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Tuesday June 13 2023: 08.00 - 08.30 Welcome coffee - Registration and check in

08.30 - 10.00 WORKSHOP: Rain Alliance: From Barcodes to RAIN, the 101 of tag data. Be a champion, do it right!

Room Number 334

This workshop explores the scope and correct use of the RAIN RFID data structures. The exploration deals with the key air protocol features to ensure efficient and effective item identification, the use of item attributes, authenticity and privacy. Notably, RAIN RFID provides a reliable reading of many tags over distances of 10m, which assists in full automation. The massive increase in the RAIN tag population (more than 30 billion tags were consumed in 2022) has RAIN-enabled applications read space increasingly overlapping. Understanding the use of RAIN data structures will prevent applications from being swamped by unwanted tags, which may lead to application failure when least expected. The exploration considers RAIN, barcode and NFC data interoperability, acknowledging that in many cases RAIN is added to an existing barcode system.
Presented by:
Chris Brown: RFID Subject Matter Expert at TSC Printronix Auto ID
Bertus Pretorius: Solution Architect at Tönnje

10.00 - 10.30 Coffee Break

Room Number 334

10.30 - 12.00 Tutorial: Context-Aware Physical Spaces

Room Number 334

As the AIDC industry celebrates its 50th anniversary this year, the technology has evolved such that today, almost anything can be radio-identified, using standard passive and active tags, at a range of several metres or more. As such, contextual awareness at the scale of a physical space becomes a possibility through the identification, location and sensor data capture of everything present. This tutorial will cover how this data is captured, processed, represented and distributed to enable context-aware physical spaces, with a focus on RAIN RFID and Bluetooth Low Energy technologies, off-the-shelf hardware, and open source middleware. Current and emerging use cases will be presented, as well as a live, interactive demonstration.
Presented by:
Jeffrey Dungen: Co-Founder and CEO of reelyActive

12.00 - 13.00 Lunch

Room Number 334

13.00 - 14.30 Workshop: Motion Capture (MoCap) & Localization

Room Number 334

(1) "Safety first! The role of RFID localization in augmented safety systems"
Industrial environments and outdoor construction sites or agricultural/forestry working areas are characterized by numerous hazards leading to highly probable fatal accidents or severe injuries for workers. Therefore, the design of reliable safety systems based on wireless communications has recently been addressed. Passive UHF-RFID technology has been recently approached as having great potential. The passive feature of RFID tags and the slimness of their structure, which looks like a label, allows to easily install them on worker Personal Protective Equipment (PPE). Moreover, the low-cost enables system redundancy so increasing system reliability. The operating frequency in the UHF band allows a suitable operating distance of some meters which mitigates the occurrence of false positive alarms.

Presented by:
Andrea Motroni, Ph.D., Department of Information Engineering - University of Pisa. 56122, Pisa, Italy

Ambiguity-Free 3D Millimeter-Precision RFID Tag Localization Inside Building Materials...1

Guoyi Xu and Edwin Kan (Cornell University, USA)

Phase-based 3D radio-frequency identification (RFID) tag localization has the advantage of high accuracy, but the inherent phase-range ambiguity needs to be resolved by either frequency or spatial diversity. We propose a reliable 3D tag localization method that exploits spatial diversity to achieve millimeter-precision inside building materials with heavy multi-path interferences. We first obtain the functional relationship between differential phase and differential distance using polynomial fitting and optimization for reference tags and then evaluate the 3D positions of new tags given only phase measurements. A novel ambiguity-free algorithm is devised to identify the correct tag location from multiple candidates by leveraging redundant channel resources with spatial diversity. We prototyped the tag localization system on Universal Software Radio Peripheral (USRP) devices and harmonic backscatter RFID tags and demonstrated millimeter-level localization accuracy at 1.8 GHz second-harmonic carrier frequency inside building materials.

