

June 18–22, 2023
Helsinki, Finland



Association for
Computing Machinery

Advancing Computing as a Science & Profession



MobiSys '23

Proceedings of the 21st ACM International Conference on
Mobile Systems, Applications, and Services

Sponsored by:

ACM SIGMOBILE in cooperation with ACM SIGOPS

General Chairs:

Petteri Nurmi, University of Helsinki

Pan Hui, Hong Kong University of Science and Technology (Guangzhou) and University of Helsinki

Program Chairs:

Ardalan Amiri Sani, University of California Irvine

Yunxin Liu, Institute for AI Industry Research (AIR), Tsinghua University



**Association for
Computing Machinery**

Advancing Computing as a Science & Profession

The Association for Computing Machinery

**2 Penn Plaza, Suite 701
New York, New York 10121-0701**

Copyright © 2023 by the Association for Computing Machinery, Inc. (ACM). Permission to make digital or hard copies of portions of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyright for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permission to republish from permissions@acm.org or Fax +1 212 869-0481.

For other copying of articles that carry a code at the bottom of the first or last page, copying is permitted provided that the per-copy fee indicated in the code is paid through www.copyright.com.

Notice to Past Authors of ACM-Published Articles

ACM intends to create a complete electronic archive of all articles and/or other material previously published by ACM. If you have written a work that has been previously published by ACM in any journal or conference proceedings prior to 1978, or any SIG Newsletter at any time, and you do NOT want this work to appear in the ACM Digital Library, please inform permissions@acm.org, stating the title of the work, the author(s), and where and when published.

ISBN: 979-8-4007-0110-8

Additional copies may be ordered prepaid from:

**ACM Order Department
PO Box 30777
New York, NY 10087-0777, USA**

Phone: +1 800 342-6626 (USA and Canada)

+1 212 626-0500 (Global)

Fax: +1 212 944-1318

Email: acmhelp@acm.org

Hours of Operation: 8:30 am–4:30 pm ET

Welcome Message from the General Chairs

On behalf of the entire organizing committee, it is with immense pleasure that we invite you to the 21st ACM International Conference on Mobile Systems, Applications, and Services (ACM MobiSys 2023) held in Helsinki, Finland on June 18 - 22, 2023. Since the previous year's event, which was the first in-person event since the beginning of the pandemic, a lot has happened. The WHO declared the pandemic to be officially over, but the world remains shrouded by an uncertain outlook, including a tough economic climate. Nevertheless, MobiSys continues strong and remains the leading conference for innovative research in mobile systems, applications, and services. As the chairs of the organizing committee, we are delighted and excited to be able to welcome you in-person in Helsinki, Finland.

We begin with a special thanks to our sponsors. ACM, SIGMOBILE, Bosch Sensortec, Google, Microsoft, the City of Helsinki, NSF, and the University of Helsinki. We are grateful to the University of Helsinki for providing consistent support in hosting the conference.

We are proud that the program committee, led by the co-chairs Ardalan Amiri Sani and Yunxin Liu, have compiled an excellent technical program by selecting 41 outstanding papers from 198 submissions (21% acceptance rate) that are presented at the conference. We express our deepest gratitude to the entire program committee for their work and effort at making a strong technical program.

Reproducibility of research results is critical for science and this year special attention was placed on rewarding papers that promote and support reproducibility. This process was handled by the artifact evaluation committee, which was expertly led by Przemysław Pawełczak and Robert LiKamWa. In total, 16 (39%) of the accepted papers received at least one badge. The conference featured for the first time a separate artifact evaluation committee, and the artifact process features as part of the award programme for the first time. We thank the entire artifact committee for their work and effort at validating the artifacts and helping to make the artifacts a prominent part of the program. We hope future conferences can build on the excellent work and process set out by the artifact committee.

The conference program also features three impressive keynote presentations. We are grateful to Scott Burleigh from California Institute of Technology, Mikko Uusitalo from Nokia Bell Labs, and Yong Li from Tsinghua University. We thank the keynote presenters for their presentations and for sharing their insights and experiences.

The conference is co-located with multiple workshops on emerging and evolving topics. The workshops offer an opportunity to discuss potential new topics, to share insights, and to network. We thank the workshop chairs, Zheng Wang and Yang Chen who worked hard to coordinate and organize a strong workshop program that features 6 workshops. We also express our gratitude to the organizers of the individual workshops and the workshop participants.

The conference continues the tradition of hosting a dedicated IoT day. The chairs, Jörg Ott and Stephan Sigg, compiled an excellent program that includes a keynote talk, sessions with invited

talks on emerging IoT topics, and a panel discussion on privacy and ethics in IoT. We are grateful to all the presenters and panelists.

The conference features interactive and social technical forums for posters and demonstrations. In total, 15 posters and 13 demonstrations were selected for the presentation. We are thankful to the poster chairs, Huber Flores and Sourav Bhattacharya, and the demonstration chairs, Xiang Su and Pengyuan Zhou, for their work and effort in composing and organizing these sessions.

