SHIJIA PAN

CONTACT INFORMATION	Carnegie Mellon University 5000 Forbes Avenue, Pittsburgh PA, 15213, USA	*Voice:* (412)354-1876 *E-mail:* shijiapan@cmu.edu *Homepage:* andrew.cmu.edu/user/shijiapa

AREAS OF INTERESTS

Cyber-Physical Systems; Internet-of-Things (IoT); Ubiquitous computing; Indoor positioning systems; Vibration/acoustic signal processing; Multimodal signal processing for mobile applications

EDUCATION

Carnegie Mellon University, Moffett Field, CA, 94043, USA

Ph.D. Electronic and Computer Engineering **August, 2012 - May, 2018**
- Advisor: Professor Pei Zhang (ECE), Professor Hae Young Noh (CEE)
- Thesis title: Indoor human information acquisition from physical vibrations.

University of Science and Technology of China, Hefei, Anhui P.R.China

B.Eng Computer Science **September, 2007 - July, 2012**
- Exchange scholar at CMU in 2011

CURRENT POSITIONS

Carnegie Mellon University, Pittsburgh, PA, USA **June, 2018 - present**
Postdoctoral Research Associate
Joint appointment: Electrical and Computer Engineering and Civil and Environmental Engineering

Intelligent Fabric LLC, Pleasanton, CA, USA **June, 2018 - present**
Research Advisor

HONORS AND AWARDS

N2Women Young Researcher Fellowship	**2018**
Rising Stars in EECS	**2018**
NSF CPS Week 2018 Student Travel Grant	**2018**
HotMobile 2018 Student Travel Grant	**2018**
BuildSys 2017 Audience Choice Award	**2017**
SenSys 2017 Doctoral Colloquium Best Presentation Award	**2017**
SenSys 2017 Student Travel Grant	**2017**
SenSys 2016 Best Poster Award	**2016**
NSF CPS Week 2015 Student Travel Grant	**2015**
CPS Week 2015 Best Poster Award	**2015**
HotMobile 2015 Student Travel Grant	**2015**
Nick G. Vlahakis Graduate Fellowship	**2013**
SenSys Student Travel Grant	**2012**
N2Women Student Fellowship	**2012**
Excellent Undergraduate Thesis Award at USTC	**2012**
Excellent Undergraduate Research Program Award at USTC	**2012**
UbiComp 2011 Best Demo Award	**2011**
Google Anita Borg Scholarship (China)	**2011**
Outstanding Student Scholarship Silver at USTC	**2010**
Outstanding Student Scholarship Gold at USTC	**2009**
Outstanding Student Scholarship Bronze at USTC	**2008**

MAJOR RESEARCH PROJECTS

Indoor Human Information Acquisition from Physical Vibration **2013-present**
Carnegie Mellon University
Advisor: Professor Pei Zhang, Professor Hae Young Noh
My role: initiating and leading the project

A smart building's ability to gather information about its occupants (number, location, identity, etc.) is essential to the new generation of smart building applications, such as energy management, space management, etc. Our system utilizes measurements of structural vibrations to sense indoor pedestrian information. A number of challenges appear when exploring human-induced structural vibration, and I focus on **combining physical and data-driven knowledge** to guide sensing and learning. To be more specific, I explore the following aspects:

- **Sensing System** Obtaining high fidelity vibration signals for human information learning is challenging due to the rapid change of human footstep locations. Utilizing the model of human movement in a space to predict the optimal hardware setting for human vibration sensing allows us to obtain high resolution and low distortion human-induced vibration signals.

- **Signal Characterization** Humans interact with structures in various ways which may induce different types of waves (e.g., impact, friction). Understanding the wave properties allows us to extract the signal characteristics accurately.

- **Information Learning/Inferring** Human-centric sensing and learning face a challenge in getting labeled data for different sensing conditions. However, the data distribution change is correlated with physical phenomena that can be measured. Utilizing transfer learning iteratively guided by these physical measurements allows high prediction accuracy through each iteration while covering a large range of data distribution changes.