Reconstruction of Passive UHF RFID Tag Trajectories with a Distributed Antenna Reader System...7

Thomas M. Pohl, Holger Arthaber and Christoph F Mecklenbräuker (TU Wien, Austria)

We report on UHF RFID phase measurements for the reconstruction of passive RFID tag trajectories in an experimental setup. The setup consists of a UHF RFID reader connected to eight distributed antennas in a lab room. The antennas are multiplexed in time by phase-stable coaxial switches. The techniques of Gaussian processes are used to estimate missing phase values in the trajectory. The final tag's position in a two-dimensional space is estimated via an evaluation of the maximum phase difference in the trajectory, followed by a grid search to find the most probable position. For test measurements, this algorithm provides over a traveled distance of 15 m an RMS error of approximately 50 cm.

Lane Keeping through RFID...13

Spyros Megalou, Aristidis Raptopoulos Chatzistefanou, Stavroula Siachalou, Traianos Yioultsis and Antonis G Dimitriou (Aristotle University of Thessaloniki, Greece)

In this paper we present a prototype method for guiding a user to a target by introducing RFID-lanes. The user is equipped with a portable RFID reader, which measures the phase of RFID tags arranged at known positions on the floor, forming lanes. By calculating the Rate Of Change (ROC) of the phase measurements of each tag along discrete time-steps, motion of the user can be accurately tracked, while proper direction-guidance is updated. The proposed method, calculates the user's direction of motion, by sorting the measured phase-ROCs from the nearby tags while keeping track of the user's position by feeding the phase-ROCs in a particle filter. Simulations and experimental results show precise localization and guidance while maintaining real-time computations.

15.00 - 16.30 Workshop: Ocean Internet of Things (IoT)

Room Number 334

Ocean IoT has generated a lot of attention due to its potential for exploring new possibilities in underwater technologies and systems such as sensing, imaging, communication, drone technology, localization, marine life monitoring, and carbon cycle tracking. The Workshop on Ocean IoT serves as a platform to explore and discuss these latest innovations for large-scale sensing of the underwater world.

Presented by:
Sayed Saad Afzal, Massachusetts Institute of Technology,
Aline Eid, Department of Electrical Engineering and Computer Science, University of Michigan Ann Arbor.

17.00 - 18.30 Tuesday June 13 2023: Happy Hour

Room: Zillow Commons in the Gates Center for Computer Science & Engineering

Wednesday June 14 2023: PLENARY SESSION

Room Number 334

08.00 - 08.45 Welcome coffee - Registration and check in

08.45 - 09.15 Featured Keynote: Chris Diorio - The Journey to Trillions of Connected Things **(Location change to South Ballroom for this event only)**
Note change of location to South Ballroom for this event only

09.20 - 09.25 Josh Ensworth Conference Opening

09.25 - 09.35 Pavel Nikitin General Chair's Welcome Message

09.35 - 09.40 Ultan Mc Carthy / Aline Eid TPC review & IEEE RFID 2023 Best Paper Award

09.40 - 09.43 Pavel Nikitin: IEEE RFID 2023 presentation of Best paper award

09.43 - 09.45 James Rosenthal / Luca Catarinucci: IEEE RFID 2023 Best Poster Award teaser & casting your vote

09.45 - 10.25 Keynote: Ranveer Chandra - FarmVibes: Democratizing Digital Tools for Sustainable Agriculture
Keynote Bio: Ranveer Chandra is a high-profile technology researcher, currently serving as the Managing Director for Research for Industry and CTO of Agri-Food at Microsoft, while also leading the Networking Research Group at Microsoft Research, Redmond. He is known for his work on VirtualWiFi, low power Wi-Fi, and Software Defined Batteries, which have shipped as features in various Microsoft products. Ranveer is an active member of the networking and systems research community and has published over 100 papers, holds over 150 patents, and has won numerous awards. He was recently recognized by Newsweek magazine as one of America's 50 most Disruptive Innovators.