An important focus for this year's conference has been support for students. This was considered particularly important given the difficult and uncertain economic situation. Student participation is boosted by an outstanding Rising Star Forum, organized and chaired by Chenren Xu and Qing Wang. The conference also has an extensive travel grant program, which was run excellently by the travel grant chairs, Gareth Tyson, Gang Wang, and Susanna Pirttikangas. The grant program was highly successful, and 16 grants were awarded. The travel grants were generously supported by NSF and SIGMOBILE.

Complementing the visible activities are other critical tasks that form the backbone of the conference. The publication process was overseen by Ngoc Thi Nguyen and Tristan Braud, who worked through a very tight schedule to make sure the proceedings not only were ready in time but also that all contributions were included in the proceedings. The sponsorship chairs, Roberto Morabito and Aaron Yi Ding, worked tirelessly and successfully to seek corporate sponsorship. The registration chairs, Xiaoli Liu and Gopika Premasankar, handled the registration process excellently. The publicity chairs, Ella Peltonen, Lik-Hang Lee, and Bo Han, have been advertising the conference extensively, including publishing information in social media. The video chairs, Agustin Zuniga and Zhigang Yin, made sure videos of the contributions and the conference talks were available online, including on the conference website and in social media channels. Special thanks to Boyu Fan and Xian Wang for continuously making sure that the conference website was informative, detailed, and up to date. Finally, we express our deepest gratitude to the local organizing team, led by Ashwin Rao and Naser Hossein Motlagh, which has worked tirelessly to ensure the best possible conference experience.

Naturally there have also been challenges along the way. As the world was emerging from one crisis, new challenges have emerged, and the organization process has been carried out under significant uncertainties. We would like to express our sincerest gratitude to ACM and SIGMOBILE, our sponsors, all organizing committee members, program committee members, artifact evaluation committee members, keynote speakers, and volunteers. Thanks to everyone's hard work, the conference has a very strong program and these challenging times have been navigated through excellently. Finally, our sincere thanks to each conference participant.

ACM MobiSys 2023 General Co-Chairs

Petteri Nurmi
University of Helsinki

Pan Hui
*Hong Kong University of Science and Technology (Guangzhou) &
University of Helsinki*

Welcome Message from the Technical Program Committee Chairs

It is our great pleasure to welcome you to the 21st ACM International Conference on Mobile Systems, Applications, and Services, i.e., ACM MobiSys 2023. Over the past two decades, MobiSys has cemented itself as one of the flagship conferences in mobile computing and systems research. We are happy to continue this trend with a strong program this year.

To review the papers submitted to MobiSys 2023, we put together an excellent and highly qualified set of researchers in our Technical Program Committee (TPC). The TPC comprised 56 researchers from 12 countries and 50 universities/organizations.

This year, we received 198 submissions. We rejected 4 of these submissions because they did not adhere to the submission requirements of MobiSys. We reviewed the rest of the papers in a two-round review process. In round 1, each paper received 3 reviews. This was followed by an online discussion phase, resulting in 63 of the papers being rejected. We sent out early-rejection notifications after round 1 in order to provide timely feedback for the authors of these papers.

131 papers advanced to round 2, where they received 2 additional reviews. Round 2 was followed by a rebuttal process, a first for MobiSys. The authors were asked to provide a rebuttal of at most 500 words. The reviewers then studied and discussed the rebuttal (as well as their reviews) in an online discussion phase, during which 86 papers were selected for discussion in the TPC meeting. We believe this is the highest number of papers to be discussed in a MobiSys TPC meeting.

The TPC meeting spanned across 1.5 days (which we also believe is a first for MobiSys). The meeting was held in person in Orange County, CA (collocated with HotMobile'23), although some members joined virtually. The TPC spent a total of 16 hours discussing the papers and made sure all the selected submissions were discussed adequately. The TPC also made a concerted effort to have a positive attitude and accept all good submissions. We believe this attitude paid off and the TPC conditionally accepted a total of 41 papers, which is also a record for MobiSys.

We assigned shepherds to all conditionally accepted papers. The shepherding process was double-blind, similar to the review process itself. The authors worked closely with their shepherds to improve their papers. All conditionally accepted papers successfully completed the shepherding process.

Continuing the tradition of artifact evaluation in MobiSys, all conditionally accepted papers were given a chance to submit their artifacts for rigorous evaluation. 16 papers submitted their artifacts and received at least 1 badge.

Putting together the program for MobiSys takes a huge amount of effort and is only possible through collaboration of a large set of individuals. We are very thankful to the TPC members for all the time and effort they put into reviewing and discussing the papers. We are also thankful

to our general chairs, Petteri Nurmi and Pan Hui, for helping us with organizing the program. We also thank the artifact evaluation chairs, Przemysław Pawełczak and Robert LiKamWa, for organizing an excellent artifact evaluation process. We hope that you enjoy attending the conference and reading the papers in the program.