Headio: Multimodal Context Sensing for Heading Acquisition   2012-2013
Carnegie Mellon University
Advisor: Professor Pei Zhang, and Dr. Zheng Sun
Headio is an orientation acquisition system for smart devices equipped with cameras. It solves the problem of high orientation reading error caused by the complexity of the indoor magnetic interference. To achieve this, the system utilizes image processing algorithms that combine acceleration sensing data and image data to extract ceiling patterns even when the phone is in a tilted position. Then based on the ceiling pattern, the system obtains the accurate orientation information for various applications. My role in this project is to assist on the algorithm design as well as system implementation.

SensorFly: Indoor Navigation on Micro UAV Platforms   2010-2013
Carnegie Mellon University
Advisor: Professor Pei Zhang, and Dr. Aveek Purohit
SensorFly is a low cost micro unmanned aerial vehicle platform that autonomously navigates and senses indoor environments with various sensors on board. It is designed to be able to swarm and communicate with other units during tasks. It can be used in emergency situations such as fire and earthquake for seeking survivors and navigation assistance. SugarTrail is an indoor navigation system that is built on the SensorFly platform. It uses integrated signatures consisting of distance information from round-trip time of flights of RF signals and compass readings to achieve indoor mapping and navigation. My role in this project is to assist on the system and algorithm design, experiment design and implementation.

PANDAA: Networked Devices Localization through Ambient-Sound   2010-2011
Carnegie Mellon University
Advisor: Professor Pei Zhang, and Dr. Zheng Sun
PANDAA is an indoor positioning system that utilizes ambient acoustic sensing data to determine devices' relative locations. The system is readily applicable for commercial off-the-shelf mobile devices. It achieves a considerable accuracy of 17cm in terms of localization. My role in this project is to assist on the algorithm design and experimentation for evaluation.

PEER REVIEWED
PUBLICATION

[29] Ji Jia, Chengtian Xu, **Shijia Pan**, Stephen Xia, Peter Wei, Hae Young Noh, Pei Zhang, and Xiaofan Jiang. Conductive Thread-Based Textile Sensor for Continuous Perspiration Level

Monitoring. Sensors, 18(11), 3775.
Impact factor 2.475.

[28] Ji Jia, Chengtian Xu, **Shijia Pan**, Stephen Xia, Peter Wei, Hae Young Noh, Pei Zhang, and Xiaofan Jiang. Moisture Based Perspiration Level Estimation. Ubicomp Workshop CPD 2018.

[27] Xinlei Chen, Xiangxiang Xu, Xinyu Liu, **Shijia Pan**, Jiayou He, Hae Young Noh, Lin Zhang, Pei Zhang. PGA: Physics Guided and Adaptive Approach for Mobile Fine-Grained Air Pollution Estimation. Ubicomp Workshop CPD 2018.

[26] **Shijia Pan**, Mostafa Mirshekari, Jonathon Fagert, Carlos Ruiz, Hae Young Noh, and Pei Zhang. Area Occupancy Counting through Sparse Ambient Structural Vibration Sensing. IEEE Pervasive Computing Special Issue - IoT Communication.

[25] Carlos Ruiz, **Shijia Pan**, Adeola Bannis, Xinlei Chen, Carlee Joe-Wong, Hae Young Noh, Pei Zhang. IDrone: Robust Drone Identification through Motion Actuation Feedback. In Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT) 2018.

[24] Jun Han, **Shijia Pan**, Manal Kumar Sinha, Hae Young Noh, Pei Zhang and Patrick Tague. Smart Home Occupant Identification via Sensor Fusion Across On-Object Devices. Fast-tracked at ACM Transactions on Sensor Networks (TOSN) - Special Issue on Systems for Smart and Efficient Built Environments, 2018.

[23] Mostafa Mirshekari, **Shijia Pan**, Jonathon Fagert, Eve Schooler, Pei Zhang and Hae Young Noh. Occupant Localization using Footstep-Induced Structural Vibration. Mechanical Systems and Signal Processing 112 (2018): 77-97.
Impact factor 3.99.

