Hanbin Zhang

CONTACT INFORMATION

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ABOUT ME

I love defining and addressing problems in an interdisciplinary team. I have strong problem-solving skills gained from fruitful collaboration and projects. I would love to follow the latest artificial intelligence algorithm, and I highly believe machine learning holds great promise for advancing our daily livings (e.g., health, IoTs, and autonomous vehicles). Throughout my Ph.D. career, I leverage machine learning and data engineering to address problems in healthcare, IoTs, and wireless sensing and networking. Together with my team, I publish about 20 papers (including 8 first-author papers) in top research venues, i.e., MobiCom, MobiSys, SenSys, and UbiComp.

RESEARCH INTERESTS

Digital Health, Machine Learning, Internet-of-Things, Time-series Data Analysis and Modeling, Wireless Network and Sensing, Mobile Computing, Optimization.

EDUCATION

University at Buffalo, New York

Ph.D., Computer Science & Engineering, Aug. 2016 - Present
Advisor: **Wenyao Xu**

Xidian University, Xi'an, China

M.S., Wireless Communication and Networking, Sep. 2013 - May. 2016

Xidian University, Xi'an, China

B.S., Electrical Engineering, Aug. 2009 - Jul. 2013

INTERNSHIP

Research Intern in Wyze AI Lab, Kirkland, WA May 2021 - Aug. 2021
Open-set Audio Recognition in Home Environment

- Implemented baseline algorithms, i.e., Softmax and OpenMax, for open-set audio recognition
- Implemented and tested Self-supervision, WGAN, Learning Placeholders, Prototype Learning on publicly available datasets (e.g., Audioset and ESC-50) and Wyze in-house dataset
- Improved the Wyze in-house audio recognition accuracy by 16.9% and F1 score by 49.4%

Research Intern in Samsung Research America, Mountain View, CA Jan. 2021 - Apr. 2021
Energy-Efficient AF (atrial fibrillation) Detection in An Ambulatory Free-living Environment

- Identified that the time interval between every two AF episodes may obey to the negative exponential distribution and occurrences of AF episodes obey to the Possion distribution
- Designed and implemented a dynamic down-sampling strategy improving the energy efficiency by 77.5%.
- Published results as a first-author paper in **BSN'21**

Research Intern in Samsung Research America, Mountain View, CA Jun. 2020 - Aug. 2020
AF Detection in An Ambulatory Free-living Environment

- Implemented a baseline algorithm, logistic regression, for AF detection
- Designed and implemented a 1D CNN for AF detection, achieving ∼10% higher accuracy than baseline model and is robust to motion artifacts
- Published results as a first-author paper in **UbiComp'21**

JOURNAL PUBLICATIONS

J6 [**TMC'21**] Li, Huining; Xu, Chenhan; Rathore, Aditya Singh; Li, Zhengxiong; **Zhang, Hanbin**; Song, Chen; Wang, Kun; Su, Lu; Lin, Feng; Ren, Kui; Xu, Wenyao, "VocalPrint: A mmWave-based Unmediated Vocal Sensing System for Secure Authentication", in IEEE Transactions on Mobile Computing

J5 [**JMIR'20**] Yu-Ping Chang, Yanjun, Zhou, **Hanbin Zhang**, "The Health Outcomes of VR-enhanced Intervention Among Individuals with Cognitive Impairment: A Systematic Review", in Journal of Medical Internet Research May 2020 (**Under Reviewing**)

J4 [**JCSM'20**] Rebecca A. Lorenz, **Hanbin Zhang**, Wenyao Xu, Yu-Ping Chang, "The Relationship between Skin Temperature and Objectively-Measured Sleep among Adults with Multiple Sclerosis (MS): A Pilot Study", in Journal of Clinical Sleep Medicine May 2020 (**Under Reviewing**)

J3 [**RBME'20**] **Hanbin Zhang**, Chen Song, Aditya Singh Rathore, Ming-Chun Huang, Yuan Zhang, Wenyao Xu "mHealth Technologies towards Parkinson's DiseaseDetection in Daily Life: A Comprehensive Reviewfrom", in Reviews in Biomedical Engineering May 2020

