BIOGRAPHICAL SKETCH

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NAME: Chakraborty, Samarjit

eRA COMMONS USER NAME (credential, e.g., agency login): SAMARJIT_CHAKRABORTY

POSITION TITLE: Distinguished Professor of Computer Science

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Jadavpur University, India	BE	07/1996	Computer Science
Indian Institute of Technology Kanpur	MTech	07/1998	Computer Science
Swiss Federal Institute of Technology (ETH) Zurich	PhD	04/2003	Electrical Engineering

A. Personal Statement

My research is centered around embedded (computer) systems and software design. I have worked on a broad spectrum of problems in this domain, including hardware design, wireless communications, power management, battery systems design, model-based software synthesis, and formal verification. My prior work on designing wearable sensors for health and activity monitoring, and low-power wireless communication protocols, are of particular relevance to this project. I have participated and also led multidisciplinary research projects involving hospitals, medical device manufacturers, and university researchers, where we have successfully designed and prototyped affordable and mass-deployable medical screening devices. Such devices were targeted for primary schools and rural healthcare centers in developing countries, where there is a lack of trained medical personnel and therefore a need for screening and diagnostic devices that may be used by lay people.

Recent work from my group led to the first complete energy model for the Bluetooth Low Energy (BLE) wireless communication protocol and was awarded the 2021 ACM Trans. Embedded Computing Systems Best Paper Award. We have also developed the first optimal protocol for neighbor discovery in BLE (SIGCOMM 2019 & IEEE Trans. Mobile Computing 2022). We plan to leverage these results and our experience in this domain to successfully contribute to this project.

Before coming to UNC in 2019, I was a professor of Electrical Engineering at the Technical University of Munich (TUM) in Germany from 2008 – 2019, and an assistant professor of Computer Science at the National University of Singapore from 2003 – 2008. From 2003 – till date, I have mentored 27 graduate students who completed their PhD degrees, 7 postdoctoral scholars, and over 50 undergraduate and master's students who wrote their theses under my mentorship. 16 of my former PhD and postdoc mentees went on to faculty positions at top academic institutions around the world, such as UPenn, TU Eindhoven, TU Berlin, and the Chinese Academy of Sciences in Beijing. My current research group at UNC consists of 3 graduate students, 1 postdoc, and 2 undergraduate students. In addition, I continue to mentor 5 students at TUM, who will complete their PhD soon.

I have co-authored over 300 publications since completing my PhD in 2003 and raised the equivalent of over US$ 15M (my share) in research funding from various governmental funding agencies and industry sponsors in Singapore, Germany, and the United States (including NSF). These include contracts from General Motors, Google, Intel, BMW, Audi, Siemens, and Bosch. My contributions to computer science and engineering are well recognized by the scientific community (*e.g.*, through various awards for our research, and my participation in the editorial boards of multiple prominent journals on embedded computing systems), and also by the industry.

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2022 – present	Chair, Department of Computer Science, University of North Carolina at Chapel Hill, NC
2019 – present	William R. Kenan, Jr. Distinguished Professor of Computer Science, UNC Chapel Hill
2008 – 2019	Professor & Chair of Real-Time Computer Systems, Technical University of Munich (TUM)
2011 – 2016	Scientific Advisor, TUM CREATE Center for Electromobility, Singapore
2003 – 2008	Assistant Professor of Computer Science, National University of Singapore

2022 – present	Associate Editor, *ACM Journal on Autonomous Transportation Systems*
2016 – present	Associate Editor, *ACM Transactions on Cyber-Physical Systems*
2013 – present	Associate Editor, *Leibniz Transactions on Embedded Systems*
2011 – present	Editorial Board Member, *Springer Lecture Notes on Electrical Engineering*
2016 – 2020	Associate Editor, *IEEE Transactions on Computers*
2012 – 2021	Associate Editor, *Design Automation for Embedded Systems*
2018 – 2021	Associate Editor, *Journal of Systems Architecture*

2020 & 2021	Chair of the ACM SIGBED Early Career Researcher Award Committee
2020 & 2021	Member of the ACM SIGBED Paul Caspi Memorial Dissertation Award Committee
2021	Member of the EMSOFT Test-of-Time Award Committee
2021 – present	Member of the Board of Directors of ACM SIGBED (SIG on Embedded Computing Systems)

Honors

2022	IEEE Fellow (for contributions to system-level timing analysis of cyber-physical systems)
2022	ACM Distinguished Speaker
2022	Alexander von Humboldt Professor
2022	Our article on COVID contact tracing featured on the cover page of Comm. of the ACM
2021	ACM Trans. Embedded Computing Systems (TECS) Best Paper Award
2019	ACM Trans. Design Automation of Electronic Systems (TODAES) Best Paper Award
2017	35th IEEE International Conference on Computer Design (ICCD) Best Paper Award
2017	23rd IEEE Int. Conf. Embedded & Real-Time Com. Sys. & Appl. (RTCSA) Best Paper Award
2017	ACM/IEEE Int. Symp. on Low Power Electronics and Design (ISLPED) Best Paper Award
2013	11th Int. Conf. on Mobile Systems, Applications & Services (Mobisys) Best Demo Award
2012	National Centres of Competence in Research in Switzerland (NCCR) Best Thesis Award
2011	16th Asia and South Pacific Design Automation Conference (ASP-DAC) Best Paper Award
2010	8th International Conf. on Embedded and Ubiquitous Computing (EUC) Best Paper Award
2004	European Design & Automation Assoc.'s (EDAA) Outstanding Doctoral Dissertation Award
2004	ETH Medal and prize for excellent doctoral dissertation

C. Contributions to Science

(a). Low-power wireless communication

Being able to communicate data with low energy overheads is crucial for the success of many wearable devices. Here, my research group has been the first to develop a complete energy model for the well-known Bluetooth Low Energy (BLE) protocol. Today, BLE is in all commercially available wearable devices for health and activity monitoring and is used by the wearable device to communicate data with an edge-device such as a smartphone. An energy model is the first step towards optimal protocol parameterization, to minimize energy consumption. We have also developed optimal neighbor discovery protocols – that are used by two devices to recognize their mutual presence before they can start communicating. Neighbor discovery is the key to applications like smartphone-based electronic contact tracing. If the protocol for it is not properly configured, neighbor discovery can not only take substantial time, but also drain the battery life of the device.