10.25 - 10.30 OPEN FLOOR Question time

10.30 - 11.00 Coffee Break

Room Number 334

11.00 - 12.30 Uni. of Washington - Dept of ECE Lab tours

The meeting point for those wishing to be part of this tour is the ECE Building atrium. Please ask a member of the OC if you have any questions

12.00 - 13.30 Lunch

Room Number 334

Wednesday June 14 2023: PAPER / TECHNICAL SESSION: Next Gen RFID & ID+ / AI for RFID

Room Number 334

13.30-13.50 Modulated Noise Communication: Reading UHF RFID tags without a carrier
13.50-14.10 Dual-Polarized Electronic Mode Stirring for Improved Backscatter Communication Link Margin in a Reverberant Cavity Animal Cage Environment
14.10-14.30 Exploiting Synergies between Augmented Reality and RFIDs for Item Localization and Retrieval
14.30-14.50 Towards a UHF RFID Electromagnetic Fingerprint-Based Web Resolver for Digital Twins

Modulated Noise Communication: Reading UHF RFID tags without a carrier…19

Joshua R. Smith and Shanti Garman (University of Washington, USA); Zerina Kapetanovic (Stanford University, USA); Ali Saffari (University of Washington, USA); Daisuke Kobuchi (The University of Tokyo, Japan)

This paper demonstrates that UHF RFID tags can be read without a carrier. More specifically, using an alternative reader design that does not emit a carrier, we show that it is possible to read an RFID tag that was designed to be read by a conventional RFID reader that does emit a carrier. Typical RFID tags are designed to modulate a carrier; it turns out that, in addition to modulating a carrier, a backscatter modulator circuit also modulates tag circuit noise, including Johnson noise; Johnson and other noise is present in a tag even if a carrier is not. Modulated Noise Communication (MNC) can be read by an alternative reader design. The reader for modulated noise communication is simpler than a conventional backscatter reader because it does not have to contend with the problem of self-jamming. The absence of a carrier means that the tag needs an alternative power source; this could be an energy harvester such as a photovoltaic cell, or could be a time-multiplexed continuous wave signal from the reader. The use of time multiplexing means that the reader would still inherit the benefits of not needing to counteract self jamming.

Dual-Polarized Electronic Mode Stirring for Improved Backscatter Communication Link Margin in a Reverberant Cavity Animal Cage Environment…25

Sara M Reyes and Austin Oursland (University of Washington, USA); Madeleine Lee (Cornell University, USA); Theodore Moody and Matthew Reynolds (University of Washington, USA)

It has previously been shown that the metal cages used for housing research animals resemble a reverberant cavity, presenting dense multipath interference for communication channels within the cage. This is due to the metal walls of such cages forming a resonant cavity having deep nulls at many locations within the cage volume. This creates significant challenges for neuroscience research where non-human primates are equipped with brain-computer interfaces (BCIs) to record neural activity. Prior work has shown that electronic mode stirring can be used to mitigate the deep nulls by selectively changing the electromagnetic boundary conditions on the cage walls. We present a novel dual-polarized 2.4 GHz electromagnetic mode stirring system consisting of integrated dual-polarized air dielectric patch antennas with CMOS RF switches enabling each polarization to be terminated in either a short or open condition and thus selectively changing the phase of reflection from the antennas. In initial testing over 72 surveyed locations within a test cage across the 2.4 GHz ISM band (2400-2483 MHz), dual-polarized mode stirring is shown to improve the worst-case two-way insertion loss between the BCI antenna and a cage-mounted antenna by 28.6 dB with dual-polarized mode stirring enabled, relative to without mode stirring. This approach is also shown to reduce the standard deviation of two-way insertion loss from 8.6 dB without mode stirring to 7.3 dB with dual-polarized mode stirring.