ACM MobiSys 2023 Technical Program Committee Co-Chairs

Ardalan Amiri Sani

University of California Irvine

Yunxin Liu

Institute for AI Industry Research (AIR), Tsinghua University

Contents

MobiSys 2023 Organization	xii
--	------------

MobiSys 2023 Sponsors & Supporters	xvi
---	------------

Session 1: Sound

DF-Sense: Multi-user Acoustic Sensing for Heartbeat Monitoring with Dualforming	1
--	----------

Lei Wang (*Soochow University and Peking University*); Tao Gu (*Macquarie University*); Wei Li (*Peking University*); Haipeng Dai (*Nanjing University*); Yong Zhang (*SIAT,CAS*); Dongxiao Yu (*Shandong University*); Chenren Xu, Daqing Zhang (*Peking University*)

Towards Bone-Conducted Vibration Speech Enhancement on Head-Mounted Wearables	14
--	-----------

Lixing He, Haozheng Hou, Shuyao Shi, Xian Shuai, Zhenyu Yan (*The Chinese University of Hong Kong*)

SoundSieve: Seconds-Long Audio Event Recognition on Intermittently-Powered Systems	28
---	-----------

Mahathir Monjur (*UNC Chapel Hill*); Yubo Luo, Zhenyu Wang (*University of North Carolina at Chapel Hill*); Shahriar Nirjon (*UNC Chapel Hill*)

Session 2: Machine Learning and AI I

HarvNet: Resource-Optimized Operation of Multi-Exit Deep Neural Networks on Energy Harvesting Devices	42
--	-----------

Seunghyeok Jeon (*Yonsei University*); Yonghun Choi (*Korea Institute of Science and Technology*); Yeonwoo Cho, Hojung Cha (*Yonsei University*)

ElasticTrainer: Speeding Up On-Device Training with Runtime Elastic Tensor Selection	56
---	-----------

Kai Huang, Boyuan Yang, Wei Gao (*University of Pittsburgh*)

NN-Stretch: Automatic Neural Network Branching for Parallel Inference on Heterogeneous Multi-Processors	70
--	-----------

Jianyu Wei (*University of Science and Technology of China, Microsoft Research*); Ting Cao, Shijie Cao, Shiqi Jiang (*Microsoft Research*); Shaowei Fu (*University of Science and Technology of China*); Mao Yang (*Microsoft Research*); Yanyong Zhang (*University of Science and Technology of China*); Yunxin Liu (*Institute for AI Industry Research (AIR), Tsinghua University, Shanghai Artificial Intelligence Laboratory*)

Session 3: Health Monitoring

Wireless earbuds for low-cost hearing screening	84
--	-----------

Justin Chan, Antonio Glenn, Malek Itani, Lisa R. Mancil (*University of Washington*); Emily Gallagher (*Seattle Children's Hospital and Research Institute*); Randall Bly (*University of Washington*); Shwetak Patel (*University of Washington and Google*); Shyamnath Gollakota (*University of Washington*)

Passive Vital Sign Monitoring via Facial Vibrations Leveraging AR/VR Headsets	96
--	-----------

Tianfang Zhang (*Rutgers University*); Cong Shi (*New Jersey Institute of Technology*); Payton Walker (*Texas A&M University, College Station*); Zhengkun Ye, Yan Wang (*Temple University*); Nitesh Saxena (*Texas A&M University, College Station*); Yingying Chen (*Rutgers University*)

PTEase: Objective Airway Examination for Pulmonary Telemedicine using Commodity Smartphones	110
Xiangyu Yin, Kai Huang (<i>University of Pittsburgh</i>); Erick Forno, Wei Chen (<i>University of Pittsburgh, UPMC Children's Hospital of Pittsburgh</i>); Heng Huang, Wei Gao (<i>University of Pittsburgh</i>)	
Session 4: Wireless	
SmartShell: A Near-Field Reflective Surface Enhancing RSS	124
Linling Zhong, Mingwei Ouyang, Fengyuan Zhu, Meng Jin, Xinbing Wang, Xinping Guan (<i>Shanghai Jiao Tong University</i>); Chenghu Zhou (<i>Chinese Academy of Sciences</i>); Xiaohua Tian (<i>Shanghai Jiao Tong University</i>)	
Towards Seamless Wireless Link Connection	137
Lili Chen (<i>Tsinghua University</i>); Bozhong Yu (<i>Northwest University</i>); Ju Ren (<i>Tsinghua University</i>); Jeremy Gummeson (<i>University of Massachusetts Amherst</i>); Yaoxue Zhang (<i>Tsinghua University</i>)	
SIGNiPHY: Reconciling random access with directional reception for efficient mmWave WLANs .	150
Nina Grosheva, Sai Pavan Deram (<i>IMDEA Networks Institute, Universidad Carlos III de Madrid</i>); Jesus O. Lacruz (<i>IMDEA Networks Institute</i>); Joerg Widmer (<i>IMDEA Networks</i>)	
Session 5: Sensing	
Mozart: A Mobile ToF System for Sensing in the Dark through Phase Manipulation	163
Zhiyuan Xie, Xiaomin OUYANG, Li Pan (<i>The Chinese University of Hong Kong</i>); Wenrui Lu (<i>University of Michigan, Ann Arbor</i>); Guoliang Xing (<i>The Chinese University of Hong Kong</i>); Xiaoming Liu (<i>Michigan State University</i>)	
Boosting the Long Range Sensing Potential of LoRa	177
Binbin Xie, Minhao Cui, Deepak Ganesan, Xiangru Chen, Jie Xiong (<i>University of Massachusetts Amherst</i>)	
BioScatter: Low-Power Sweat Sensing with Backscatter	191
Wenli Jiao, Yanlin Li, Xiangdong Xi, Ju Wang, Dingyi Fang, Xiaojiang Chen (<i>Northwest University</i>)	
Session 6: Security and Privacy I	
No More Companion Apps Hacking but One Dongle: Hub-Based Blackbox Fuzzing of IoT Firmware	205
Xiaoyue Ma, Qiang Zeng (<i>George Mason University</i>); Haotian Chi (<i>Shanxi University</i>); Lannan Luo (<i>George Mason University</i>)	
"Is this my president speaking?" Tamper-proofing Speech in Live Recordings	219
Irtaza Shahid, Nirupam Roy (<i>University of Maryland, College Park</i>)	
Minimizing a Smartphone's TCB for Security-Critical Programs with Exclusively-Used, Physically-Isolated, Statically-Partitioned Hardware	233
Zhihao Yao, Seyed Mohammadjavad Seyed Talebi, Mingyi Chen, Ardalan Amiri Sani (<i>University of California, Irvine</i>); Thomas Anderson (<i>University of Washington</i>)	