J2 [**IMWUT'19**] **Hanbin Zhang**, Chenhan Xu, Huining Li, Aditya Singh Rathore, Chen Song, Zhisheng Yan, Dongmei Li, Feng Lin, Kun Wang, Wenyao Xu "PDMove: Towards Passive Medication Adherence Monitoring of Parkinson's disease Using Smartphone-based Gait Assessment", Sep. 2019

J1 [**JAMDA'19**] **Hanbin Zhang**, Wenyao Xu, Yu-ping Chang "Correlates, Precedence, and Tendency of Functional Decline inPeople with Dementia: A Nationwide Longitudinal Study", in Journal of the American Medical Directors Association Nov. 2019 (**Under Reviewing**)

Conference Publications

C15 [**BSN'21**] **Hanbin Zhang**, Li Zhu, Viswam Nathan, Jilong Kuang, Jocab Kim, Alex Gao "Better Battery Life: Towards Energy-Efficient Smartwatch-based Atrial Fibrillation Detection in Ambulatory Free-living Environment"

C14 [**UbiComp'21**] **Hanbin Zhang**, Li Zhu, Viswam Nathan, Jilong Kuang, Jocab Kim, Alex Gao, Jeffrey Olgin "Towards Early Detection and Burden Estimation of Atrial Fibrillation in Ambulatory Free-living Environment" in ACM UbiComp, Jun. 2021

C13 [**UbiComp'21**] Chenhan Xu, Huining Li, Zhengxiong Li, **Hanbin Zhang**, Aditya Singh Rathore, Xingyu Chen, Kun Wang, Wenyao Xu "CardiacWave: A mmWave-based Scheme of Non-Contact and High-Definition Heart Activity Computing"

C12 Unveiling the Symptoms Complexity of Multiple Sclerosis using Wearable Computing (**Under Reviewing**)

C11 InertiaOptics: Towards Effort-free Wearable Computing (**Under Reviewing**)

C10 [**SenSys'20**] Huining Li, Chenhan Xu, Aditya Singh Rathore, Zhengxiong Li, **Hanbin Zhang**, Chen Song, Kun Wang, Lu Su, Feng Lin, Kui Ren, Wenyao Xu "VocalPrint: Exploring A Resilient and Secure Voice Authentication via mmWave Biometric Interrogation" in ACM SenSys, Nov. 2020 (Acceptance Rate: 20.7%, 44 out of 213)

C9 [**MobiCom'20**] **Hanbin Zhang**, Gabriel Guo, Chen Song, Chenhan Xu, Kevin Cheung, Jasleen Alexis, Huining Li, Dongmei Li, Kun Wang, Wenyao Xu "PDLens: Smartphone Knows Drug Effectiveness among Parkinson's via Daily-Life Activity Fusion" in ACM MobiCom, Oct. 2020 (Acceptance Rate: 16.1%, 62 out of 384)

C8 [**MobiSys'20**] **Hanbin Zhang**, Gabriel Guo, Emery Comstock, Baicheng Chen, Xingyu Chen, Chen Song, Jerry Ajay, Jeanne Langan, Sutanuka Bhattacharjya, Lora A Cavuoto, Wenyao Xu "RehabPhone: A Software-Defined Tool using 3D Printing andSmartphones for Personalized Home-based Rehabilitation" in ACM MobiSys, June 2020 (Acceptance Rate: 19.4%, 34 out of 175)

C7 [**MobiCom'19**] **Hanbin Zhang**, Chen Song, Aosen Wang, Chenhan Xu, Dongmei Li, Wenyao Xu "PDVocal: Towards Privacy-preserving Parkinson's Disease Detection Using Non-speech Body Sounds" in ACM MobiCom, Oct. 2019 (Acceptance Rate: 19.0%, 55 out of 290)

C6 [**UbiComp'19**] **Hanbin Zhang**, Chenhan Xu, Huining Li, Aditya Singh Rathore, Chen Song, Zhisheng Yan, Dongmei Li, Feng Lin, Kun Wang, Wenyao Xu "PDMove: Towards Passive

Medication Adherence Monitoring of Parkinson's disease Using Smartphone-based Gait Assessment" in ACM UbiComp , Sep. 2019