[22] Jun Han, Albert Chung, Manal Kumar Sinha, Madhumitha Harishankar, **Shijia Pan**, Hae Young Noh, Pei Zhang, and Patrick Tague. Do You Feel What I Hear? Enabling Autonomous IoT Device Pairing using Different Sensor Types. In the Proceedings of the IEEE Symposium on Security & Privacy, May 2018.
Acceptance rate = 11.5%

[21] **Shijia Pan**, Carlos Ruiz, Jun Han, Adeola Bannis, Patrick Tague, Hae Young Noh and Pei Zhang. UniverSense: IoT Device Pairing through Heterogeneous Sensing Signals. In Proceedings of the 16th International Workshop on Mobile Computing Systems and Applications. ACM, 2018.
Acceptance rate = 29.2%

[20] Amelie Bonde, **Shijia Pan**, Zhenhua Jia, Yanyong Zhang, Hae Young Noh and Pei Zhang. VRRM: Vehicular Vibration-based Heart RR-Interval Monitoring System. In Proceedings of the 16th International Workshop on Mobile Computing Systems and Applications, ACM, 2018.
Acceptance rate = 29.2%

[19] Tong Yu[*], **Shijia Pan**[*], Susu Xu Mostafa Mishakeri, Jonathon Fagert, Xinlei Chen, Haeyoung Noh, Pei Zhang and Ole J. Mengshoel. ILPC: Iterative Learning using Physical Constraints in Real-world Sensing Data. Accepted by AAAI Workshop SmartIoT 2018.
[*]equal contribution among authors

[18] **Shijia Pan**, Mostafa Mirshekari, Jonathon Fagert, Ceferino Gabriel Ramirez, Albert Jin Chung, Chih Chi Hu, John Paul Shen, Pei Zhang, and Hae Young Noh. "Characterizing human activity induced impulse and slip-pulse excitations through structural vibration." Journal of Sound and Vibration 414 (2018): 61-80.
Impact factor 2.593.

[17] Xinlei Chen, Aveek Purohit, **Shijia Pan**, Carlos Ruiz, Jun Han, Zheng Sun, Frank Mokaya, Patrick Tague and Pei Zhang. "Design Experiences in Minimalistic Flying Sensor Node Platform through SensorFly." Transactions on Sensor Networks (TOSN), vol. 13, no. 4 (2017).
Impact factor 2.19.

[16] Jun Han, **Shijia Pan**, Manal Kumar Sinha, Hae Young Noh, Pei Zhang and Patrick Tague. SenseTribute: Smart Home Occupant Identification via Fusion Across On-Object Sensing Devices. In Proceedings of the 4th ACM International Conference on Systems for Energy-Efficient Built Environments (BuildSys 2017).
Acceptance rate = 31.3%, Audience's Choice Award

[15] **Shijia Pan**, Tong Yu, Mostafa Mirshekari, Jonathon Fagert, Amelie Bonde, Ole J. Mengshoel, Hae Young Noh, and Pei Zhang. "FootprintID: Indoor Pedestrian Identification through Ambient Structural Vibration Sensing." In Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT) 1, no. 3 (2017): 89.

[14] Jonathon Fagert, Mostafa Mirshekari, **Shijia Pan**, Pei Zhang, and Hae Young Noh. "Monitoring Hand-Washing Practices using Structural Vibrations." In Proceedings of the 11th International Workshop on Structural Health Monitoring, Stanford University, Stanford, CA, USA, September 2017.

[13] **Shijia Pan**, Ceferino Gabriel Ramirez, Mostafa Mirshekari, Jonathon Fagert, Albert Jin Chung, Chih Chi Hu, John Paul Shen, Hae Young Noh, and Pei Zhang. "SurfaceVibe: vibration-based tap & swipe tracking on ubiquitous surfaces." In Proceedings of the 16th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN 2017), pp. 197-208. 2017.
Acceptance rate = 18.3%

[12] Jonathon Fagert, Mostafa Mirshekari, **Shijia Pan**, Pei Zhang, and Hae Young Noh. "Characterizing Left-Right Gait Balance Using Footstep-Induced Structural Vibrations." In SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring, pp. 1016819-1016819. International Society for Optics and Photonics, Portland, Oregon, United States, March 2017.