Session 7: Mobile Devices and Edge

- MixMax: Leveraging Heterogeneous Batteries to Alleviate Low Battery Experience for Mobile Users** 247
Jaeheon Kwak, Sunjae Lee, Dae R. Jeong, Arjun Kumar, Dongjae Shin, Ilju Kim (KAIST); Donghwa Shin, Kilho Lee (Soongsil University); Jinkyu Lee (Sungkyunkwan University); Insik Shin (KAIST)
- OmniLive: Super-Resolution Enhanced 360° Video Live Streaming for Mobile Devices** 261
Seonghoon Park, Yeonwoo Cho, Hyungchol Jun, Jeho Lee, Hojung Cha (Yonsei University)
- EMSAssist: An End-to-End Mobile Voice Assistant at the Edge for Emergency Medical Services** . 275
Liuyi Jin, Tian Liu, Amran Haroon, Radu Stoleru, Michael Middleton (Texas A&M University); Ziwei Zhu (George Mason University); Theodora Chaspari (Texas A&M University)

Session 8: Localisation

- Sirius: A Self-Localization System for Resource-Constrained IoT Sensors** 289
Nakul Garg, Nirupam Roy (University of Maryland, College Park)
- Hawkeye: Hectometer-range Subcentimeter Localization for Large-scale mmWave Backscatter** . 303
Kang Min Bae, Hankyeol Moon (KAIST); Sung-Min Sohn (Arizona State University); Song Min Kim (KAIST)
- LocRa: Enable Practical Long-Range Backscatter Localization for Low-Cost Tags** 317
Jinyan Jiang, Jiliang Wang, YiJie Chen, Yihao Liu, Yunhao Liu (Tsinghua University)

Session 9: Camera, Switch

- RoFin: 3D Hand Pose Reconstructing via 2D Rolling Fingertips** 330
Xiao Zhang, Griffin Klevering, Juexing Wang, Li Xiao, Tianxing Li (Michigan State University)
- When VLC Meets Under-Screen Camera** 343
Hanting Ye (Delft University of Technology); Jie Xiong (University of Massachusetts Amherst); Qing Wang (Delft University of Technology)
- Industrial Knee-jerk: In-Network Simultaneous Planning and Control on a TSN Switch** 356
Zeyu Wang, Jingao Xu, Xu Wang, Xiangwen Zhuge, Xiaowu He, Zheng Yang (Tsinghua University)

Session 10: Security and Privacy II

- BystandAR: Protecting Bystander Visual Data in Augmented Reality Systems** 370
Matthew Corbett, Brendan David-John (Virginia Tech); Jiacheng Shang (Montclair State University); Y. Charlie Hu (Purdue University); Bo Ji (Virginia Tech)
- EchoAttack: Practical Inaudible Attacks To Smart Earbuds** 383
Gen Li, Zhichao Cao, Tianxing Li (Michigan State University)
- BioCase: Privacy Protection via Acoustic Sensing of Finger Touches on Smartphone Case Mini-Structures** 397
Yilin Yang, Xin Li (Rutgers University); Zhengkun Ye, Yan Wang (Temple University); Yingying Chen (Rutgers University)