C5 [**MobiSys'19**] Chenhan Xu, Zhengxiong Li, **Hanbin Zhang**, Aditya Singh Rathore, Huining Li, Chen Song, Wenyao Xu "WaveEar: Exploring a mmWave-based Noise-resistant Speech Sensing for Voice-User Interface" in ACM MobiSys , June 2019 (Acceptance Rate: 23.2%, 40 out of 172)

C4 [**NINR'19**] Rebecca A. Lorenz, **Hanbin Zhang**, Wenyao Xu, Yu-Ping Chang "Daily Diary and Ambulatory Activity Monitoring of Sleep in Patients with Multiple Sclerosis: An Investigation into Causal Hypotheses of Overheating-Revoked Awakenings" in National Institute for Nursing Researchers, June 2019

C3 [**CANS'19**] Rebecca A. Lorenz, **Hanbin Zhang**, Wenyao Xu, Yu-Ping Chang "The Relationship between Body Temperature during and Objectively-Measured Sleep among Adults with Multiple Sclerosis: the First Study" in the Council for the Advancement of Nursing Science, June 2019

C2 [**BHI'18**] **Hanbin Zhang**, Aosen Wang, Dongmei Li, Wenyao Xu "DeepVoice: A Voiceprint-based Parkinsons' Disease Identification Application for Mobile Health" in IEEE Conference on Biomedical and Health Informatics (**BHI'18**), Las Vegas, Nevada, March 2018

C1 [**INFOCOM'18 WORKSHOPS**] Sihua Shao, **Hanbin Zhang**, Dimitrios Koutsonikolas, Abdallah Khreishah "Two-dimensional Reduction of Beam Training Overhead in Crowded 802.11ad based Networks" in Millimeter-Wave Networked Systems, Honolulu, HI, May 16, 2018

Abstract/Poster Papers

A1 [**SenSys'19**] Gabriel Guo, Joshua Segal, **Hanbin Zhang**, Wenyao Xu, "Demo Abstract: AR-Move: A Smartphone Augmented Reality Exergaming System for Upper and Lower Extremities Stroke Rehabilitation" in ACM International Conference on Sensor Networked Systems (SenSys'19), New York City, New York, USA, November 2019

Projects

- 2020 - present: **Smartwatch-based Atrial fibrillation detection and management**
  - Interned at SRA and collaborated with UCSF medical centers to collect data from 205 subjects
  - Designed and implemented a baseline model (logistic regression) and STOA model (1D CNN) for AF detection in ambulatory free-living environment
  - Improved the energy-efficient by 77.5%
  - **Skills: Time-series data analysis and modeling, Deep Learning, Optimization, Python, PyTorch**
  - **Achievements: Published results in top research venues (UbiComp × 1, BSN × 1)**
- 2020 - present: Smart health technologies towards physical and cognitive rehabilitation
  - Led the collaboration with with UB rehabilitation team to collect data from 20+ subjects using smartphones.
  - Designed and implemented a software-defined rehabilitation tool using 3D Printing and smartphones for personalized in-house rehabilitation
  - **Skills: Database and Time-series data analysis**
  - **Achievements: Published results in top research venues (MobiSys × 1)**
- 2017 - 2020: **Smart health technologies towards Parkinson's disease management**
  - Collaborated with UR Medicine to collect data from 890+ subjects using smartphones.

