

CAI, Mingjing

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Educations

Ph.D. in Mechanical and Automation Engineering (Advisor: Prof. Wei-Hsin Liao)

The Chinese University of Hong Kong

Aug. 2017-Aug. 2020

M. Eng. in Mechanical Design and Theory (Advisor: Prof. Longhan Xie)

South China University of Technology

Sept. 2013-Jun. 2016

B. Eng in Mechanical Engineering and Automation (Advisor: Prof. Longhan Xie)

South China University of Technology

Sept. 2009-Jun. 2013

Working Experiences

• *Associate Professor*

Guangzhou Institute of Technology, Xidian University

Feb. 2022-present

• *Postdoctoral Fellow* (Advisor: Prof. Wei-Hsin Liao)

The Chinese University of Hong Kong

Hong Kong Centre for Logistics Robotics

Oct. 2020- Oct. 2021

• *Junior Research Assistant* (Advisor: Prof. Wei-Hsin Liao)

The Chinese University of Hong Kong

Jul. 2016-Jul. 2017

Research Experiences

Embedded Generator for Self-Powered IoT applications

Dec. 2016-present

- Investigated systematic methods to capture kinetic energy of human limb swinging, and enhance the performance to realize self-powered wearables and IoT applications;
- Developed a highly compact generator with magnetic frequency-up converter for self-powered smart watches and wristbands, generating power of 1.74 mW (4 times of the counterparts);
- Explored magnetic spring to achieve power improvement of 425% for wrist-worn energy harvesters;
- Studied proof-massless design for inertial energy harvesters to improve high power density by 1000%.

Smart Harvester for Power Generation and Walking Assistance

Jul. 2016-Aug. 2018

- Developed a wearable device to convert the negative of the ankle dorsiflexion into electricity;
- Explored smart negative work identification mechanism to reduce human efforts during walking;
- Reduced metabolic cost by 0.84 W while generating electrical energy of 0.35 W.

Biomechanical Energy Harvesting from Human Motion

Sept. 2013-Jul. 2016

- Investigated energy harvesting mechanisms to capture biomechanical energy from various motions;
- Developed slide mechanisms for electromagnetic and piezoelectric energy harvesters to efficiently scavenge impact energy of human foot strike;
- Explored backpack energy harvester with enhanced power density (0.273 W/kg);
- Studied tunable stiffness mechanism to generate electricity and reduce accelerative load for backpacks.

Publications & Patents

Journal Papers:

1. **M. Cai** and W. H. Liao, "A Coaxial Wrist-worn Energy Harvester for Self-Powered Internet of Things Sensors," *IEEE Internet Things J.*, 10(1), 133-143, 2023. **(IF 10.238)**
2. **M. Cai** and W. H. Liao, "Design, Modeling and Experiments of Electromagnetic Energy Harvester Embedded in Smart Watch and Wristband as Power Source," *IEEE/ASME Trans. Mechatron.*, 26(4), 2104-2114, 2021. **(IF 5.867)**
3. **M. Cai** and W.H. Liao, "High Power Density Inertial Energy Harvester Without Additional Proof Mass for Wearables," *IEEE Internet Things J.*, 8(1), 297-308, 2021. **(IF 10.238)**
4. **M. Cai** and W.H. Liao, "Enhanced Electromagnetic Wrist-Worn Energy Harvester Using Repulsive Magnetic Spring," *Mech. Syst. Signal Process.*, 150, 107251, 2021. **(IF 8.934)**
5. **M. Cai**, Z. Yang, J. Cao, and W. H. Liao, "Recent Advance in Human Motion Excited Energy Harvesting Systems for Wearables," *Energy Technol.*, 8, 2000533, 2020. **(IF 4.149)** (*Featured with Research News*)
6. **M. Cai**, J. Wang, and W.H. Liao, "Self-Powered Smart Watch and Wristband Enabled by Embedded Generator," *Appl. Energy*, 263, 114682, 2020. **(IF 11.446)** (*Featured Article with Best Paper Award*)
7. **M. Cai**, W. H. Liao, and J. Cao, "A Smart Harvester for Capturing Energy from Human Ankle Dorsiflexion with Reduced User Effort," *Smart Mater. Struct.*, 28(1), 015026, 2019. **(IF 4.131)** (*Featured Article with Best Student Poster Award*)
8. L. Xie and **M. Cai**, "An In-Shoe Harvester with Motion Magnification for Scavenging Energy from Human Foot Strike," *IEEE/ASME Trans. Mechatron.*, 20 (6), 3264-3268, 2015. **(IF 5.867)**
9. L. Xie and **M. Cai**, "Development of a Suspended Backpack for Harvesting Biomechanical Energy," *J. Mech. Des.*, 137 (5), 054503, 2015. **(IF 3.441)**
10. L. Xie and **M. Cai**, "Increased Energy Harvesting and Reduced Accelerative Load for Backpacks via Frequency Tuning," *Mech. Syst. Signal Process.*, 58, 399-415, 2015. **(IF 8.934)**
11. L. Xie and **M. Cai**, "Human Motion: Sustainable Power for Wearable Electronics," *IEEE Pervas. Comput.*, 13 (4), 42-49, 2014. **(IF 3.175)**
12. L. Xie and **M. Cai**, "Increased Piezoelectric Energy Harvesting from Human Footstep Motion by Using an Amplifying Mechanism," *Appl. Phys. Lett.*, 105 (14), 143901, 2014. **(IF 3.971)**

