

# SIGMOBILE FY'19 Annual Report

July 2018 – June 2019

The purpose of ACM SIGMOBILE is to promote research and development by bringing together researchers and practitioners and fostering interest in the mobility of systems, users, data, and computing. SIGMOBILE will address the above spectrum of topics, sharing one common theme - mobility. The group's technical scope reflects the emerging symbiosis of portable computers and wireless networks, addressing the convergence of mobility, computing and information organization, its access, services, management and applications.

In the past few years, mobile computing has developed into a fast moving, topical, and exciting area of computer science and engineering. Supporting the mobile computing and wireless networking research community, SIGMOBILE sponsors multiple successful conferences and workshops (e.g., MobiCom, MobiSys, MobiHoc, SenSys, UbiComp, PerDis, SEC, and HotMobile) that are well attended by its members, and generating high-quality and widely cited publications. These are valuable services for SIGMOBILE's members and the community, resulting in a strong Special Interest Group, with about 700 members.

SIGMOBILE's Executive Committee (EC) in this period comprised of:

- Chair: Prof. Marco Gruteser (Rutgers University, New Brunswick, USA)
- Vice Chair: Prof. Jason Flinn (University of Michigan, Ann Arbor, USA).
- Secretary: Prof. Giovanni Pau (Sorbonne Universite, France)
- Treasurer: Prof. Falko Dressler (University of Paderborn, Germany)
- Past Chair: Prof. Suman Banerjee (University of Wisconsin, Madison, USA)

## Awards

SIGMOBILE has a number of awards that it bestows on community members. In addition to the Outstanding Contributions Award (OCA) for career-long achievements, the Rockstar award for early career achievements, the Distinguished Service Award for service to the community, the Doctoral Dissertation Award for best PhD work in the field, the The Test of Time award for papers that had a significant influence in the community, and various best paper awards at the leading conferences. In addition, SIGMOBILE also recognizes some of the best work in the current year, as identified by a selection committee, which are considered the Research Highlights of SIGMOBILE.

Some of the notable award winners are mentioned below.

Outstanding Contributions Award: Dr. Roy Want (Google)  
Rockstar Award: Prof. Xia Zhou (Dartmouth College)

The SIGMOBILE Test of Time awards were selected by a committee chaired by Prof. Guiseppe Bianchi. The committee comprising Prof. Badri Nath, Prof. David F. Kotz, Prof. Shyam Gollakota, Dr. Stefan Saroiu, Prof. Tanzeem Choudhury, and Dr. Thyaga Nandagopal selected the following articles:

- Patrick Murphy, Ashutosh Sabharwal, and Behnaam Aazhang. "Design of WARP: a wireless open-access research platform," European Signal Processing Conference, 2006.
  - WARP was a groundbreaking open-source specialized hardware platform for high-performance wireless research. As one of the very few university hardware projects that moved outside the university, WARP has served as an experimental enabler for hundreds of ideas, which otherwise would have hardly been demonstrated, due to code base limitations and the large cost of wireless platforms capable of supporting high-end research. In the process, WARP was instrumental in changing the way the SIGMOBILE wireless community did research – strong experimental evidence versus oversimplified simulations.
- Prashanth Mohan, Venkata N. Padmanabhan, and Ramachandran Ramjee. "Nericell: Rich Monitoring of Road and Traffic Conditions using Mobile Smartphones," ACM SenSys, 2008.

- Nericell pioneered the use of smartphones as a vehicular sensing platform, at a time when these devices lacked the sensing capabilities that are commonplace today. Nericell showed how smartphones could be used to sense various aspects of road and traffic conditions. In addition to the technical achievements, it influenced a large body of research, inspired others to develop novel uses of smartphone sensors, and fostered new lines of academic and commercial research.
- Emiliano Miluzzo, Nicholas D. Lane, Kristof Fodor, Ronald Peterson, Hong Lu, Mirco Musolesi, Shane B. Eisenman, Xiao Zheng, and Andrew T. Campbell. "Sensing meets mobile social networks: the design, implementation and evaluation of the CenceMe application," ACM SenSys, 2008.
  - CenceMe was the first paper to demonstrate how smartphones can be used to derive rich behavioral insights continuously from onboard sensors. Since its publication, the work has inspired a huge body of research and commercial endeavors that has continued to increase the breadth and depth of personal sensing. Some of the activity inference methods that are now common in smartphone operating systems can be traced back to the original CenceMe system.

