

# **2024 IEEE International Conference on RFID Technology and Applications (RFID-TA 2024)**

**Daytona Beach, Florida, USA  
18-20 December 2024**



**IEEE Catalog Number: CFP24RFT-POD  
ISBN: 979-8-3315-4023-4**

**Copyright © 2024 by the Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP24RFT-POD
ISBN (Print-On-Demand):	979-8-3315-4023-4
ISBN (Online):	979-8-3315-4022-7
ISSN:	2377-018X

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

## TABLE OF CONTENTS

ID-Yarn: Form-Factoring an RFID Tag into a Yarn and How it Can Work Well..... 1 <i>Tianyang Chen, Yulong Liu, Zhengzheng Li, Yuchen Jiang, Mengxia Yu, Lulu Xu, Terry Tao Ye</i>	1
Phase-Based Spatial Resolution of Chipless RFID Tags..... 5 <i>F. Villa-Gonzalez, R. Bhattacharyya, J. Y. Hu, S. E. Sarma</i>	5
Evaluating Channel Based Relay Attack Detection in the Near-Field..... 9 <i>Radi Abubaker, Guang Gong</i>	9
A Practical Assessment of Integrating RFID into Over-The-Counter Liquid Suspension Supply Chains..... 13 <i>Danielle Cummins, Ethan Claunch, Jordyn Nowaczyk, Nimai Patel, Bahar Aliakbarian</i>	13
RFID Toolkit for Customizable Game Controlling ..... 17 <i>Asif Shaikh, Sari Merilampi, Ruowei Xiao, Shiva Jabari, Oguz 'Oz' Buruk, Juho Hamari, Johanna Virkki</i>	17
Design and Development of a Patch Antenna Array for Wireless Power Transfer in Drones ..... 21 <i>Vinicius Uchoa Oliveira, Ricardo A. M. Pereira, Amit Baghel, Nuno Borges Carvalho</i>	21
Scattering Bluetooth Messages Between Battery-Less Transponder and Mobile Telephones..... 25 <i>Matthias Schütz</i>	25
Motion-Modulated Harmonic Sensors ..... 29 <i>Meng Yang, Nicolas Barbot</i>	29
A Novel Array of Strongly Coupled Magnetic Resonators for Misalignment-Resilient Wireless Power Transfer, Harvesting, and Sensing in Wearable Applications..... 32 <i>Dieff Vital</i>	32
Compact Fully Integrated Rectenna System with a Reconfigurable Power Management System for Energy Harvesting at 2.45 GHz..... 34 <i>Jelle Jocqué, Joryan Sennesael, Jo Verhaever, Patrick Van Torre, Hendrik Rogier</i>	34
Miniaturized Epidermal RFID-Based Wireless Programmable Frequency Selective Surface as a Smart Shield for Implantable Cardiac Devices..... 38 <i>Francesco Lestini, Gaetano Marrocco, Cecilia Occhiuzzi</i>	38
Towards a Conformal Metasurface Transmitter for Programmable Near-Field Power Transfer to Miniaturized Bioelectronics ..... 42 <i>Wenpu Xia, Hamed Rahmani</i>	42
The Impact of Array Size on Fading in Retrodirective Backscatter Channels: Modelling and Simulation ..... 46 <i>Sebastian Böller, Thorben Greuter</i>	46
A 2.4 GHz Frequency Selective Backscatter Modulator for Bluetooth and Wi-Fi Backscatter..... 50 <i>Kevin J. Ho, Matthew S. Reynolds</i>	50
IBID: Intra-Body Identification Using Capacitive Backscatter..... 54 <i>Noor Mohammed, Robert W. Jackson, Sunghoon Ivan Lee, Jeremy Gummeson</i>	54

A First Prototype of an Ambient Backscatter Communication Tag Working in 5G-NR Frequency: Experimental Test and Power Levels Measurements .....	58
<i>Mariam Lefki, Sahbi Baccar, Moncef Kadi, Hanen Shall, Mohamed Ghorbel</i>	
Improved Package Orientation Estimation Through RFID Signal Analysis with LightGBM.....	62
<i>Joaquin Dillen, N. Simões, João M. Faria, Luis Vilas Boas, Inês Caetano, Luis Cardoso, João Borges, António H. J. Moreira</i>	
RFID Tag Motion Detection Through Machine Learning with a Single Antenna Setup.....	66
<i>João M. Faria, Luis Vilas Boas, Joaquin Dillen, N. Simões, Inês Caetano, Luis Cardoso, João Borges, António H. J. Moreira</i>	
SHF RFID Based Localization: Combining Time-Of-Flight and Angle-Of-Arrival .....	70
<i>Sebastian Böller, Alexander Bödder, Jona Riegler, Thorben Greuter</i>	
Direct Positioning in Single-Channel UHF-RFID Systems with Particle Filter-Based Algorithms .....	74
<i>Thomas M. Pohl, Christoph F. Mecklenbräuker, Lukas Wielandner, Holger Arthaber</i>	
Towards Multi-Frequency and Multi-View Localization Via UHF-RFID Passive Tags .....	78
<i>Giuseppe Martino, Martina T. Bevacqua, Luca Catarinucci, Massimo Merenda</i>	
Towards Memristor-Based Neuromorphic RFID Circuits and Architectures .....	81
<i>Riccardo Colella, Alberto Arciello, Giuseppe Grassi, Massimo Merenda</i>	
From Backscatter to Digital Twins: The Evolving Landscape of Additively Manufactured and Lens- Based RFIDs for Ultra-Long Range, Sub-Cm Accuracy, and Origami-Inspired Reconfigurability.....	85
<i>Hani Al Jamal, Marvin Joshi, Manos M. Tentzeris</i>	
A 32-Channel Fully-Digital Adaptive Applebaum Aperture at 5.8 GHz for Array RF Sensing .....	89
<i>Umesha Kumarasiri, Sivakumar Sivasankar, Chamira Edussooriya, Viduneth Ariyaratna, Arjuna Madanayake</i>	
Decentralized Neighborhood Discovery and Management in Dense RFID Systems.....	93
<i>Bernard Amoah, Xiangyu Wang, Jian Zhang, Shiwen Mao, Senthilkumar Cg Periaswamy, Justin Patton</i>	
Wideband Digital N-Beam Delay-Sum Apertures at O(N) Complexity: Towards 64 GS/s 8-Beams on Intel Agilex-9 Direct-RF Chiplets .....	97
<i>Sirani M. Perera, Arjuna Madanayake</i>	
Novel mmWave/5G RFID Architectures for Next Generation of IoT Devices and VR Applications.....	101
<i>Theodore W. Callis, Marvin Joshi, Manos M. Tentzeris</i>	
eNVM Based Physical Unclonable Function for Enhanced RFID .....	105
<i>Alberto Arciello, Massimo Merenda</i>	
High-Sensitive Demodulator with Built-In Negative Offset Comparator for Passive UHF RFID Tags .....	109
<i>Rohit Kesharwani, André Jager, Martin Grabmann, Georg Glaser, Eric Schafer</i>	
A Dual-Band Approach for Backscattering Modulation.....	113
<i>Joryan Sennesael, Jelle Jocqué, Hendrik Rogier, Patrick Van Torre</i>	
UHF-RFID System for Real-Time Sheep Location in Sheepfold Environments .....	117
<i>Lotfi Batel, François Dehmas, Nicolas Deparis, Sebastien Duroy, Uranie Jean-Louis, Elisa Peugny</i>	