Exploiting Synergies between Augmented Reality and RFIDs for Item Localization and Retrieval…30

Tara Boroushaki and Maisy L Lam (MIT, USA); Wei-Tung Chen and Laura Dodds (Massachusetts Institute of Technology, USA); Aline Eid (University of Michigan, Ann Arbor, USA); Fadel Adib (MIT,

USA)

Locating RFID-tagged items in the environment and guiding humans to retrieve the tagged items is an important problem in the RFID community. This paper explores how to exploit synergies between Augmented Reality (AR) headsets and RFID localization to help solve this problem by improving both user experience and localization accuracy. Using fundamental mathematical formulations for RFID localization, we derive confidence metrics and guidance to the user to improve their experience and enable them to retrieve items faster. We build our primitives into an end-to-end system, RF-AR, and show that it achieves 8.6 cm median localization accuracy within 76 seconds and enables 55% faster retrieval than state-of-the-art past systems. Our results demonstrate that AR-based "human-in-the-loop" designs can make the localization task more accurate and efficient, and thus holds the potential to improve processes where items need to be retrieved quickly, such as in manufacturing, retail, and warehousing.

Towards a UHF RFID Electromagnetic Fingerprint-Based Web Resolver for Digital Twins...36

Shah Md Nehal Hasnaeen, Suman Neupane and Andrew Chrysler (Idaho State University, USA)

The viability of utilizing the frequency domain electromagnetic (EM) fingerprint of passive Ultra-High Frequency (UHF) Radiofrequency Identification (RFID) tags as the basis for a digital twin resolver is explored. A framework is laid out for a digital twin resolver utilizing the XGBoost machine learning algorithm to classify EM fingerprints of tags attached to physical objects to associated digital counterparts. Preliminary analysis indicates an ability to differentiate between RFID tags based on the Electronic Product Code (EPC) with 99% overall accuracy, meaning a machine learning model can act as a resolver to identify digital twins by analyzing and classifying EM fingerprints with differing EPC content if the training database is large enough.

14.50 - 15.30 Coffee Break

15.30 - 16.45 Wednesday June 14 2023: Poster Session

Room: North Ballroom

Dont forget to cast your best poster vote (QR codes on site during the poster session) but before doing so please check out a preview video of all our IEEE RFID 2023 posters
https://youtu.be/qv4WtTFV3xQ

You can cast your vote here - https://forms.gle/RaezZFiunnnPWUfu6

18.30 - 20.00 Wednesday June 14 2023: Networking Dinner

Room: Impinj headquarters in Seattle's South Lake Union

Thursday June 15 2023: Welcome coffee - Registration and check in

Room Number 334

Thursday June 15 2023: PLENARY SESSION

Room Number 334

09.00-09.01 Josh Ensworth: Opening and day 2 welcome

09.01-09.06 Luca Catarinucci & James Rosenthal: IEEE RFID 2023 best poster award

09.06-09.16 Greg Durgin: CRFID Updates

09.16-10.01 KEYNOTE: Fadel Adib - Bringing Backscatter to New Domains: Oceans, In-Body, Robotics, and Augmented Reality

Fadel Adib is an Associate Professor at the MIT Media Lab and EECS, where he leads the Signal Kinetics research group. He is an inventor of new wireless and sensor technologies that address complex problems in health monitoring, networking, robotics, and ocean IoT. Adib has founded multiple startups, including Cartesian Systems, which aims to sense the physical world at an unprecedented scale and precision. His research has been recognized with various honors, including being named one of the world's top 35 innovators under 35 and the ACM SIGMOBILE Rockstar Award.