1) P. H. Kindt, T. Chakraborty, S. Chakraborty: How reliable is smartphone-based electronic contact tracing for COVID-19? *Commun. ACM* 65(1): 56-67 (2022) DOI: https://doi.org/10.1145/3471933
2) P. H. Kindt, S. Narayanaswamy, M. Saur, S. Chakraborty: Optimizing BLE-Like Neighbor Discovery. *IEEE Trans. Mob. Comput*. 21(5): 1779-1797 (2022) DOI: https://doi.org/10.1109/TMC.2020.3028270

3) P. H. Kindt, D. Yunge, R. Diemer, S. Chakraborty: Energy Modeling for the Bluetooth Low Energy Protocol. *ACM Trans. Embed. Comput. Syst*. 19(2): 13:1-13:32 (2020) DOI: https://doi.org/10.1145/3379339
4) P. H. Kindt, S. Chakraborty: On optimal neighbor discovery. *Proceedings of the ACM Special Interest Group on Data Communication (SIGCOMM)* 441-457 (2019) DOI: https://doi.org/10.1145/3341302.3342067

(b). Power management in portable edge devices

The usability of edge devices like smartphones in conjunction with wearables, heavily depend on their power consumption and therefore how long their battery lasts on one charge. Modern smartphones use multicore processors and hardware accelerators like graphics processing units (GPUs), whose voltage and operating clock frequencies can be adjusted at runtime. Operating systems like Android or iOS have built in power management governors that dynamically adjust the processor's voltage and frequency in response to time-varying workloads from the software running them. We have developed new power management strategies that are application-aware and can save considerably (> 50%) more energy than what Android's default governors can. In collaboration with researchers from Intel and Google (see https://doi.org/10.1145/3205289.3205293) we have demonstrated these benefits on Google's Chrome browser running on Android smartphones.

1) E. Shamsa, A. Pröbstl, N. Taherinejad, A. Kanduri, S. Chakraborty, A. M. Rahmani, P. Liljeberg: UBAR: User- and Battery-aware Resource Management for Smartphones. ACM Trans. Embed. Comput. Syst. 20(3): 23:1-23:25 (2021) DOI: https://doi.org/10.1145/3441644
2) D. Yunge, S. Park, P. H. Kindt, S. Chakraborty: Dynamic Alternation of Huffman Codebooks for Sensor Data Compression. IEEE Embed. Syst. Lett. 9(3): 81-84 (2017) DOI: https://doi.org/10.1109/LES.2017.2714899
3) B. Dietrich, D. Goswami, S. Chakraborty, A. Guha, M. Gries: Time Series Characterization of Gaming Workload for Runtime Power Management. IEEE Trans. Computers 64(1): 260-273 (2015) DOI: https://doi.org/10.1109/TC.2013.198
4) B. Dietrich, S. Chakraborty: Lightweight graphics instrumentation for game state-specific power management in Android. Multim. Syst. 20(5): 563-578 (2014) DOI: https://doi.org/10.1007/s00530-014-0377-x

(c). Battery systems and charger design

In our effort to design energy-efficient systems and improve usability, we have also developed new battery management techniques with the goal of improving the lifetime of battery packs and reduce their aging. Towards this, we have studied (i) new algorithms and power electronics for charge balancing across cells in a battery pack, (ii) intelligent battery chargers that are cognizant of when a smartphone might be used, and schedules its charging accordingly to minimize battery aging; this is done by reducing the duration for which the battery remains in a high charge state, and (iii) techniques to schedule wireless data communication in small sensor nodes to exploit the charge recovery effect in the batteries that power the nodes.

1) A. Pröbstl, B. Islam, S. Nirjon, N. Chang, S. Chakraborty: Intelligent Chargers Will Make Mobile Devices Live Longer. IEEE Des. Test 37(5): 42-49 (2020) DOI: https://doi.org/10.1109/MDAT.2020.3006799
2) S. Narayanaswamy, S. Steinhorst, M. Lukasiewycz, M. Kauer, S. Chakraborty: Optimal Dimensioning and Control of Active Cell Balancing Architectures. IEEE Trans. Veh. Technol. 68(10): 9632-9646 (2019) DOI: https://doi.org/10.1109/TVT.2019.2936646
3) M. Kauer, S. Narayanaswamy, S. Steinhorst, S. Chakraborty: Rapid Analysis of Active Cell Balancing Circuits. IEEE Trans. Comput. Aided Des. Integr. Circuits Syst. 36(4): 694-698 (2017) DOI: https://doi.org/10.1109/TCAD.2016.2597224
4) S. Narayanaswamy, S. Schlüter, S. Steinhorst, M. Lukasiewycz, S. Chakraborty, H. E. Hoster: On Battery Recovery Effect in Wireless Sensor Nodes. ACM Trans. Design Autom. Electr. Syst. 21(4): 60:1-60:28 (2016) DOI: https://doi.org/10.1145/2890501

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/samarjit.chakraborty.1/bibliography/public/
https://dblp.org/pid/c/SamarjitChakraborty.html (publications in Computer Science public bibliography DBLP)