

MOBILE CROWD SENSING: PART 2



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Mobile crowd sensing (MCS) presents a new sensing paradigm that empowers ordinary citizens to contribute data sensed or generated from their mobile devices (e.g., smartphones, wearable devices, smart vehicles), and aggregates and fuses the data in the cloud for crowd intelligence extraction and human-centric service delivery. MCS benefits a number of application areas regarding urban/community dynamics monitoring, environment monitoring, traffic planning, public safety, and beyond. At the same time, numerous and unique research challenges, such as participatory data collection, optimal sensing node selection, proper incentive mechanisms, transient network communication, data quality/trust maintenance, cross-space data processing, and so on, arise from the MCS paradigm.

Among the 42 articles submitted from around the globe, nine were finally selected for publication. The articles are organized as Parts 1 and Part 2. Part 1 involved six articles and was published in the August 2014 issue. The other three are published as Part 2 in this issue. The three articles cover three different application areas of MCS: smart city services, wireless communication, and social sensing.

The first article, “ParticipAct Mobile Crowd Sensing Living Lab: The Testbed for Smart Cities” by Cardone *et al.*, presents the design of ParticipAct, an MCS experiment ongoing at the University of Bologna. The article describes the architecture of ParticipAct which allows it to represent MCS campaigns and act as support for external applications that can exploit crowd sensing. The initial deployment involving 150 students allowed the authors to identify resiliency to poor data quality, simple crowd sensing campaign design, and repeated involvement requests as key techniques to ensure efficient and effective collection of crowd sensed data.

The second article, “MCNet: Crowdsourcing Wireless Performance Measurements through the Eyes of Mobile Devices” by Rosen *et al.*, presents a system for efficiently

and effectively monitoring enterprise WiFi networks through MCS. Using unmodified consumer mobile devices to passively collect measurements, MCNet produces an aggregate map of performance problems that directly reflects the performance experienced by users. Periodic sampling and leveraging mobile sensor information to intelligently schedule measurements allows meaningful WLAN performance problems to be detected while keeping battery consumption low.

The third article, “Crowdsensing the Speaker Count in the Wild: Implications and Applications” by Xu *et al.*, presents an MCS engine, Crowd++, which infers the number of speakers in a place by analyzing the audio captured by mobile devices’ microphones. Crowd++ enables a number of social sensing applications. For places, Crowd++ is able to characterize the social engagement of the place itself: for example, is this a place where people often hold conversations? Is it a social hotspot? For individuals, Crowd++ can be leveraged to assess a person’s social well being by, for example, detecting social isolation, which is often a precursor of clinical conditions such as depression.

In concluding this overview, we would like to address our special thanks to Dr. Sean Moore, Editor-in-Chief of *IEEE Communications Magazine*, and Charis Scoggins and Jennifer Porcello for their great support and effort throughout the whole publication process of this Feature Topic. We are also grateful to all the authors for submitting their papers, and the reviewers for their professional and timely work in making it possible to publish this Feature Topic.

BIOGRAPHY

BIN GUO [M’06, SM’14] is a professor at Northwestern Polytechnical University, China. He received his Ph.D. degree in computer science from Keio University, Tokyo, Japan, in 2009. During 2009–2011, he was a post-doctoral researcher at Institute TELECOM SudParis, France. His research interests include pervasive computing, mobile social networking, and mobile crowd sensing. He has served as an Associate Editor of *IEEE Communications Magazine*, *IEEE Transactions on Human Machine Systems*, and *Personal and Ubiquitous Computing*. He is the lead Guest Editor of the *ACM Transactions on Intelligent Systems*

and *Technology Special Issue on Participatory Sensing and Crowd Intelligence* and the *Springer Journal of Ambient Intelligence and Humanized Intelligence* Special Issue called *From Digital Footprints to Social and Community Intelligence*. He edited the book *Creating Personal, Social, and Urban Awareness through Pervasive Computing* (IGI Global, 2013). He has served as General Chair of ACM/IEEE SCI '11 and '14, Program or Vice Program Chair of IEEE UIC '13, ANT '14, and IEEE CIT '14, Workshop Chair of iThings '13, and a TPC member for a number of conferences. He has published over 70 scientific papers in referred journals, conferences, and book chapters. He won the best paper award at IEEE CPSCom '13, AMT '12, and GPC '12.

FRANCESCO CALABRESE is an advisory research staff member at the IBM Research — Ireland Center in Dublin. He manages the Smarter Urban Dynamics group, focusing on developing analytics and tools to better understand and optimize urban dynamics. He received his Laurea (B.S. and M.S.) degree in computer engineering cum laude in 2004, and his Ph.D. in computer and system engineering from the University of Naples Federico II, Italy, in 2007. He was research scientist and postdoctoral associate at the Massachusetts Institute of Technology from 2007 to 2010, where he led research in urban networks and society. His research interests include ubiquitous computing, intelligent transportation systems, urban network analysis, and the design of distributed control systems. He has co-authored over 60 scientific publications. His work has been exhibited in leading museums worldwide, including the Venice Biennale, Science Gallery, and Museum of Modern Art, New York. He was lead Guest Editor of the Special Issue on "Pervasive Urban Applications of the *Pervasive and Mobile Computing Journal*."

EMILIANO MILUZZO is a researcher at AT&T Labs Research. His work sits at the intersection of mobile systems and applied machine learning, pioneering

the field of smartphone sensing research, where a person's smartphone can be used to infer personal and surrounding context in a resource-efficient manner. Results of his research have been published at top-tier conferences such as SenSys, MobiSys, UbiComp, and workshops (e.g., HotMobile). He serves on the program committees of leading venues and co-organizes a number of smartphone sensing, infrastructure, and data analytics workshops, and mobile app competitions (co-located with SIGCOMM '13 and SenSys '13, MobiCom'14 Mobile App Competition, and more). He holds a Ph.D. in computer science from Dartmouth College, and his M.Sc. and B.Sc. in electrical engineering from the University of Rome "La Sapienza," Italy.

MIRCO MUSOLESI is a reader in networked systems and data science at the School of Computer Science at the University of Birmingham, United Kingdom. He received a Ph.D. in computer science from University College London in 2007 and a Master's in electronic engineering from the University of Bologna in 2002. Before joining Birmingham, he was a lecturer in computer science at the School of Computer Science at the University of St. Andrews, United Kingdom. From October 2005 to August 2007 he was a research fellow at the Department of Computer Science, University College London. From September 2007 to August 2008 he was an ISTS Postdoctoral Research Fellow at Dartmouth College, and from September 2008 to October 2009 a Postdoctoral Research Associate at the Computer Laboratory, University of Cambridge. His research interests are in the areas of ubiquitous computing, networked systems, and large-scale data mining. He has been involved in several ACM and IEEE events in the past years as Program Chair and Program Committee Member. He is also a reviewer for leading computer science journals including many ACM and IEEE Transactions.

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