10.01-10.15 OPEN FLOOR

10.30 - 11.00 Coffee Break

Thursday June 15 2023: PAPER / TECHNICAL SESSION: Sensors / Digital Spectrum Twinning

Room Number 334

11.00-11.20 Dielectric Sensing using T-matched RAIN RFID Tags
11.20-11.40 RFID Tags as Passive Temperature Sensors
11.40-12.00 Virtualized Controller for Computational RFID-based IoT Sensors
12.00-12.20 Low-Power RFID Enabled Bistatic Reflect Antenna Array for Small-Scale Fading Mitigation

Dielectric Sensing using T-matched RAIN RFID Tags...42

Pavel Nikitin, Megan Brewster, John Kim and Kvs Rao (Impinj, USA)

In this paper, we show how measurement of backscattered signal from commercial off-the-shelf RAIN (passive UHF) RFID tags attached to dielectric materials can be used for reliable measurement of dielectric properties of those materials. The method is robust, in that the tags can be generic and do not need to be specially designed or calibrated. The directly measured quantity is the frequency of backscatter (POTR) peak resonance, from which effective dielectric permittivity can be extracted. We show that it is independent of tag type used for measurement. Our approach can differentiate between at least four different types of dielectrics that we used in testing. One possible application of this sensing technique is identification for sorting items in recycling and sustainability use cases, such as plastics.

RFID Tags as Passive Temperature Sensors...48

Madhushanka Padmal, Christian Rohner and Robin Augustine (Uppsala University, Sweden); Thiemo Voigt (Swedish Institute of Computer Science & Uppsala University, Sweden)

Temperature sensing and monitoring play a vital role in various applications. Non-invasive, item-level temperature sensing methods that require no direct line of sight with the measuring object are attractive. This paper presents such a temperature sensing method using commodity RFID tags with no infrastructure changes. RFID tags are widely deployed for product identification purposes. We explore the possibility of leveraging the RSSI measurements from commodity RFID tags for temperature sensing. Essentially, we model a relationship between the temperature and the relative permittivity of a material in terms of RSSI. Our method can measure temperature in the range of 22◦C to 60◦C and achieves a measurement accuracy of 2◦C with a mean error of 1.5◦C.

Virtualized Controller for Computational RFID-based IoT Sensors...54

Elisa Pantoja, Rahul Sreekumar, Sergiu Mosanu, Tommy Tracy II and Mircea Stan (University of Virginia,

USA)

This paper presents a Computational Radio Frequency Identification (CRFID) system that utilizes far-field RF for sensing, computing, and self-powering. We created a virtual environment that uses radio frequency to transmit SPI instructions and enable wireless control of the RFID-based IoT sensors. Our system tackles the issue of energy constraints on RFID-based IoT sensors by transferring the computation load from the tag sensor to the reader, accomplished by the virtualization of SPI functions over the RF channel. This virtualization of functions enables the design of a circuit without a microcontroller, providing greater flexibility and allowing for wireless reconfiguration of tag functions over RF using wireless SPI instructions, even after deploying the devices for operation. Furthermore, the results demonstrate a 97% reduction in energy consumption compared to other energy-harvesting RFID tags with microcontrollers. As a result, the saved power budget, previously allocated to power the tag's microcontroller, is now used to power the tag sensors without requiring batteries, thus maximizing the efficiency of the harvested RF power. The solution proposed in this work integrates an RFID reader, Tx antenna, and RFID tag with an advanced virtualized controller to achieve a cost-effective and ultra-low-power solution combined with a full-scale computational capacity.

Low-Power RFID Enabled Bistatic Reflect Antenna Array for Small-Scale Fading Mitigation...60

Kaitlyn Graves (Georgia Tech, USA); Michael Varner (Georgia Institute of Technology, USA); Gregory Durgin (Georgia Tech, USA)

Small-scale fading places fundamental limits on range and reliability of radio systems, particularly for the small, low-powered, low-cost radio units required by future spectrum sensing networks. In this work, we propose a low-power, low-cost additive solution to conventional, omnidirectional radio antennas to help mitigate the effects of small-scale fading. The proposed Reflect Antenna Array (RAA) utilizes a crown of RFID tags to scatter incoming power indicative of spectrum use towards the main receiver they encircle, which could otherwise be experiencing a deep fading null. The RAA is shown to provide a diversity gain of up to 15 dB for a 1% probability of outage as it increases received power and mitigates small-scale fading effects.