### Highlight Papers

- Mehrdad Moradi, Eugene Chai, Karthik Sundaresan, Z. Morley Mao, Sampath Rangarajan, "SkyCore: Moving Core to the Edge for Untethered and Reliable UAV-based LTE Networks," MobiCom 2018.
  - SkyCORE presents a new implementation study of a mobile LTE core network on UAVs. This paper embodies our vision of a untethered, reliable UAV-based LTE network, and presents the necessary re-design of the traditional EPC architecture to realize this vision. This is the first real-world prototype of a fully functional LTE core network that harnesses the high mobility offered by UAVs to achieve a uniquely reliable and scalable core network that can be deployed anywhere at short notice. The insights gained from this re-engineering of the EPC, as well as the real-world UAV evaluations presents an exciting and significant development in UAV solutions. UAV technology has advanced to the point that operators are now empowered to deploy on- demand, real-time sensing and communication solutions. However, UAV solutions are constrained by the limited resources on UAV platforms, and require research to fully harness the power, flight, mobility and autonomous features in order to develop future UAV-based solutions. SkyCORE presents an early demonstration and direction of UAV solutions, and is of general interest to the CS research community.
- Nivedita Arora, Steven L. Zhang, Fereshteh Shahmiri, Diego Osorio, Yi-Cheng Wang, Mohit Gupta, Zhengjun Wang, Thad Starner, Zhong Lin Wang, Gregory D. Abowd, "SATURN: A Thin and Flexible Self-powered Microphone Leveraging Triboelectric Nanogenerator", IMWUT 2019
  - SATURN showcases the novel device design, fabrication, and evaluation of an audio and vibration sensing material. SATURN is one of the first prototypes for the new compelling vision of self-sustainable computational material where innovation has been achieved in all parameters -- power, form factor, and cost to create a material which can sense sound and vibrations in the environment. In particular, SATURN leverages triboelectric effect or static electricity to convert tiny mechanical vibrations caused by sound on the surface it hits into electrical energy. The design of SATURN has been experimentally and theoretically optimized to allow it to be used as a self-powered sensor or a sound-energy harvesting device. A small SATURN patch of 4x4 cm<sup>2</sup> as self-powered sensor achieves sensitivity comparable to an active microphone (which consumes power) till 6000 Hz frequency band. The same patch as a sound harvester generates 10 microwatts in the presence of loud sound. Furthermore, SATURN consists of a multilayered structure of thin and flexible materials - Paper and dielectric PTFE. The work explores easy, reliable and reproducible ways of deploying SATURN on everyday objects and surfaces. Finally, SATURN is made of cheap and readily available materials and has a simple assembly technique to support an easy and large-scale manufacturing process.
- Rajalakshmi Nandakumar, Vikram Iyer, Shyamnath Gollakota, "3D Localization of Sub-Centimeter Sized Devices", ACM SenSys 2018.