  - Designed and implemented smartphone-based systems for PD detection, PD drug intake detection, and PD medication effectiveness detection.
  - **Skills: Time-series data analysis and modeling, Deep Learning, Python, PyTorch**
  - **Achievements: Published results in top research venues (MobiCom × 2, UbiComp × 1, BHI × 1)**
- 2016 - 2017: Monitoring human subjects' breathing and heartbeat rate using mmWave wireless signal
  - Established the mmWave platform; enrolled and collected data from 10+ subjects
  - Investigated the impact of locations, distances, and angles of mmWave RF devices on the prediction of breathing and heartbeat rate
  - **Skills: USRP N210 FPGA, Programming C, MATLAB**
- 2016 - 2017: Beam sweeping strategy for indoor mmWave Networks (802.11ad)
  - Designed and simulated a compressed sensing-based model for beam searching and sweeping
  - Designed a two-dimensional protocol for fast beam searching and reduced the time complexity from O(n^2) to O(n).
  - **Skills: Optimization, LabVIEW, MATLAB**
  - **Achievements: Published the results in INFOCOM WORKSHOPS**
- 2015 - 2016: Techniques, standardization, and prototype development in the next generation of WLAN (802.11 ax)
  - Simulated and emulated the network capacity in ultra-dense environments
  - **Skills: MATLAB, WARPv3, FPGA, Verilog programming, OFDM, C/C++**
- 2013 - 2016: Interference and capacity management in 5G heterogeneous wireless network
  - Implemented channel coding and decoding algorithm with Verilog on Xilinx FPGA
  - Implemented MU-MIMO coding and decoding algorithm with Verilog on Xilinx FPGA
  - Simulated and emulated the Interference Alignment (IA) algorithm on six (three senders and three receivers) Xilinx Virtex-6 FPGAs
  - **Skills: Optimization, MATLAB, FPGA, Verilog programming, OFDM, MIMO**
- 2010 - 2011: A Simple digital signal transmission performance analyzer
  - Designed and implement the circuit, controlling program, and signal generator
  - **Skills: Circuit design and implementation, FPGA, Verilog programming, Microcontroller programming, C programming**
  - **Achievements: The 3rd Prize in National (China) Undergraduate Electronic Design Competition, 2011**
- 2010 - 2011: A smart irrigation system
  - Designed and implemented the circuit, and the program for master and slave
  - **Skills: Circuit design and implementation, Microcontroller programming, C programming, Visual Basic**
  - **Achievements: The 2nd Prize in campus Electronic Design Competition, 2010**
- 2009 - 2010: An Arbitrary Waveform Generator Using Direct Digital Synthesis Techniques
  - Designed and implemented the circuit and controlling program
  - **Skills: Circuit design and implementation, Microcontroller programming, C programming**
  - **Achievements: The 1st Prize in campus Electronic Design Competition, 2009**

Awards and Honors

A7. Best Graduate Research Award, Computer Science & Engineering, University at Buffalo (top 1%), 2019

A6. Student Travel Award, The Annual International Conference on Mobile Computing and Networking (MobiCom), 2019

A5. The Second Prize in National (China) Graduate Electronic Design Competition, 2014

A4. The Third Prize in National (China) Undergraduate Electronic Design Competition, 2011

A3. The Third Prize in Texas Instruments (TI) Undergraduate Electronic Design Competition, 2011

A2. The Second Prize in Xidian University Electronic Design Competition, 2011

A1. The First Prize in Xidian University Electronic Design Competition, 2010

Services

Conference Reviewer:

- IEEE/ACM Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE), 2019
- IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI), 2019, 2021
- IEEE International Conference on Computer Communications (INFOCOM), 2019, 2020

Journal Reviewer:

- IEEE Internet of Things Journal, 2021
- IEEE Transactions on Mobile Computing, 2020, 2021
- International Journal of Wireless Information Networks, 2018

Skills

Python, C/C++, Matlab, SAS, SPSS, Machine Learning, Deep Learning, PyTorch, TensorFlow, Smart Health, Mobile Health, Public Health, Large-scale Data Analysis, Wireless Technology, Mobile Computing, Virtual Reality, 5G, Hardware, FPGA, Digital Signal Processing, Voice Signal Processing, Image Processing and Computer Vision.

Teaching Assistant

- CSE521: *Operating Systems*, Fall 2019/2020
- CSE586: *Distributed Systems*, Spring 2019
- CSE589: *Modern Network Concepts*, Fall 2018
- CSE341: *Computer Organization*, Fall 2017

Medical Collaborator

Jeffrey E. Olgin, MD	UCSF Heart and Vascular Center
Dongmei Li, PhD	University of Rochester Medical Center
Yu-Ping Chang, PhD, RN, FGSA, FAAN, FIAAN	School of Nursing, University at Buffalo
Rebecca Lorenz, PhD, RN	School of Nursing, University at Buffalo
Jeanne Langa, PT, PhD	Department of Rehabilitation Science, University at Buffalo
Sutanuka Bhattacharjya, PhD	Department of Rehabilitation Science, University at Buffalo