12.00 - 13.00 Lunch

Room Number 334

Thursday June 15 2023: PAPER / TECHNICAL SESSION Circuits, Devices & Interrogations / Energy harvesting

Room Number 334

13.30-13.50 USCoCa: A Subcarrier Frequency Continuous Calibration Method for Backscattered Concurrent Data Mode in UHF RFID System

13.50-14.10 A Novel Dual Passive Mixer-first Receiver Front-End with Enhanced RF Carrier Leakage Suppression for UHF RFID Reader

14.10-14.30 Simple Open-Source UHF RFID Tag Platform

14.30-14.50 A Cascade Structure with Burst Charging Mode for RF Energy Harvesting

USCoCa: A Subcarrier Frequency Continuous Calibration Method for Backscattered Concurrent Data Mode in UHF RFID System...66

Yuxiao Zhao, Haoyu Jiang, Zhongyuan Ying, Feng Gao and Shiyu Li (Fudan University, China); Zheng Shen and Kuanfeng Tang (State Key Lab of ASIC & System, Fudan University, China); Hanyang Wang

(Fudan University, China); Jin Mitsugi (Keio, Japan); Hao Min (State Key Lab of ASIC & System, Fudan University, China)

Concurrent data communication based on backscatter is an unnoticed research domain in the past, but recently it is considered as a promising technology for Massive IoT in the B5G/6G wireless sensor network (WSN). In this domain, it is a practical multiple access solution to use multiple subcarriers. This paper proposes a frequency continuous calibration method to improve the frequency accuracy of uplink subcarrier (USC) in the concurrent data communication mode, called USC continuous calibration (USCoCa). Tag obtains a 10kHz amplitude modulation frequency reference from reader, uses a digital frequency lock loop to calibrate the on-chip digital controlled ring oscillator, and generates USC with a wide frequency range and good frequency accuracy. The tag with USCoCa is fabricated with 0.51mmx1.02 mm area size. The test result shows that USCoCa can keep continuous calibration of USC frequency, and the USC frequency deviation is less than 0.25% within the range of 100-620kHz frequency. At the same time, the USC frequency stability can even be maintained under the +134℃/min rate temperature environment. Therefore, USCoCa can ensure stable frequency channel assignment for the multiple subcarrier UHF RFID system and guarantee robust concurrent data stream transmission.

A Novel Dual Passive Mixer-first Receiver Front-End with Enhanced RF Carrier Leakage Suppression for UHF RFID Reader…72

Zheng Shen, Kuanfeng Tang and Qiang Guo (State Key Lab of ASIC & System, Fudan University, China); Yuxiao Zhao (Fudan University, China); Hao Min (State Key Lab of ASIC & System, Fudan University, China)

The paper presents a novel on-chip UHF RFID reader receiver front-end with enhanced RF carrier leakage suppression, exploring a dual passive mixer-first with transformer-based matching network architecture. The receiver front-end is composed of 2 paths. In the main path, a bandpass RF input impedance forms by the 4-phase passive mixer and the baseband transimpedance amplifier. Similarly, the auxiliary path is adopted to achieve band-stop input impedance at the input. With the main and the auxiliary mixer designed independently, the high power carrier current flows into the ground through the auxiliary path, while the in-band signal enters the main path to be amplified, thus avoiding the receiver being blocked by the carrier. Furthermore, a transformer is used to enhance the voltage carrier leakage suppression by deducing impedance at both in-band and carrier frequency. Implemented in a 55nm CMOS process, the RF carrier leakage rejection ratio is 22.7dB, which is 9.4dB higher than the single mixer-first receiver. Suffering from +5dBm leakage, the noise figure(NF) of the receiver is 20.4dB. The results demonstrate that the novel receiver front-end architecture is more promising than the single mixer-first structure in RF leakage suppression while keeping high sensitivity.