- Existing wireless localization systems do not address the needs of size-constrained IoT applications. Today, it is difficult to continuously track objects through walls in homes and warehouses using a small size coin cell battery. While Wi-Fi and ultra-wideband radios can track objects through walls, they consume tens of milliwatts of power and can run only for a month on coin cell batteries. On the other end, RFID tags are passive and small but they have very limited range and does not work consistently across walls. Instead, we propose the first sub-centimeter sized localization system ‘uLocate’ that consumes microwatts of power at a mobile device and can be localized across multiple rooms in settings such as homes and hospitals.  
uLocate is a multi-band backscatter system that operates across 900 MHz, 2.4 and 5 GHz and can extract the backscatter phase information from signals below the noise floor. The sub-centimeter sized prototype consumes 93 uW and can last five to ten years on button cell batteries. The system achieves a range of up to 60m from the router as well as enables 3D tracking capabilities.
- Mao, Mei Wang, Lili Qiu, “AIM: Acoustic Imaging on a Mobile Wenguang,” Mobisys 2018.
  - Acoustic imaging is an attractive complement to camera based imaging since it can image under darkness and/or obstruction. This is the first work that brings acoustic imaging to widely available smartphones without any special hardware. Their smartphone app lets a user image an object by simply swiping the phone across the target. The app plays a special audio file through a smartphone speaker and processes the acoustic signals reflected from the target to the smartphone microphone to produce an image within 100 ms. It can not only image an object in clear sight but also under clothes and plastic bags. The work is inspired by RADAR imaging, but addresses several unique challenges in using narrowband acoustic signals available on smartphone. Its design is creative and rigorous. It is not only theoretically sound but also has been empirically validated extensively. The work deepens our understanding of RADAR technology, significantly advances the state-of-the-art in acoustic imaging, and has the potential to make impact (e.g., weapon detection, cognitive assistance, and health applications).
- Umar Farooq, Zhijia Zhao, “RuntimeDroid: Restarting-Free Runtime Change Handling for Android Apps,” Mobisys 2018.
  - This work presents the first formative study on runtime change handling of real-world Android apps. The study not only reveals the current landscape of runtime change handling, but also points out a root cause of various runtime change issues, i.e., activity restarting. Based on the findings, this work designs a restarting-free runtime change handling solution, which can automatically load resources online without restarting the activity. More importantly, the solution ensures that the user interaction state is properly preserved during the resource loading. By avoiding activity restarting, this paper shows that the proposed solution successfully fixed a large set of reported runtime change issues, meanwhile reducing the handling delays by an order of magnitude.

### Significant and Innovative Programs

After a successful inaugural Internet of Things Day with a keynote by Dr. Vint Cerf (Google), SIGMOBILE held an Internet of Things Day again with MobiSys’19 in Seoul this year to establish it as an annual event. The program included keynotes by Dr. Feng Zhang (CTO Haier) and Dr. Jaeyeon Jung (Samsung), a panel on “*The Convergence of 5G, AI and IoT and its Impact on Human Productivity*” moderated by Dr. Fahim Kawsar (Nokia Bell Labs and TU Delft), as well as invited talks from industry and academia. The event grew to about 250 participants this year. More details are available here:

[https://www.sigmobile.org/mobisys/2019/iot\\_day/](https://www.sigmobile.org/mobisys/2019/iot_day/)

Under the direction of SIGMOBILE’s information director Prof. Xia Zhou (Dartmouth), SIGMOBILE launched a significant update of its web presence that serves as an introduction to the SIGMOBILE, a hub for upcoming events, as well as a better reflection of SIGMOBILEs overall activities. The website can be found:

<https://www.sigmobile.org/>

Dr. Landon Cox (Microsoft) is the new editor-in-chief of *GetMobile*, SIGMOBILE’s significantly transformed quarterly publication, which is a revamped version of the ACM SIGMOBILE Mobile Computing and Communications Review (MC<sup>2</sup>R). Each issue of *GetMobile* consists of a set of regular sections curated by a

committed group of editors and has won a lot of praise from the broad community for improved quality of content and articles.

SIGMOBILE's MobiCom conference will continue a multiple submission deadline model with a summer and winter deadline per year. Papers submitted to both deadlines undergo the same rigorous review process with decisions rendered at an in-person technical program committee meeting after the reviewing phase for each deadline. To reduce travel, one of the TPC meetings will be co-located with the conference itself this year.

