Libo **Wu**

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Education

Texas A&M University *College Station, TX, USA*

Ph.D. Candidate in Mechanical Engineering (Transfer Student), GPA: 4.0/4.0 *Aug. 2018 - May. 2021*

Stony Brook University *Stony Brook, NY, USA*

Ph.D. Candidate in Electrical and Computer Engineering, GPA: 3.9/4.0 *Aug. 2015 - Jul. 2018*

University of Science and Technology of China *Hefei, Anhui, China*

B.S. in Applied Physics, GPA: 3.71/4.3 *Aug. 2011 - Jun. 2015*

Skills

Software Embedded C , Python, Matlab, Assembler, LaTeX, C++, Java

Skills Linux System, ARM Cortex-M Microcontroller Driver Development, Microcontroller Interfaces (ADC, GPIO, I2C, SPI, UART), Version Control (Git), Automated Test Frameworks, Firmware Security, Low Power Embedded Software Development, Bootloader, VLSI Design, Digital Signal Processing, Data Structures & Algorithms, Machine Learning and Frameworks (TensorFlow, Keras), Electrical Schematic Design (OrCAD, Altium, Eagle), Wireless Communication (BLE, RF, Zigbee), Sensors (Infrared, Optical, Camera)

Work Experience

Embedded Software Engineer Intern *Marlborough, MA*

Marvell Semiconductor Inc. *Jun. 2020 - Aug. 2020*

- Integrated an automated test framework, RobotFramework, to test the behavior of a tool developed by the team.
- Designed over 100 and implement over 40 test cases that cover the functionality test, multi-threading test, performance test, and memory test.
- Wrote helper scripts to assist test automation. Wrote automated test scripts to generate reports.
- Implemented the structures and APIs for a secured communication protocol between a server and an SoC.

Research Experience

SLEEPIR Sensor Network for Human Presence Detection in Residential Buildings *College Station, TX, USA*

Research Assistant, Advisor: Dr. Ya Wang *Dec. 2019 - May. 2021*

- Built a wireless sensor network. Each end device contains multiple sensors, including SLEEPIR presence sensor, motion sensors and temperature/humidity sensor.
- Implemented a hub that receives report from end devices and controls smart thermostats via a cloud service.
- Built the thermal transfer model of indoor environment and found relationship between the signals of sensors to environmental conditions.

Liquid Crystal Optical Shutter on Passive Infrared Sensor for True Presence Detection *College Station, TX, USA*

Research Assistant, Advisor: Dr. Ya Wang *Aug. 2018 - May. 2021*

- Solved the common issue that all commercial motions sensors (PIR sensors) could not detect stationary occupants.
- Created a liquid crystal (LC) infrared shutter that can modulate long-wave infrared radiation with low driving voltage and ultra low power consumption ($< 0.1\mu$A).
- Manufactured Polymer Dispersed Liquid Crystal (PDLC) infrared shutter with high contrast ratio.
- Developed a synchronized low-energy electronically-chopped PIR sensor for true presence detection by applying the created LC shutter to a PIR sensor and being packaged in an extremely low power embedded system ($\sim 20\mu$W).
- Designed realistic protocols for experiments which cover most regular daily actions and activities.
- Extracted statistical features and ran machine learning algorithms (NN, SVM, Random Forest, etc.) for presence detection.
- Reached 99.9% accuracy for true presence detection and over 97.7% accuracy for realistic, long-term test.

Compressive Sensing for Human Localization Using Single Thermopile Pixel Sensor
RESEARCH ASSISTANT, ADVISOR: DR. YA WANG

College Station, TX, USA
Aug. 2018 - Mar. 2019

- Designed a random binary mask to compress the radiation within the field of view (FOV).
- Integrated one thermopile sensor and rotating optical mask to acquire compressive infrared signals from human.
- Built a physical model that shows the linear relationship among the output signal of sensor, the rotating mask and radiation distributions. Found the relationship could be solved by compressive sensing theory.
- Reconstructed spatial radiation distributions using basis pursuit denoising algorithm to recover localization information.
- Reached over 90% accuracy for localization of indoor the human object with a very low cost (less than $10).

Co-Mentor of Senior Design Project: Occupant-centered Light and HVAC Control Using Machine Learning for Human Comfort and Energy Efficiency
RESEARCH ASSISTANT

College Station, TX, USA
Fall 2019

- Guided and managed the team to build a lighting and HVAC control system under $100 budget.
- Generated a Gantt chart to track the progress of the project. Assigned different tasks based on the skills of the team members.
- Gave guidance of selecting proper hardware (MCU, sensors, wireless communication), design concepts (mechanical and electrical), user-centered product development, and software development (reinforcement learning).

Passive Infrared Sensor for Indoor Localization and Tracking
RESEARCH ASSISTANT, ADVISOR: DR. YA WANG

Stony Brook, NY, USA
Sept. 2017 - Mar. 2018

- Used a single passive infrared (PIR) and an optical shutter embedded with micro-controller unit (MCU) in the device to analyze the occupancy status of the indoor environment, such as presence, localization, and facial direction.
- Utilized an innovative rotating optical shutter in front of the PIR sensor to modulate the infrared radiation in a nonlinear manner. Built a physical model that shows the relationship between the output signal and the mechanical shutter.
- Extracted two features from the output signals from PIR sensors (peak to peak value, and pulse width).
- Applied machine learning methods (SVM and Neural Network) to improve the performance in predicting and classifying occupancy situations that reached 98% accuracy in localization.
- Extended the functionality of PIR sensors in indoor occupancy detection with high performance, such as human tracking with 0.44 m RSME, localization with 98% accuracy and facial direction detection with 83% accuracy.