Conference Papers:

1. **M. Cai** and W. H. Liao, "Towards Self-Powered Wearables via Wrist-Worn Energy Harvesters," 13th International Conference on Applied Energy, 2021.
2. **M. Cai** and W. H. Liao, "Design of Smart Harvester for Capturing Energy from Human Ankle Dorsiflexion to Reduce User Effort," *Proc. SPIE 10598*, 105982Q, 2018.

Patents:

1. W.H. Liao, **M. Cai**, Biokinetic Energy Collection Apparatus and Fabrication Method Thereof," PCT patent application: PCT/CN2022/120715, 2022.
2. W.H. Liao, **M. Cai**, Biokinetic Energy Collection Apparatus and Fabrication Method Thereof," US Patent application: 17/944,286, 2022.

3. W.H. Liao, **M. Cai**, “Apparatus and Method of Embedded Biomechanical Energy Harvester for Wearables,” China Patent Application: 202111120926.0, 2021.
4. W.H. Liao, **M. Cai**, and J. Wang, “Human Motion Energy Harvesting Apparatus and Conversion Method,” US Patent: 11,316,405, 2022, and China Patent: 201910104425, 2023.
5. L. Xie and **M. Cai**, “Tubular Backpack Kinetic Energy Harvesting Apparatus and Method,” China Patent: ZL201410753977.0, 2017.
6. L. Xie, **M. Cai**, and X. Mei, “Self-Recharged Battery Apparatus and Method,” China Patent: ZL201410698357.1, 2017
7. L. Xie, J. Li, and **M. Cai**, “Regenerative Shock Absorber and Energy Harvesting Method,” China Patent: ZL201510114617.0, 2016.
8. L. Xie and **M. Cai**, “Wrist Device for Harvesting Energy from Human Motion,” China Patent: ZL201310362907.8, 2015.
9. L. Xie and **M. Cai**, “Human Kinetic Energy Harvester with Tunable Frequency,” China Patent: ZL201310362800.3, 2015.
10. L. Xie and **M. Cai**, “Apparatus and Method for Harvesting Mechanical Energy and Converting into Electricity,” China Patent: ZL201210260906.8, 2014.

Honors&Awards

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| • ASME 2020 Energy Harvesting Best Paper Award | Sep. 2021 |
| • Faculty Outstanding PhD Thesis Award 2020 (<i>The only awardee of Faculty of Engineering, CUHK</i>) | Jun. 2021 |
| • Second Class Award, Guangdong Province Science and Technology Progress Award | Mar. 2021 |
| • Gold Medal, The 48 th International Exhibition of Inventions of Geneva | Mar. 2021 |
| • Best Student Poster Award, The 2 nd International Conference on Vibration and Energy Harvesting Applications | Jul. 2019 |
| • First Runner-Up, Professor Charles K.Kao Student Creativity Awards | May 2019 |
| • National Scholarship for Graduate Student | Dec. 2015 |
| • National Scholarship for Graduate Student | Dec. 2014 |