[11] **Shijia Pan**, Susu Xu, Mostafa Mirshekari, Pei Zhang, and Hae Young Noh. "Collaboratively Adaptive Vibration Sensing System for High Fidelity Monitoring of Structural Responses Induced by Pedestrians." Frontiers in Built Environment 3 (2017): 28.

[10] **Shijia Pan**, Mostafa Mirshekari, Pei Zhang, and Hae Young Noh. "Occupant traffic estimation through structural vibration sensing." SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring (2016): 980306-980306.

[9] Mostafa Mirshekari, **Shijia Pan**, Pei Zhang, and Hae Young Noh. "Characterizing wave propagation to improve indoor step-level person localization using floor vibration." SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring (2016): 980305-980305.

[8] Lam, Mike, Mostafa Mirshekari, **Shijia Pan**, Pei Zhang, and Hae Young Noh. "Robust occupant detection through step-induced floor vibration by incorporating structural characteristics." In Dynamics of Coupled Structures, Volume 4, pp. 357-367. Springer International Publishing, 2016.

[7] **Shijia Pan**, Ningning Wang, Yuqiu Qian, Irem Velibeyoglu, Hae Young Noh, and Pei Zhang. "Indoor person identification through footstep induced structural vibration." In Proceedings of the 16th International Workshop on Mobile Computing Systems and Applications. ACM, 2015.
Acceptance rate = 28.8%

[6] **Shijia Pan**, Amelie Bonde, Jie Jing, Lin Zhang, Pei Zhang, and Hae Young Noh. "Boes: building

occupancy estimation system using sparse ambient vibration monitoring." SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring (2014): 90611O-90611O.

[5] **Shijia Pan**, An Chen, and Pei Zhang. "Securitas: user identification through rgb-nir camera pair on mobile devices." In Proceedings of the Third ACM workshop on Security and privacy in smartphones & mobile devices, pp. 99-104. ACM, 2013.

[4] Aveek Purohit, Zheng Sun, **Shijia Pan**, and Pei Zhang. "Sugartrail: Indoor navigation in retail environments without surveys and maps." In Proceedings of the 10th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), 2013 , pp. 300-308. IEEE, 2013.
Acceptance rate = 29.5%

[3] Zheng Sun, **Shijia Pan**, Yu-Chi Su, and Pei Zhang. "Headio: zero-configured heading acquisition for indoor mobile devices through multimodal context sensing." In Proceedings of the 2013 ACM international joint conference on Pervasive and ubiquitous computing (Ubicomp 2013), pp. 33-42. ACM, 2013.
Acceptance rate = 23.4%

[2] Zheng Sun, Aveek Purohit, **Shijia Pan**, Frank Mokaya, Raja Bose, and Pei Zhang. "Polaris: getting accurate indoor orientations for mobile devices using ubiquitous visual patterns on ceilings." In Proceedings of the Twelfth Workshop on Mobile Computing Systems & Applications, p. 14. ACM, 2012.
Acceptance rate = 21.6%

[1] Zheng Sun, Aveek Purohit, Kaifei Chen, **Shijia Pan**, Trevor Pering, and Pei Zhang. "PAN-DAA: physical arrangement detection of networked devices through ambient-sound awareness." In Proceedings of the 13th international conference on Ubiquitous computing (Ubicomp 2011), pp. 425-434. ACM, 2011.
Acceptance rate = 16.6%

SELECTED POSTER AND DEMO PAPERS

[7] **Shijia Pan**, Kent Lyons, Mostafa Mirshekari, Hae Young Noh, and Pei Zhang. Multiple Pedestrian Tracking through Ambient Structural Vibration Sensing. ACM SenSys 2016, Stanford, CA, USA, November 2016.
Best Poster Award

[6] **Shijia Pan**, Mostafa Mirshekari, Hae Young Noh, and Pei Zhang. Structural sensing system with networked dynamic sensing configuration. ACM IPSN 2015, Seattle, April 2015.

