected by the Muroran City Museum in Japan. :]

INTERESTS

Painting Hiking Cycling rock climbing Basketball Electronics