LeopardSeal: Detecting Call Interception via Audio Rogue Base Stations	410
Christian Peeters, Tyler Tucker, Anushri Jain, Kevin Butler, Patrick Traynor (<i>University of Florida</i>)	
 Session 11: Backscatter	
Enabling Native WiFi Connectivity for Ambient Backscatter	423
Longzhi Yuan, Wei Gong (<i>University of Science and Technology of China</i>)	
Leggiero: Analog WiFi Backscatter with Payload Transparency	436
Xin Na, Xiuzhen Guo, Zihao Yu, Jia Zhang, Yuan He, Yunhao Liu (<i>Tsinghua University</i>)	
Timespan-based Backscatter Using a Single COTS Receiver	450
Caihui Du, Jiahao Liu, Shuai Wang (<i>Beijing Institute of Technology</i>); Rongrong Zhang (<i>Capital Normal University</i>); Wei Gong (<i>University of Science and Technology of China</i>); Jihong Yu (<i>Beijing Institute of Technology</i>)	
 Session 12: mmWave	
mm3DFace: Nonintrusive 3D Facial Reconstruction Leveraging mmWave Signals	462
Jiahong Xie, Hao Kong (<i>Shanghai Jiao Tong University</i>); Jiadi Yu (<i>Shanghai Jiao Tong University</i>); Yingying Chen (<i>Rutgers University</i>); Linghe Kong (<i>Shanghai Jiao Tong University, China</i>); Yanmin Zhu, Feilong Tang (<i>Shanghai Jiao Tong University</i>)	
Contactless Material Identification with Millimeter Wave Vibrometry	475
Hailan Shanbhag (<i>EPFL</i>); Sohrab Madani, Akhil Isanaka, Deepak Nair, Saurabh Gupta (<i>UIUC</i>); Haitham Hassanieh (<i>EPFL</i>)	
Fusang: Graph-inspired Robust and Accurate Object Recognition on Commodity mmWave Devices	489
Guorong He, Shaojie Chen, Dan Xu, Xiaojiang Chen (<i>Northwest University</i>); Yaxiong Xie (<i>University at Buffalo</i>); Xinhui Wang (<i>Xidian University</i>); Dingyi Fang (<i>Northwest University</i>)	
 Session 13: Machine Learning and AI II	
ConvReLU++: Reference-based Lossless Acceleration of Conv-ReLU Operations on Mobile CPU .	503
Rui Kong (<i>Shanghai Jiao Tong University</i>); Yuanchun Li, Yizhen Yuan (<i>Institute for AI Industry Research (AIR), Tsinghua University</i>); Linghe Kong (<i>Shanghai Jiao Tong University</i>)	
Boosting DNN Cold Inference on Edge Devices	516
Rongjie Yi (<i>State Key Laboratory of Networking and Switching Technology, Beijing, China</i>); Ting Cao (<i>Microsoft Research</i>); Ao Zhou, Xiao Ma, Shangguang Wang, Mengwei Xu (<i>State Key Laboratory of Networking and Switching Technology, Beijing, China</i>)	
Harmony: Heterogeneous Multi-Modal Federated Learning through Disentangled Model Training	530
Xiaomin Ouyang, Zhiyuan Xie, Heming Fu, Sitong Cheng (<i>The Chinese University of Hong Kong</i>); Li Pan (<i>Centre for Perceptual and Interactive Intelligence</i>); Neiwen Ling, Guoliang Xing (<i>The Chinese University of Hong Kong</i>); Jiayu Zhou (<i>Michigan State University</i>); Jianwei Huang (<i>The Chinese University of Hong Kong, Shenzhen</i>)	

EEFL: High-Speed Wireless Communications Inspired Energy Efficient Federated Learning over Mobile Devices	544
Rui Chen, Qiyu Wan (<i>University of Houston</i>); Xinyue Zhang (<i>Kennesaw State University</i>); Xiaoqi Qin, Yanzhao Hou (<i>Beijing University of Posts and Telecommunications</i>); Di Wang (<i>King Abdullah University of Science and Technology</i>); Xin Fu, Miao Pan (<i>University of Houston</i>)	

Poster Session

Poster: A Privacy-Preserving Heart Rate Prediction System for Drivers in Connected Vehicles . .	557
Hui Ruan, Qingyuan Gong, Yang Chen (<i>Fudan University</i>); Jiong Chen (<i>NIO</i>); Ziyue Li (<i>University of Cologne</i>); Xiang Su (<i>Norwegian University of Science and Technology</i>)	

Poster: Automatic Mass Power Outage Detection in Radio Access Networks	559
Milla Lintunen (<i>Elisa Oy, University of Helsinki</i>); Gopika Premasankar (<i>University of Helsinki</i>); Henri Tenhunen (<i>Elisa Oy</i>); Sasu Tarkoma, Ashwin Rao (<i>University of Helsinki</i>)	

Poster: Rethinking Embedded Sensor Data Processing and Analysis with Large Language Models	561
Pramuka Sooriya Patabandige, Steven Waskito, Kunjun Li, Kai Jie Leow (<i>National University of Singapore</i>); Shantanu Chakrabarty (<i>NCS Group</i>); Ambuj Varshney (<i>National University of Singapore</i>)	

Poster: mmLeaf: Versatile Leaf Wetness Detection via mmWave Sensing	563
Maolin Gan, Yimeng Liu, Li Liu (<i>Michigan State University</i>); Chenshu Wu (<i>The University of Hong Kong</i>); Younsuk Dong, Huacheng Zeng, Zhichao Cao (<i>Michigan State University</i>)	