Comparing Smart Post Box Concept Preferences in Pre- And Post-COVID19 Global Pandemic in the Czech Republic Postal Sector .....	121
<i>Jan Procházka, Alena Kubáčová, Martin Fiala</i>	
RFID-Equipped Stability Chamber for in-Vial Wireless Monitoring of Pharmaceuticals.....	125
<i>Nicoletta Panunzio, Adina Bianca Barba, Sara Amendola, Cecilia Occhiuzzi, Gaetano Marrocco</i>	
Analysis of Antenna Arrays in Command and Non-Payload Communication for Unmanned Aircraft Systems in the C-Band .....	129
<i>Mubark Alghamdi, Ivica Kostanic</i>	
Switching Millimeter Wave Channels Using Fuzzy Controller System .....	133
<i>Esmail Abuhdima, Abdulmajid Mrebit, Naomi Rolle, Jason Laing, Nabeyou Tedessa, Jian Liu, Amirhossein Nazeri, Gurcan Comert, Chin-Tser Huang, Pierluigi Pisu</i>	
Next-Generation Battery Management Systems: Integrating RFID for Battery Passport Applications.....	137
<i>Florian Scherr, Fikret Basic, Patrick Eder, Christian Steger, Robert Kofler</i>	
Interference Cancellation at the Source for Passive Wireless Sensing Applications .....	141
<i>Ali Abedi</i>	
Passive Cylindrical Resonator Temperature Sensor Based on Commercial Low-Loss Dielectric Material .....	145
<i>Jayaprakash Shivakumar, Nicholas Reed, Cory Clark, Rishikesh Srinivasaraghavan Govindarajan, Daewon Kim, Eduardo Rojas</i>	
Enhancing RFID Observations Using Masked Autoencoders for Improved Indoor Localization.....	149
<i>Pritom Dutta, Jian Zhang, Bernard Amoah, Xiangyu Wang, Kanchon Kanti Podder, Shiwen Mao</i>	
Wireless and Continuous Strain Measurement of Rotating Helicopter Blades Using Implanted Backscatter Sensors .....	153
<i>Zidan Zhao, Jin Mitsugi</i>	
Optimizing Adaptive Power Control for Enhancing Robustness in RFID Sensing .....	157
<i>Bernard Amoah, Xiangyu Wang, Jian Zhang, Shiwen Mao, Senthilkumar Cg Periaswamy, Justin Patton</i>	
RFID and IoT-Enabled Sign Language to Speech Conversion Using Deep Learning .....	161
<i>K Saikumar, Prasadareddy Patakottu, Mohamed Baza, K Srinivas Rao, Amar Rasheed, Wassila Lalouani</i>	
Radio Frequency Fingerprinting Enrollment for Proximity Integrated Circuit Cards .....	165
<i>Jin Kuan Li, Bryan Ng Guowei, Helio Augusto Muzamane, Hsin-Chin Liu</i>	
Evaluating the Performance of RF Fingerprinting Feature Extractor for Proximity Integrated Circuit Cards.....	169
<i>Bryan Ng Guo Wei, Jin-Kuan Li, Helio Augusto Muzamane, Hsin-Chin Liu</i>	
CryptoPUF: A Lightweight and ML-Resilient Strong PUF Based on a Weak PUF and Crypto Core.....	173
<i>Yimin Gao, John Chilaka, Elisa Pantoja, Robert Klenke, Mircea Stan</i>	
Enhancing Security of RFID Implants in the Healthcare Industry .....	177
<i>Bewaji Oluwaseun, Abiodun Ogunmilua, Eslam G. Abdallah</i>	

Cryptographic Key Generation Based on RF Graphene Quantum Capacitor Trimmers ..... 181  
*Yichong Ren, Chia-Heng Sun, Pai-Yen Chen*

Detection of Hardware Trojans in IoT Devices Using mmWave RADAR..... 185  
*Rachel Swan, Harkiran Kaur Bhullar, Eduardo A. Rojas-Nastrucci*

**Author Index**