SONGFAN LI

Hong Kong SAR, China
lisongfan@ust.hk

Postdoctoral Fellow
The Hong Kong University of Science and Technology (HKUST)

ABOUT ME

I am currently a postdoctoral fellow in the Department of Computer Science and Engineering (CSE) at HKUST, under the supervision of Prof. Mo Li. I am fortunate to receive guidance from Prof. Mo Li both at HKUST and previously at NTU, Singapore (as a research fellow from July 2023 to October 2023 and as a visiting student from May 2021 to September 2022). I obtained my Ph.D. in 2022 from the University of Electronic Science and Technology of China (UESTC), where I had the privilege of being supervised by Prof. Li Lu.

RESEARCH INTERESTS

My research interests include ultra-low power enabling techniques such as backscatter communication and reflective smart surfaces for Internet of things (IoT) and smart cities.

WORKING EXPERIENCE

Postdoctoral Fellow - HKUST, Hong Kong, China — 11/2023 – Current
Research Fellow - NTU, Singapore — 07/2023 – 10/2023

EDUCATION

Ph.D. Computer Science - UESTC, China — 09/2017 – 12/2022
Visiting Ph.D. student - NTU, Singapore — 06/2021 – 09/2022
M.S. Computer Science - UESTC, China — 09/2015 – 06/2017
B.S. Software Engineering - Longyan University, China — 09/2011 – 06/2015

TEACHING EXPERIENCE

Course G0805720.02: Computer systems and networking technology — Teaching Assistant, UESTC, 2018 – 2019

ACADEMIC SERVICE

Reviewer
- IEEE Transactions on Mobile Computing (TMC)
- IEEE/ACM Transactions on Networking (TON)
- IEEE Transactions on Wireless Communications (TWC)
- ACM Transactions on Sensor Networks (TOSN)
- ACM IMWUT/Ubicomp 2020
- IEEE International Conference on Parallel and Distributed Systems (ICPADS 2018)
- IEEE International Conference on Computer Communications and Networks (ICCCN 2018)

HONORS & AWARDS

- Doctoral Dissertation Award, ACM SigMobile China, 2023
- Outstanding Doctoral Graduates of Sichuan Province, Sichuan Provincial Department of Education, 2022
- Academic Rookie in UESTC, conferred by UESTC, 2021
- The Best Presentation Award in the Outstanding Ph.D. Student Forum, CCF Annual Conference on Distributed and Parallel Computing Symposium (DPCS), 2020
- Service Award, the Organizing Committee of the ACM TURC, 2019
- Outstanding Student in 2018, conferred by SCSE, UESTC, 2019
- Service Award, the Organizing Committee of the ACM TURC, 2018
- Third Class Award for Science and Technology Progress, conferred by the State Grid of China, No. 7, Jan 2016
- The Best Presentation Award, 10th ACM International Workshop on IoT and Cloud Computing, Wuxi, China, 2015

PUBLICATIONS

Conference papers:

1. [**MobiSys 2024**] Yanbo Zhang, Panrong Tong, **Songfan Li**, Yaxiong Xie and Mo Li. Face Recognition In Harsh Conditions: An Acoustic Based Approach. In Proceedings of the 22nd ACM International Conference on Mobile Systems, Applications, and Services (MobiSys'24). Association for Computing Machinery, Tokyo, Japan.

2. [**Mobicom 2023**] **Songfan Li**, Qianhe Meng, YanXu Bai, Chong Zhang, Yihang Song, Shengyu Li, Li Lu. Go Beyond RFID: Rethinking the Design of RFID Sensor Tags for Versatile Applications. In Proceedings of the 29th Annual International Conference on Mobile Computing and Networking (MobiCom '23). Association for Computing Machinery, Madrid, Spain.

3. [**ASPLOS 2023**] Chong Zhang, **Songfan Li**, Yihang Song, Qianhe Meng, Minghua Chen, YanXu Bai, Li Lu, Hongzi Zhu. 2023. LEGO: Empowering Chip-level Functionality Plug-and-play for Next-generation IoT devices. Accepted to appear in the 28th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2023).

4. [**NSDI 2022**] **Songfan Li**, Hui Zheng, Chong Zhang, Yihang Song, Shen Yang, Minghua Chen, Li Lu, Mo Li. Passive DSSS: Empowering the Downlink Communication for Backscatter Systems. In 19th USENIX Symposium on Networked Systems Design and Implementation (NSDI '2022) (pp. 913-928).

5. [**Mobicom 2020**] **Songfan Li**, Chong Zhang, Yihang Song, Hui Zheng, Lu Liu, Li Lu, and Mo Li. Internet-of-Microchips: Direct Radio-to-Bus Communication with SPI Backscatter. In Proceedings of the 26th Annual International Conference on Mobile Computing and Networking (Mobicom '2020). Association for Computing Machinery, New York, NY, USA, Article 25, 1–14. DOI:https://doi.org/10.1145/3372224.3419182

6. [**RFID 2016**] Die Wu, Muhammad Jawad Hussain, **Songfan Li**, Li Lu, "R^2: Over-the-Air Reprogramming on Computational RFIDs", IEEE International Conference on RFID (RFID), Orlando, FL, 2016, pp. 1-8. doi: 10.1109/RFID.2016.7488004.