Poster: Enhanced ZigBee Backscatter Communication using Fine-Grained Chip-Level Modulation	565
Shixin Wang, Zhaoyuan Xu, Wei Gong (<i>University of Science and Technology of China</i>)	

Poster: Preventing Fake News through Live Speech Signature	567
Irtaza Shahid, Nirupam Roy (<i>University of Maryland, College Park</i>)	

Poster: Ultra-low-power Angle-of-Arrival Estimation Using a Single Antenna	569
Nakul Garg, Nirupam Roy (<i>University of Maryland, College Park</i>)	

Poster: Towards Battery-Free Machine Learning Inference and Model Personalization on MCUs .	571
Yushan Huang, Hamed Haddadi (<i>Imperial College London</i>)	

Poster: Image Acquisition and Storage System for Battery-Free WiFi Camera	573
Zhili Wang, Longzhi Yuan, Wei Gong (<i>University of Science and Technology of China</i>)	

Poster: Towards Multi-Radio Access in 5G Networks	575
Matan Broner, Sangwoo Lee, Liuyi Jin, Radu Stoleru (<i>Texas A&M University</i>)	

Poster: Submillimeter Localization for mmWave Backscatter Using Commodity 77 GHz Radar . .	577
Kang Min Bae, Hankyeol Moon, Song Min Kim (<i>KAIST</i>)	

Poster: VoCopilot: Enabling Voice-Activated Tracking for Everyday Interactions	579
Goh Sheen An, Ambuj Varshney (<i>National University of Singapore</i>)	

Poster: Radar-CA: Radar-Sensing Multiple Access with Collision Avoidance	581
Yanlong Qiu (<i>Temple University, USA; Southern University of Science and Technology</i>); Jiayi Zhang (<i>Southern University of Science and Technology; Hong Kong University of Science and Technology</i>); Kaiyi Huang (<i>Southern University of Science and Technology</i>); Jin Zhang (<i>Shenzhen Key Laboratory of Safety and Security for Next Generation of Industrial Internet, Southern University of Science and Technology</i>); Bo Ji (<i>Virginia Tech</i>)	
Poster: BystandAR: Protecting Bystander Visual Data in Augmented Reality Systems	583
Matthew Corbett, Brendan David-John (<i>Virginia Tech</i>); Jiacheng Shang (<i>Montclair State University</i>); Y. Charlie Hu (<i>Purdue University</i>); Bo Ji (<i>Virginia Tech</i>)	
Poster: Contactless Material Identification with Millimeter Wave Vibrometry	585
Hailan Shanbhag (<i>EPFL</i>); Sohrab Madani, Akhil Isanaka, Deepak Nair, Saurabh Gupta (<i>UIUC</i>); Haitham Hassanieh (<i>EPFL</i>)	
Demo Session	
Demo : On-device Puff Detection System for Smoking Cessation	586
Shalini Mukhopadhyay, Swarnava Dey, Avik Ghose (<i>TCS Research</i>)	
Demo: UE Assisted Ambient IoT in LTE Downlink, in Real-time and Open Source	588
Jingyi Liao, Kalle Ruttik, Riku Jäntti (<i>Aalto University</i>); Dinh-Thuy Phan-Huy (<i>Orange Innovation</i>)	
Demo: Real-Time WebXR Edge-based Object Detection for AR	590
Jacky Cao (<i>University of Oulu</i>); Kit Yung Lam (<i>The Hong Kong University of Science and Technology</i>); Lik-Hang Lee (<i>Hong Kong Polytechnic University</i>)	
Demo: Domino: A High-Precision Performance Monitoring and Analysis Platform for Client Applications	592
Dong Li, Kaiyan Zhang, Dongping Cao, Jing Shen, Run Kang, Qian Kang Mao, Jiawei Chen (<i>Douyin Co., Ltd.</i>)	
Demo: 3TierView - A Three-tier Privacy-preserving Live Video Surveillance IoT System	594
Haoran Li, Qi Zhang, Gajraj Kuldeep (<i>Aarhus University</i>)	
Demo: EMSAssist – An End-to-End Mobile Voice Assistant at the Edge for Emergency Medical Services	596
Liuyi Jin, Tian Liu, Amran Haroon, Radu Stoleru, Michael Middleton (<i>Texas A&M University</i>); Ziwei Zhu (<i>George Mason University</i>); Theodora Chaspari (<i>Texas A&M University</i>)	
Demo: Exploiting Indices for Man-in-the-Middle Attacks on Collaborative Unpooling Autoencoders	598
Kichang Lee, Jonghyuk Yun, Jun Han, JeongGil Ko (<i>Yonsei University</i>)	
Demo: An Educational Platform to Learn Radio Frequency Wireless Communication	600
Tobias Mages, Wenqing Yan (<i>Uppsala University</i>); Ambuj Varshney (<i>National University of Singapore</i>); Christian Rohner (<i>Uppsala University</i>)	
Demo: Debugging Constraint Devices with EDWARD	602
Tom Lauwaerts (<i>Universiteit Gent</i>); Carlos Rojas Castillo, Elisa Gonzalez Boix (<i>Vrije Universiteit Brussel</i>); Christophe Scholliers (<i>Universiteit Gent</i>)	