Long-term True Presence Detection Platform
RESEARCH ASSISTANT, ADVISOR: DR. YA WANG

Stony Brook, NY, USA
Jan. 2018 - Jun. 2018

- Utilized the low-power Lavet stepper motor (< 10mA) to drive a machanical optical shutter on PIR sensors for true presence detection that could detect both stationary and moving occupants.
- Built a long-term experiment platform consists of Raspberry Pi, Pi camera, Shutterd PIR sensors and MCU.
- Used computer vision algorithms (YoLo and R-CNN) on videos to extract presence information as groundtruth.
- Reached 97% accuracy for classifying occupied and unoccupied scenes from 31-hour experiment.

VLSI Course Project: VLSI Design for 8-bit Adder
INSTRUCTOR: DR. EMRE SALMAN

Stony Brook, NY, USA
Fall 2016

- Developed an 8-bit CSA adder with 45nm CMOS technology using Cadence software. The final design showed low power of 1.184 mW, low area of 1257 μm^2 , and high speed of 4.34 GHz.

Stony Brook University, Department of ECE
TEACHING ASSISTANT

Stony Brook, NY, USA
Aug. 2015 - Dec. 2017

- Embedded Microprocessor Systems Design (*Fall 2016*), Digital Systems Design (*Spring 2016*), Digital Signal Processing: Theory (*Fall 2015*)

Publications

JOURNAL PUBLICATIONS

- **Libo Wu**, Zhangjie Chen, and Ya Wang , "An Adaptive Threshold Approach for Indoor Occupancy Detection with SLEEPIR Sensor Network in Practical Environments", *will submit to IEEE Sensors Letters*, 2021.
- **Libo Wu** and Ya Wang , "Study the Characteristics of Polymer Dispersed Liquid Crystal Infrared Shutter on PIR Sensors", *will submit to IEEE Sensors Journal*, 2021.
- **Libo Wu** and Ya Wang , "True Occupancy Detection Enabled by the SLEEPIR Sensor and Machine Learning", *Accepted by IEEE Sensors Journal*, 2021.
- **Libo Wu**, Fangwang Gou, Shin-Tson Wu and Ya Wang , "SLEEPIR: Synchronized Low-Energy Electronically-Chopped PIR Sensor for True Presence Detection", *IEEE Sensors Letters*, 4(3), pp. 1-4, 2020.
- **Libo Wu**, and Ya Wang, "Compressive Sensing Based Indoor Occupancy Positioning Using A Single Thermopile Point Detector with a Coded Binary Mask", *IEEE Sensors Letters*, 3(12), pp. 1-4, 2019.
- **Libo Wu**, Ya Wang and Haili Liu, "Detection and Localization of Individuals by Monitoring Nonlinear Energy Flow of a Shutterd Passive Infrared Sensor", *IEEE Sensors Journal*, 18(21), pp. 8656-8666, 2018.

- **Libo Wu** and Ya Wang, "A Low Power Electric-Mechanical Driving Approach for True Occupancy Detection Using a Shuttered Passive Infrared Sensor", *IEEE Sensors Journal*, 19(1), pp. 47-57, 2018.

Conference Proceedings

- **Libo Wu** and Ya Wang, "True Presence Detection via Passive Infrared Sensor Network Using Liquid Crystal Infrared Shutters", *ASME SMASIS conference, 2020.*
- **Libo Wu** and Ya Wang, "Compressive Sensing Based Indoor Human Positioning Using A Single Thermopile Point Detector", *12th International Workshop on Structural Health Monitoring, September 10-12, 2019, Stanford, California, USA.*
- **Libo Wu** and Ya Wang, "Shuttered Passive Infrared Sensor for Occupancy Detection: Exploring A Low Power Electro-Mechanical Driving Approach", *ASME SMASIS conference*, 2018 (Oral presentation).

Patents

- **Libo Wu** and Ya Wang, "Shuttered Passive Infrared Sensor Apparatus with A Low Power LWIR Liquid Crystal Optical Modulator for Stationary and Moving Occupancy Detection", *U.S. Patent Application No. 62/880,058*, July 29, 2019.
- **Libo Wu** and Ya Wang, "A Single Thermopile Point Sensor Apparatus with A Set of Coding Masks (Compressive Sensing Matrix) for Indoor Human Positioning", *U.S. Patent Application No. 62/863,823*, June 19, 2019.
- **Libo Wu** and Ya Wang, "Shuttered Passive Infrared Sensor Apparatus with A Low Power Lavet Motor Driving Approach for Stationary and Moving Occupancy Detection", *U.S. Patent Application No. 62/863,808*, June 19, 2019.

Certification

Online Course Certificate Machine Learning (Cousera), Deep Learning Specialization (Cousera), Mastering RTOS: Hands on FreeRTOS (Udemy), Mastering Microcontroller with Driver Development (Udemy)

Honors & Awards

2019 **Graduate Student Travel Award,** J. Mike Walker '66 Department of Mechanical Engineering
2019 **Graduate Excellence Scholarship,** J. Mike Walker '66 Department of Mechanical Engineering
2013 **Bronze Medalist,** Outstanding Undergraduate Scholarship