Journal papers:

1. [**TC 2023**] Chong Zhang, **Songfan Li**, Yihang Song, Qianhe Meng, Li Lu, Hongzi Zhu, Xin Wang. A Lightweight and Chip-Level Reconfigurable Architecture for Next-Generation IoT End Devices. 2023. Accepted to appear in IEEE Transactions on Computers (TC).

2. [**TDSC 2023**] Shengyu Li, **Songfan Li**, Qingqing Liu, Yihang Song, Chong Zhang, and Li Lu. Watch out Your Thumb Drive: Covert Data Theft from Portable Data Storage via Backscatter. Accepted to appear on IEEE Transactions on Dependable and Secure Computing, 2023.

3. [**TMC 2023**] **Songfan Li**, Shengyu Li, Minghua Chen, Chao Song, Li Lu. Frequency Scaling Meets Intermittency: Optimizing Task Rate for RFID-Scale Computing Devices. Accepted to appear on IEEE Transactions on Mobile Computing, 2023. DOI: 10.1109/TMC.2023.3239515

4. [**TOSN 2022**] Yihang Song, Chao Song, Li Lu, Shen Yang, **Songfan Li**, Chong Zhang, Qianhe Meng, Xiandong Shao, Haili Wang. ChipNet: Enabling Large-scale Backscatter Network with Processor-free Devices. ACM Transactions on Sensor Networks. 18, 4, Article 61 (November 2022), 26 pages. https://doi.org/10.1145/3544492

5. [**IoTJ 2019**] **Songfan Li**, Li Lu, Muhammad Jawad Hussain, Yalan Ye and Hongzi Zhu, Sentinel: Breaking the Bottleneck of Energy Utilization Efficiency in RF-Powered Devices, IEEE Internet of Things Journal, vol. 6, no. 1, pp. 705-717, Feb. 2019. doi: 10.1109/JIOT.2018.2854374

6. [**TECS 2017**] Die Wu, Li Lu, Muhammad Jawad Hussain, **Songfan Li**, Mo Li, and Fengli Zhang. 2017. R^3: Reliable Over-the-Air Reprogramming on Computational RFIDs. ACM Transactions on Embedded Computing Systems (TECS). 17, 1, Article 9 (September 2017), 25 pages. DOI: https://doi.org/10.1145/3070720

RESEARCH PROJECTS

06/2021 – Present **Reconfigurable Intelligent Surfaces (RIS) for Low Power Wide Area Network (LPWAN) in Urban Settings**

Practical deployment of low-power wide-area networks (LPWAN) in urban settings meets a fundamental challenge. Dense obstacles like large buildings block signal propagation and result in a number of blind spots where the end nodes hardly reach the gateway. This project addressed such a problem in an essential way by letting signal propagation bypass obstacles. To this end, I designed an RIS to eliminate the blind spots and enhance overall communication of urban LoRaWAN. The RIS is prototyped with a planar antenna array of 16 antennas. The experimental results suggest high performance gains from the proposed design in practice.

08/2020 – 06/2021 **Empowering the Downlink Communication for Backscatter Systems**

This project addressed a functamental problem in backscatter communication systems. The uplink and downlink transmissions are highly asymmetric, in which the downlink transmission often suffers from its short range and vulnerability to interference, and thus limits the practical application and deployment of backscatter communication systems. In this project, I proposed passive DSSS to improve the downlink communication for practical backscatter systems. Passive DSSS is able to increase the downlink signal-to-interference-plus-noise ratio (SINR) by using direct sequence spread-spectrum (DSSS) techniques to suppress interference and noise. The experimental results show that passive DSSS improves the downlink SINR by 16.5 dB, which translates to a longer effective downlink range for backscatter communication systems.

01/2019 – 08/2020 **Processor-free Architecture for Internet-of-Things (IoT) end devices**

Energy consumption of IoT end devices is a major constraint that limits their long-term and large-scale deployment. Conventionally, the radios and processors used in these end devices are major power consumption that drains at the level of milliwatts (mWs). However, in recent decades, backscatter communication has dramatically reduced the power consumed by the radios in end devices to microwatts (μWs), and thus the processor remains the major bottleneck for energy optimization. This project proposed a processor-free architecture that allows the radio to interface directly with peripheral sensor chips for control and data collection, thereby separating the processors from the end device design to significantly reduce the energy consumed by end devices. I implemented the processor-free architecture in proof-of-concept prototypes and demonstrate that the power consumption decreases by 4.5 times compared with the conventional end device design.

09/2015 – 12/2018 **Towards Energy Efficiency of Computational RFID (CRFID) Tags**

This project systematically investigated the issue of energy inefficiency on CRFID tags. I designed and implemented a low power energy sensing scheme to improve 30.2% of the energy efficiency in RF-powered systems. In addition, I also assisted with my lab mates to build the over-the-air reprogramming scheme for CRFID tags. This project is supported by the National Natural Science Foundation of China under Grant 61472068.