Demo: Landscape: Saliency and Trajectory based Viewport Prediction in Point Cloud Video Streaming	604
Jie Li, Zhixin Li, Qiyue Li, Wei Sun, Weitao Li, Huiyu Wang (<i>Hefei University of Technology</i>); Zhi Liu (<i>The University of Electro-Communications</i>)	
Demo: Horizon: a Real-time Point Cloud Video Streaming System over Wireless Networks	606
Jie Li, Huiyu Wang, Qiyue Li (<i>Hefei University of Technology</i>); Xin Liu (<i>State Grid Anhui Electric Power Company</i>); Zhixin Li (<i>Hefei University of Technology</i>); Zhi Liu (<i>The University of Electro-Communications</i>)	
Demo: Near Real-time ChatGPT-AR	608
Yuchen Ding, Pengyuan Zhou (<i>University of Science and Technology of China</i>)	
Demo: Scalable Digital Twin System for Mobile Networks with Generative AI	610
Jiahui Gong, Qiaohong Yu, Tong Li, Haoqiang Liu, Jun Zhang, Hangyu Fan, Depeng Jin, Yong Li (<i>Tsinghua University</i>)	
 Rising Stars Session	
Design and Deployment of Multi-Modal Federated Learning Systems for Alzheimer's Disease Monitoring	612
Xiaomin Ouyang (<i>The Chinese University of Hong Kong</i>)	
Towards Precise, Ubiquitous and Real-Time Positioning	615
Alejandro Blanco (<i>The University of Edinburgh</i>)	
Towards Latency-First Wireless Embedded Networks	618
Jonathan Oostvogels (<i>imec-DistriNet, KU Leuven</i>)	
Enhancing Time-of-Flight Sensing in Mobile Systems	621
Zhiyuan XIE (<i>The Chinese University of Hong Kong</i>)	
Algorithmic Sensing: A Joint Sensing and Learning Perspective	624
Tianyue Zheng (<i>Nanyang Technological University</i>)	
A Path to Holistic Privacy in Stream Processing Systems	627
Mikhail Fomichev (<i>Technical University of Darmstadt</i>)	
Ubiquitous, Secure, and Efficient Mobile Sensing Systems	629
Hong Jia (<i>University of Cambridge</i>)	
 Author index	 631

MobiSys 2023 Organization

General Chairs	Petteri Nurmi , <i>University of Helsinki</i> Pan Hui , <i>Hong Kong University of Science and Technology (Guangzhou) and University of Helsinki</i>
Program Chairs	Ardalan Amiri Sani , <i>University of California Irvine</i> Yunxin Liu , <i>Institute for AI Industry Research (AIR), Tsinghua University</i>
Artifact Evaluation Chairs	Przemysław Pawełczak , <i>TU Delft</i> Robert LiKamWa , <i>Arizona State University</i>
Workshop Chairs	Yang Chen , <i>Fudan University</i> Zheng Wang , <i>University of Leeds</i>
IoT Day Chairs	Jörg Ott , <i>Technical University of Munich</i> Stephan Sigg , <i>Aalto University</i>
Posters Chairs	Sourav Bhattacharya , <i>Samsung AI, UK</i> Huber Flores , <i>University of Tartu</i>
Demonstration Chairs	Xiang Su , <i>Norwegian University of Science and Technology</i> Pengyuan Zhou , <i>University of Science and Technology of China</i>
Rising Star Forum Chairs	Chenren Xu , <i>Peking University</i> Qing Wang , <i>Delft University of Technology</i>
Student Travel Grants Chairs	Gareth Tyson , <i>Hong Kong University of Science and Technology</i> Gang Wang , <i>University of Illinois at Urbana-Champaign</i> Susanna Pirttikangas , <i>University of Oulu</i>
Publications Chairs	Ngoc Thi Nguyen , <i>University of Helsinki</i> Tristan Braud , <i>Hong Kong University of Science and Technology</i>
Sponsorship Chairs	Roberto Morabito , <i>University of Helsinki</i> Aaron Ding , <i>TU Delft</i>
Registration Chairs	Xiaoli Liu , <i>University of Helsinki</i> Gopika Premsankar , <i>University of Helsinki</i>
Publicity Chairs	Ella Peltonen , <i>University of Oulu</i> Lik-Hang Lee , <i>Hong Kong Polytechnic University</i> Bo Han , <i>George Mason University</i>
Video Chairs	Agustin Zuniga , <i>University of Helsinki</i> Zhigang Yin , <i>University of Tartu</i>