SIGMOBILE is continuing to expand the SIGMOBILE YouTube channel through which we provide video-recorded talks from our major conferences and workshops. This content is publicly available and anyone can now watch the talks from our conferences at their convenience, even if they were not able to attend the conference itself. Engagement on this channel is rising significantly, with a 52% increase in watch time in 2018. Many of our viewers seem to be from countries that are traditionally underrepresented at our conferences, including Asia and South America. This channel thereby allows us to reach many more constituents than our conferences and workshops currently do.

### **Events or Programs to Broaden Participation**

SIGMOBILE operates a program to broaden participation that involves several key activities: workshops designed for underrepresented groups, informal lunch meetings and mentoring, and student travel grants. To ensure coordination and stewardship of resources, SIGMOBILE has created a broadening participation committee. With the start of the next fiscal year, the role of the committee is to:

- Advise organizers and SIG officers on best practices regarding broadening participation
- Prioritize broadening participation-related funding requests within a given budget
- Develop measurable objectives for our broadening participation program and track its progress
- Help publicize SIGMOBILE's activities (through website, email, Twitter, for example)
- Coordinate among the different activities and groups that SIGMOBILE sponsors

The initial committee members are Prof. Ana Aguiar (Univ. of Porto), Prof. Rajesh Balan (SMU), Prof. Katia Jaffres-Runser (IRIT), Prof. Robin Kravets (UIUC), and Dr. Thyaga Nandagopal (NSF).

SIGMOBILE periodically holds the Asian Students Symposium on Emerging Technologies (ASSET). The goal of ASSET is to empower students from developing countries and regional universities with technical writing, speaking, and presentation skills and also allow them to experience a top-tier research conference. Each ASSET participant usually prepares a short research project writeup, record a 30s elevator pitch research presentation video, and present a research poster. These artefacts were evaluated by five faculty mentors (in small groups) and the students iterated their submissions based on this feedback. The feedback from the student participants was very positive and we plan to organize more such events, particularly also to broaden our reach to other continents.

In partnership with the N2Women group, we are hosting a N2Women dinner meeting at MobiCom'19. We also continue meetings at other main conferences, often in the form of a lunch meeting and occasionally as a full day workshop. These serve as a forum for researchers from underrepresented groups to network and to discuss career questions. Meetings are organized by a graduate student under the mentorship of a senior researcher from the community. The graduate student is usually supported with a travel grant.

SIGMOBILE operates a student grant program that co-sponsors students travel costs to SIGMOBILE conferences. Conference organizers are asked to explicitly consider the goal of broadening participation when selecting travel grant awardees.

Budget permitting, SIGMOBILE also occasionally sponsors activities from partner organizations focused on broadening participation, such as the CRA-W conference.

### **Key issues facing the community**

**Greater industry engagement:** We believe that SIGMOBILE can engage even better with the mobile and wireless industry that is having such a significant impact in the world today. We have taken some initial steps, e.g., the IoT Day, a Wireless Industry Days workshop, the Youtube channel, and the revamped GetMobile publication with a broader appeal. But much more can and should be done, and we need to look for better and greater ways of engaging with our broader industry.

**Conference co-locations:** SIGMOBILE today sponsors multiple major conferences --- MobiCom, MobiHoc, MobiSys, SenSys, UbiComp, along with newer additions such as PerDis. Each conference has a slightly different focus, has thrived over the years, and is considered a premier venue in the field. However, sometimes there is a concern that too many conferences may dilute a community and there maybe need for periodic co-locations and greater coordination. This is an issue that requires further introspection.

## **Summary**

Mobile computing and wireless networking are among the fastest growing fields within computer science and engineering, and as a result SIGMOBILE continues to be a strong, successful, well-supported organization. This year, newer SIGMOBILE initiatives included establishing the IoT Day to reach out to industry and the wider technical community as an annual event through a second successful meeting, a new SIGMOBILE website to serve the community, and expanding broadening participation activities under a broadening participation program.

The SIG's conferences and workshops are well attended, creating a wealth of publications for the ACM digital library and the SIG's members. The community continues to create significant impact both technically and to the broader society through research, education, and other activities.