Guest Editorial
Best Paper Finalists from the IEEE RFID 2021

THE NEED to bridge the digital world to the physical one is growing quickly and the RFID technology is mature enough to meet this need. Moreover, the versatility of RFIDs inspires researchers from all over the world to find new techniques that further improve the technology for new cross-disciplinary applications involving localization, healthcare, energy harvesting, computer science and so on.

The six papers in this issue for the IEEE Journal on RIFD were presented at the 2nd Online Edition of the IEEE International Conference on RFID, in April 27-29, 2021 and were among the finalists for the Best Paper Award. The papers introduce new insights about UHF chip design, challenge the meaning of RIFD, use RFID tags for localization in new scenarios, tackle the problem for long-range communications, and demonstrate new ways for the wireless transfer of power.

In [A1], Giannelos *et al.* revisits particle filtering RFID localization methods and introduces a procedure that makes it more robust to phase measurement noise, works without reference tags, and requires a short time for execution. The presented theoretical results are validated through a measurement campaigns for localizing books on bookshelves through a robot-reader involving a multipath rich environment.

Thomas *et al.* challenge the RFID community in [A2] by asking the question on what constitutes an RFID device. In fact, the authors show how a passive vector backscattering technique can be implemented by using a device that is not meant for backscattering systems: an off-the-shelf microcontroller with reconfigurable pins where the backscattering modulation is implemented with GPIO pins. The article details the design procedures, the experimental setups, and the results, hence contributing to bringing more topics of discussion to the RFID community.

In [A3], Bhanushali *et al.* stands out for the creative semiconductor implementation in an RFID application. It presents a 125×245 μm^2 mainly digital UHF RFID Gen2 chip in 55 nm CMOS process. By relying on the digital design process, it can simplify the integration of RFID technology in many existing ICs as a block and create new applications for the RFID technology.

In [A4], Varner *et al.* introduce new theoretical metrics for characterizing and designing successful Ambient Scatter Communication Systems. The authors analyze the methodologies behind current ReMoRa techniques and synthesize and compare performance data with the state of the art. Moreover, the authors show that management of Primary User Interference (PUI) will be essential to achieving long range communications and identify future research directions for the community to overcome the problem of PUI.

Kapoor *et al.* explore the use of RFIDs to monitor work pressure and burnout of hospital employees in [A5]. The authors describe a real-time location system based on RFID technology to track the movements of hospital staff and evaluate the percent sedentary time to have an indicator of the risk of burnout. The work is a practical application that demonstrates the feasibility of using RFID technology for a continuous monitoring of some parameters that can estimate the hospital staff workload. Data were acquired in a real scenario (the emergency department of Mayo Clinic's hospitals in Rochester, MN), for three years. RFID tags were inside the employees' badges while readers were mounted on the ceiling of halls and rooms.

Wireless power transfer is more and more a crucial topic these days due to the ubiquity of mobile devices. In [A6], Figueroa *et al.* present, therefore, a wireless power transfer system using a five-coil asymmetric topology for extending the wireless charging range of an electronic device. With a detailed theoretical analysis and an accurate description of the prototype, the authors demonstrate the transfer of power at a distance of 61 cm.

These papers testify the evolving nature of the RFID technology and its multidisciplinary applications built upon the on-going research results achieved by the RFID community in the fields of antenna and circuit design, protocol and software development, sensors, low-powered electronics, and energy harvesting. Exploring the realm of RFIDs from several different angles is indeed bringing fresh new ideas to the field and planting seeds for new applications that will shape the way we will live our future.

Appendix
Related Articles

[A1] E. Giannelos, E. Andrianakis, K. Skyvalakis, A. G. Dimitriou, and A. Bletsas, "Robust RFID localization in multipath with phase-based particle filtering and a mobile robot," *IEEE J. Radio Freq. Identif.*, early access, Jun. 4, 2021, doi: 10.1109/jrfid.2021.3086759.

[A2] S. J. Thomas and J. Howe, "Achieving multistate vector scattering with unmodified digital input/output pins," *IEEE J. Radio Freq. Identif.*, early access, Jun. 5, 2021, doi: 10.1109/JRFID.2021.3086756.

[A3] K. Bhanushali, W. Zhao, W. S. Pitts, and P. D. Franzon, "A $125\mu\text{m}\times245\mu\text{m}$ mainly digital UHF EPC Gen2 compatible RFID tag in 55 nm CMOS process," *IEEE J. Radio Freq. Identif.*, early access, Jun. 7, 2021, doi: 10.1109/jrfid.2021.3087448.

[A4] M. A. Varner and G. D. Durgin, "Achieving long-range ambient scatter communication networks: A primary user interference perspective," *IEEE J. Radio Freq. Identif.*, early access, Jun. 15, 2021, doi: 10.1109/JRFID.2021.3089436.

Digital Object Identifier 10.1109/JRFID.2021.3098991

[A5] A. Kapoor *et al.*, "Estimating physical work-load on ED clinicians and staff using real-time location systems," *IEEE J. Radio Freq. Identif.*, early access, Jun. 30, 2021, doi: 10.1109/JRFID.2021.3091903.

[A6] R. R. Figueroa, A. G. Morinec, E. J. Jones, L. Djibo, S. Tapias, and G. Durgin, "Design and experimentation of a novel five coil asymmetric magnetic resonance wireless power transfer system," *IEEE J. Radio Freq. Identif.*, early access, Jun. 25, 2021, doi: 10.1109/JRFID.2021.3089934.

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Francesco Amato (Member, IEEE) received the B.S. and M.S. degrees in telecommunication engineering from the University of Roma Tor Vergata in 2006 and 2009, respectively, and the Ph.D. degree in electrical and computer engineering from the Georgia Institute of Technology, Atlanta, USA, in 2017. From 2009 to 2011, he was with SES, Luxembourg, as a Ground System Engineer. In 2015, he was a Research Intern with Intel Labs, Santa Clara, CA, USA. From 2017 to 2018, he was a Postdoctoral Researcher with the Sant'Anna School of Advanced Studies, Digital and Microwave Photonics Group, Pisa, Italy, and a Postdoctoral Researcher with the Pervasive Electromagnetic Lab, Tor Vergata University, Rome, Italy, in 2019 and 2020. He received, among others, the Fulbright Scholarship in 2012, the Best Student Paper Award of the IEEE International Conference on RFID-Technologies and Applications in 2015, the William Brown Fellowship in 2015, the Best Paper Award at the IEEE International Conference on RFID and the Clive Hohberger Technology Award in 2019, and the Third Prize of the Bell Labs Prize in 2020. He was a member of the organizing committee for the IEEE International Conference on RFID (IEEE RFID) from 2017 to 2020 and has been the IEEE RFID Technical Program Chair in 2021. He serves as a Treasurer and a Secretary for the IEEE Council on RFID.

Stewart J. Thomas (Member, IEEE) received the B.S. and M.Eng. degrees in electrical engineering from the University of Louisville, Louisville, KY, USA, and the Ph.D. degree in electrical and computer engineering from Duke University, Durham, NC, USA. He is currently an Assistant Professor with the Department of Electrical and Computer Engineering, Bucknell University, Lewisburg, PA, USA. His research interests include wireless power transfer, low-power communication, and RFID systems. He served as the Technical Program Vice Chair for RFID 2021.