[5] Mostafa Mirshekari, **Shijia Pan**, Adeola Bannis, YPM Lam, Pei Zhang, Hae Young Noh. Step-level person localization through sparse sensing of structural vibration. ACM IPSN 2015, Seattle, April 2015.
Best Poster Award

[4] Adeola Bannis, **Shijia Pan**, and Pei Zhang. Towards Targeted Gestures: Adding Directional Context to Gestures Using Doppler Effect. ACM Ubicomp 2014, Seattle, USA, September 2014

[3] **Shijia Pan**, Yulai Shen, Zheng Sun, Priya Mahaja, Lin Zhang and Pei Zhang. Demo Abstract: Saving Energy in Smart Commercial Buildings through Social Gaming. ACM Ubicomp 2013, Zurich, Switzerland, September 2013.

[2] **Shijia Pan**, Bo Liu, Lin Zhang, and Pei Zhang. Demo Abstract: iCEnergy: Augmented Reality Display for Intuitive Energy Monitoring. SenSys 2012, Toronto, Canada, November, 2012.

[1] Zheng Sun, Aveek Purohit, Kaifei Chen, **Shijia Pan**, Trevor Pering, and Pei Zhang. Demo Abstract: PANDAA: Physical Arrangement Detection of Networked Devices through Ambient-Sound Awareness. ACM Ubicomp 2011, Beijing, China, September 2011.
Best Demo Award

PATENTS

[3] NOH, Hae Yong, ZHANG, Pei, MIRSHEKARI, Mostafa, **PAN, Shijia**. A method to characterize wave propagation to improve indoor step-level person localization using floor vibration. Patent Cooperation Treaty Provisional Invention Disclosure Submitted, March 2016.

[2] ZHANG Pei, NOH Hae Young, **PAN Shijia**, WANG Ningning, BONDE Amelie, and MIRSHEKARI Moustafa. Indoor identification of individuals through footstep induced structural vibration. U.S. Patent App. 15/544,928.

[1] CHEN Mei An, **PAN Shijia**. Feature identification using an RGB-NIR camera pair. US Patent App. 14/168,267.

INVITED TALKS

[14] Indoor Human Information Acquisition from Physical Vibrations.
Tsinghua University, Beijing, China **Nov, 2018**

[13] Indoor Human Information Acquisition from Physical Vibrations.
Peking University, Beijing, China **Nov, 2018**

[12] Indoor Human Information Acquisition from Physical Vibrations.
University of New South Wales, Sydney, Australia **Nov, 2018**

[11] Indoor Human Information Acquisition from Physical Vibrations.
Princeton University, Princeton, New Jersey, USA **Sept, 2018**

[10] Indoor Human Information Acquisition from Physical Vibrations.
University of California, Merced, USA **Sept, 2018**

[9] Indoor Space Usage Monitoring using Structural Vibrations
Google, Sunnyvale, USA **August, 2018**

[8] PGA: Physics Guided and Adaptive Approach for Mobile Fine-Grained Environmental Monitoring
Urban Environmental Sustainability in a Smart and Connected World, USA **August, 2018**

[7] Indoor Human Information Acquisition from Physical Vibrations.
Tsinghua-UC Berkeley Shenzhen Institute, Shenzhen, China **July, 2018**

[6] Calibration-Free Occupant Localization using Structural Vibration through Locally Adaptive Multilateration.
7WCSCM, Qingdao, China **July, 2018**

[5] Indoor Human Information Acquisition from Physical Vibrations.
University of California, Santa Cruz, USA **April, 2018**

[4] Indoor Human Information Acquisition from Physical Vibrations.
Samsung Research America, Mountain View, USA **April, 2018**

[3] Indoor Human Information Acquisition from Physical Vibrations.
Singapore Management University, Singapore **March, 2018**

[2] Indoor Human Information Acquisition from Physical Vibrations.
National University of Singapore, Singapore **March, 2018**

[1] Structures as Sensors: Indoor Human Monitoring Through Ambient Vibration Sensing.
AiFi Inc., California, USA **Nov, 2017**

CONFERENCE PRESENTATIONS

[7] Structural Element Modeling for Vibration-based Indoor Human Sensing Configuration.
7WCSCM, Qingdao, China **July, 2018**