Web Chairs	Boyu Fan , <i>University of Helsinki</i>
	Xian Wang , <i>Hong Kong University of Science and Technology</i>
Local Organizing Chairs	Ashwin Rao , <i>University of Helsinki</i>
	Naser Hossein Motlagh , <i>University of Helsinki</i>
Technical Program Committee	Anh Nguyen , <i>University of Montana</i>
	Ashutosh Dhekne , <i>Georgia Institute of Technology</i>
	Chenren Xu , <i>Peking University</i>
	Dongyao Chen , <i>Shanghai Jiao Tong University (SJTU)</i>
	Felix Xiaozhu Lin , <i>University of Virginia</i>
	Fengyuan Xu , <i>Nanjing University</i>
	Gang Wang , <i>University of Illinois at Urbana-Champaign</i>
	Guoliang Xing , <i>The Chinese University of Hong Kong</i>
	Hamed Haddadi , <i>Imperial College London</i>
	Hang Qiu , <i>Waymo</i>
	Heather Zheng , <i>University of Chicago</i>
	Jie Yang , <i>Florida State University</i>
	Joerg Widmer , <i>IMDEA Networks Institute</i>
	Ju Ren , <i>Tsinghua University</i>
	Jun Han , <i>Yonsei University</i>
	Jun Luo , <i>Nanyang Technological University</i>
	Junehwa Song , <i>KAIST</i>
	Karthik Dantu , <i>University of Buffalo</i>
	Kate Lin , <i>National Chiao Tung University</i>
	Lu Su , <i>Purdue University</i>
	Luca Mottola , <i>Politecnico di Milano and RI.SE Sweden</i>
	Matthew Lentz , <i>Duke University and VMware Research</i>
	Mengwei Xu , <i>Beijing University of Posts and Telecommunications (BUPT)</i>
	Mingmin Zhao , <i>University of Pennsylvania</i>
	Nirupam Roy , <i>University of Maryland, College Park</i>
	Prabal Dutta , <i>UC Berkeley</i>
	Przemysław Pawełczak , <i>Delft University of Technology</i>
	Qian Zhang , <i>Hong Kong University of Science and Technology</i>
	Qin Lv , <i>University of Colorado Boulder</i>

Rajalakshmi Nandakumar, *Cornell Tech*
Rajesh Balan, *Singapore Management University & Google*
Rijurekha Sen, *IIT Delhi*
Robert LiKamWa, *Arizona State University*
Sicong Liu, *Northwestern Polytechnical University*
Steven Y. Ko, *Simon Fraser University*
Suman Banerjee, *University of Wisconsin-Madison*
Sung-Ju Lee, *KAIST*
Tadashi Okoshi, *Keio University*
Tauhidur Rahman, *University of California San Diego*
Tiffany Chen, *Waymo*
Ting Cao, *Microsoft Research Asia*
Ting Zhu, *The Ohio State University*
Tingjun Chen, *Duke University*
VP Nguyen, *University of Texas at Arlington*
Wei Gao, *University of Pittsburgh*
Wen Hu, *The University of New South Wales*
Xia Zhou, *Columbia University*
Yanyong Zhang, *University of Science and Technology of China*
Yasaman Ghasempour, *University of Princeton*
Yingying Chen, *Rutgers University*
Youngki Lee, *Seoul National University*
Yuanchao Shu, *Microsoft*
Yuanchun Li, *Institute for AI Industry Research (AIR), Tsinghua University*
Yuvraj Agarwal, *Carnegie Mellon University*
Amit Samanta, *University of Utah*
Ananta Narayanan Balaji, *National University of Singapore*
Artur Balanuta, *Carnegie Mellon University*
Bo Liang, *Computer Science*
Borui Li, *Southeast University, China*
Chen Gong, *School of Computer Science, Peking University*
Chengke Wang, *Peking University*
Dong Ma, *Singapore Management University*

Artifact Evaluation Committee

Gaosheng Liu, *VU Amsterdam*
Harshvardhan Takawale, *University of Maryland College Park*
Hassan Habibi Gharakheili, *UNSW Sydney*
Hongkai Chen, *Stony Brook University*
Hongyu Hè, *ETH Zurich*
Isaac Ahlgren, *Loyola University Chicago*
Jia Liu, *Nanjing University*
Jiangtao Yu, *The University of Hong Kong*
Jing Liu, *Shanghai University*
Juheon Yi, *Seoul National University*
Kunal Mukherjee, *The University of Texas at Dallas*
Mahathir Monjur, *UNC Chapel Hill*
Minghui (Scott) Zhao, *Columbia University*
Nhat (Nick) Pham, *University of Oxford*
Peisen Yao, *Zhejiang University*
Radu Stoleru, *Texas A&M University*
Rong Jin, *California State University, Fullerton*
Ruizhe Wang, *University of Waterloo*
Sofiya Semenova, *University at Buffalo*
Vivek Chandel, *Tata Consultancy Services Ltd*
Wei Gao, *University of Pittsburgh*
Xingyu Chen, *University of California San Diego*
Yang Liu, *University of Cambridge*
Yifei Liu, *Arizona State University*
Zhaoning Kong, *Purdue University*
Zheng Xinzhe, *The University of Hong Kong*
Zhenyu Yan, *The Chinese University of Hong Kong*
Zhibo Li, *University of Edinburgh*
Zhihe Zhao, *Chinese University of Hong Kong*

MobiSys 2023 Sponsors & Supporters

Sponsors:



Corporate Sponsors

Platinum Sponsors:



Bosch Sensortec



Silver Sponsors:



Host Institution :