Simple Open-Source UHF RFID Tag Platform…78

Nicolas Barbot (University Grenoble Alpes, Grenoble INP, LCIS, France); Pavel Nikitin (Impinj, USA)

In this work, we present a simple open-source software-defined based UHF (RAIN) RFID tag that can be used for academic research. This work is a follow-up to the open-source reader work presented in [1]. The hardware associated to this tag is only composed of a envelope detector and a RF switch and uses a modular design. All operations related to the RFID protocol, which includes clock recovery, data recovery and frame synchronization are entirely realized in software and can be processed by a Arduino Uno platform. The purpose of this work is to encourage researchers and students to experiment with RAIN RFID technology, to understand its protocols and standards, and to improve the proposed tag design. All relevant files (including schematic and source code) will be released as open source to the community.

A Cascade Structure with Burst Charging Mode for RF Energy Harvesting...84

Haoyu Jiang, Yuxiao Zhao and Zihan Wu (Fudan University, China); Hao Min (State Key Lab of ASIC & System, Fudan University, China)

This paper presents a novel RF energy harvest system with a burst charging mode, which achieves high sensitivity. The popular method to output high DC voltage under low input power is increasing the number of stages of the RF rectifier. However, this reduces the amplitude of the input RF signal and increases the power loss. When the amplitude of input RF signal is lower than the threshold voltage of MOSFET, the power conversion efficiency (PCE) of rectifier will drop sharply. Based on this principle, the proposed architecture uses a three-stage rectifier to output a direct-current (DC) voltage that exceeds the threshold voltage, and then uses a low-frequency charge pump working with a burst operation mode to output a high voltage. The post-layout simulation results show a -38.2 dBm sensitivity for 1 V output across a capacitive load in a 55nm CMOS process technology.

15.00 - 15.30 Coffee Break

Thursday June 15 2023: PAPER / TECHNICAL SESSION: Antennas & Propagation

Room Number 334

15.30-15.50 Software-Controlled Polarization for Longer-Range RFID Reading and Localization
15.50-16.10 Optimal Impedance Matching for UHF RFID Chip

Software-Controlled Polarization for Longer-Range RFID Reading and Localization...90

Laura Dodds and Nazish Naeem (Massachusetts Institute of Technology, USA); Aline Eid (University of Michigan, Ann Arbor, USA); Fadel Adib (MIT, USA)

The majority of existing RFID readers rely on circularly polarized or switched polarization antennas for powering and communicating with tags. In this paper, we argue that a new form of software-controlled polarization brings important benefits to the tasks of powering, communicating with, and localizing RFID tags. Using only two linearly polarized antennas, we demonstrate how one could generate an arbitrarily linear polarization in the same plane relying entirely on software control. We incorporate this approach into a protocol that automatically discovers RFID orientations in the environment and show how this approach increases the range (or alternatively reduces the transmit power of RFID readers). We also demonstrate this approach in an end-to-end RFID localization application.

Optimal Impedance Matching for UHF RFID Chip...96

Nicolas Barbot (University Grenoble Alpes, Grenoble INP, LCIS, France); Ionela Prodan (University Grenoble Alpes, France)

This paper shows that the classical conjugate impedance matching used in the UHF RFID is not optimal anymore with new chips. Two new approaches are introduced to realize the impedance matching between a UHF chip and its antenna. The first method allows one to maximize the delta RCS of any tag and corresponds to the optimal matching for semi-passive tags. This matching is only function of the two impedance state of the chip. The second method allows one to maximize the read range of any passive tag by taking into account both received power by the tag and modulated power sent to the reader. This

matching is function of the tag sensitivity and states, and the transmitted power and sensitivity of the reader. Compared to classical conjugate impedance matching, we show that these new approaches can increase the read range by 22% and 8% for a semi-passive tag based on Monza X8-K Dura chip and a passive tag based on Monza R6-P chip respectively.