[6] UniverSense: IoT Device Pairing through Heterogeneous Sensing Signals.
HotMobile 2018, AZ, USA **Feb, 2018**

[5] FootprintID: Indoor Pedestrian Identification through Ambient Structural Vibration Sensing.
Ubicomp 2017, HI, USA **Sept, 2017**

[4] SurfaceVibe: Vibration-based Tap & Swipe Tracking on Ubiquitous Surface.
IPSN 2017, PA, USA **April, 2017**

[3] Occupant Traffic Estimation through Structural Vibration Sensing.
SPIE 2016, NV, USA **March, 2016**

[2] Indoor Person Identification through Footstep Induced Structural Vibration.
HotMobile 2015, NM, USA **Feb, 2015**

[1] BOES: Building Occupancy Estimation System Using Sparse Ambient Vibration Monitoring.
SPIE 2014, CA, USA **March, 2014**

TEACHING EXPERIENCE

Mobile Hardware for Software Engineers, Pittsburgh, PA, USA **Fall, 2013**
Teaching Assistant: 1-2 lectures per semester, weekly group discussion moderator

Mobile Hardware for Software Engineers, Moffett Field, CA, USA **Fall, 2016**
Teaching Assistant: 1-2 lectures per semester, weekly group discussion moderator

Mobile Hardware for Software Engineers, Moffett Field, CA, USA **Fall, 2017**
Teaching Assistant: 1-2 lectures per semester, weekly group discussion moderator

WORK EXPERIENCE

Technicolor Research, Los Altos, CA, USA **May, 2016 - August, 2016**
Research Intern
Manager/Mentor: Dr. Kent Lyons

Qualcomm Technologies, Inc., San Diego, CA, USA **May, 2013 - August, 2013**
Interim Engineering Intern
Manager/Mentor: Dr. An Mei Chen

Qualcomm Technologies, Inc., San Diego, CA, USA **May, 2014 - August, 2014**
Interim Engineering Intern
Manager/Mentor: Dr. An Mei Chen

Microsoft Research Asia, Beijing, P.R.China **March, 2011 - August, 2011**
Research Intern
Advisor: Dr. Jacky Shen

PROFESSIONAL SERVICES

Reviewer: Sensor Journal **Sept, 2018**

Publicity Chair: CPS-IoT Week   **April, 2019**

Publicity Chair: IPSN   **April, 2019**

PC member: AAAI'19   **Feb, 2019**

TPC Chair: DATA workshop (co-located with ACM SenSys)   **Nov, 2018**

TPC member: ENSsys workshop (co-located with ACM SenSys)   **Nov, 2018**

Workshop Chair: CPD 2018 (co-located with ACM Ubicomp)   **Oct, 2018**

Reviewer: ACM IMWUT, Ubicomp   **2017-2018**

Reviewer: ACM Transactions on Sensor Networks   **2018**

Reviewer: Pervasive and Mobile Computing   **May, 2018**

Publicity Chair: SenSys 2018
Shenzhen, China   **Nov, 2018**
Conference organization.

Reviewer: IEEE/ACM Transactions on Networking   **Jan, 2018**

Social Media Chair: SenSys 2016
Stanford, CA, USA   **Nov, 2016**
Conference registration organization.

Reviewer: IEEE Transactions on Mobile Computing   **Nov, 2016**

Reviewer: IEEE Computer Magazine   **June, 2016**

CMUSV ECE Graduate Organization (EGO), Moffett Field, CA USA   **2015 - 2016**
EGO Representative
Graduate student events and logistics organizing. **Student Volunteer: IPSN 2015**, Seattle, WA,
USA   **April, 2015**

Student Volunteer: HotMobile 2015, Santa Fe, NM, USA   **February, 2011**

CMUSV-USTC Summer Research Program, Moffett Field, CA USA   **2011 - 2013**
Organizer
Undergraduate students recruitment and organization

N2Women Event at SenSys 2012, Toronto, Canada   **November, 2012**
Student Organizer
The panel discussion organization and hosting.

Student Volunteer: UbiComp 2011, Beijing, P.R.China   **September, 2011**

Societies and   ACM Member; SPIE Student Member; IEEE Student Member
Affiliations