2ND WORKSHOP OF THE NORTHEAST BRAZIL SPS CHAPTER
-
COMMUNICATION, SENSING, AND ALLOCATION IN FUTURE WIRELESS SYSTEMS 2025

SPONSERED BY:

DATE: 07 OCT 2025

TIME: 08:45 TO 16:45

ORGANIZATION:
LOCAL: LESC – UFC

NORTHEAST BRAZIL IEEE SPS CHAPTER
DAAD-CAPES PROBRAL GRANT 88887.894955/2023-00

2ND WORKSHOP OF THE NORTHEAST BRAZIL SPS CHAPTER – COMMUNICATION, SENSING, AND ALLOCATION IN FUTURE WIRELESS SYSTEMS 2025

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08:45 - 09:00

OPENING

PROF. DR. ANDRÉ DE ALMEIDA |
PROF. DR.-ING. TARCISIO MACIEL | UFC, BRAZIL
PROF. DR. FAZAL-E ASIM |

09:00 - 09:30

TENSOR-BASED NEAR-FIELD LOCALIZATION

DR.-ING. LIANA KHAMIDULLINA | TU ILMENAU, GERMANY

09:30 - 10:00

SEMI-BLIND CHANNEL ESTIMATION FOR BEYOND DIAGONAL RIS

DR. GILDERLAN TAVARES ARAÚJO | UFC/IFCE, BRAZIL

10:00 - 10:30

ENHANCED CHANNEL ESTIMATION FOR DOUBLE RIS-AIDED MIMO SYSTEMS USING COUPLED TENSOR DECOMPOSITIONS

DR.-ING. GERALD C. NWALOZIE | TU ILMENAU, GERMANY

10:30 - 11:00

TENSOR-BASED FRAMEWORK FOR NON-RECIPROCAL RIS-ASSISTED MIMO COMMUNICATIONS

DR. PAULO R. B. GOMES | UFC/IFCE, BRAZIL

ORGANIZATION:
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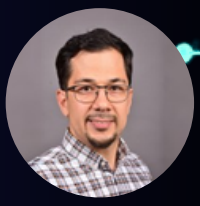
12:00 - 14:00
LUNCH BREAK

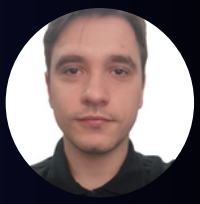
14:00 - 14:30



MULTIDIMENSIONAL BEAMSPACE PROCESSING FOR FMCW AUTOMOTIVE RADAR

M.SC. DAMIR RAKIHMOV | TU ILMENAU, GERMANY

14:30 - 15:00



JOINT ACTIVE AND PASSIVE BEAMFORMING DESIGN FOR MULTI-STREAM MIMO RIS SYSTEMS: A TENSOR BASED APPROACH

DR. BRUNO SOKAL | UFC, BRAZIL

15:00-15:30

PROBABILISTIC POSITION-AIDED BEAM SELECTION FOR MMWAVE MIMO SYSTEM

M.SC. JOSEPH. K. CHEGE | TU ILMENAU, GERMANY

15:30-16:00

SEMI-BLIND CHANNEL ESTIMATION FOR DMA-BASED SYSTEMS

M.SC. AMARILTON LOPES MAGALHÃES | UFC/IFCE, BRAZIL

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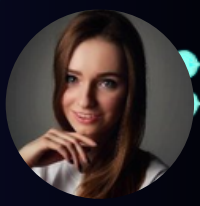
16:00-16:30

POLLEN QUANTIFICATION USING BAYESIAN PROBABILITY MASS FUNCTION ESTIMATION WITH AUTOMATIC RANK DETECTION



M.SC. ALLA MANINA | TU ILMENAU, GERMANY

16:30 - 16:45

CLOSING



PROF. DR. ANDRÉ DE ALMEIDA |
PROF. DR.-ING. TARCISIO MACIEL | UFC, BRAZIL
PROF. DR. FAZAL-E ASIM |

COFFEE-BREAK

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09:00 - 09:30

TENSOR-BASED NEAR-FIELD LOCALIZATION

DR.-ING. LIANA KHAMIDULLINA | TU ILMENAU, GERMANY

In this talk, we explore advanced tensor-based near-field localization algorithms for wireless communication and radar systems. We use the exact spherical wavefront model to avoid the common far-field and Fresnel approximations, and employ the canonical polyadic and block-term tensor decompositions to obtain high-resolution user or target locations in three-dimensional space, while supporting arbitrary array geometries and multi-path or multi-target scenarios.

09:30 - 10:00

SEMI-BLIND CHANNEL ESTIMATION FOR BEYOND DIAGONAL RIS

DR. GILDERLAN TAVARES ARAÚJO | UFC/IFCE, BRAZIL

The channel estimation problem has been widely discussed in traditional reconfigurable intelligent surface assisted multiple-input multiple-output. However, solutions for channel estimation adapted to beyond diagonal RIS need further study, and few recent works have been proposed to tackle this problem. Moreover, methods that avoid or minimize the use of pilot sequences are of interest. This work formulates a data-driven (semi-blind) joint channel and symbol estimation algorithm for beyond diagonal RIS that avoids a prior pilot-assisted stage while providing decoupled estimates of the involved communication channels. The proposed receiver builds upon a PARATUCK tensor model for the received signal, from which a trilinear alternating estimation scheme is derived. Preliminary numerical results demonstrate the proposed method's performance for selected system setups. The symbol error rate performance is also compared with that of a linear receiver operating with perfect knowledge of the cascaded channel.

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10:00 - 10:30

ENHANCED CHANNEL ESTIMATION FOR DOUBLE RIS-AIDED MIMO SYSTEMS USING COUPLED TENSOR DECOMPOSITIONS

DR.-ING. GERALD C. NWALOZIE | TU ILMENAU, GERMANY

In this paper, we consider a double-RIS (D-RIS)-aided flat-fading MIMO system and propose an interference-free channel training and estimation protocol, where the two single-reflection links and the one double-reflection link are estimated separately. Specifically, by using the proposed training protocol, the signal measurements of a particular reflection link can be extracted interference-free from the measurements of the superposition of the three links. We show that some channels are associated with two different components of the received signal. Exploiting the common channels involved in the single and double reflection links while recasting the received signals as tensors, we formulate the coupled tensor-based least square Khatri–Rao factorization (CKRAFT) algorithm which is a closed-form solution and an enhanced iterative solution with less restrictions on the identifiability constraints, the coupled-alternating least square (C-ALS) algorithm. The C-KRAFT and C-ALS based channel estimation schemes are used to obtain the channel matrices in both single and double reflection links. We show that the proposed coupled tensor decomposition-based channel estimation schemes offer more accurate channel estimates under less restrictive identifiability constraints compared to competing channel estimation methods. Simulation results are provided showing the effectiveness of the proposed algorithms.

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10:30 - 11:00

TENSOR-BASED FRAMEWORK FOR NON-RECIPROCAL RIS-ASSISTED MIMO COMMUNICATIONS

DR. PAULO R. B. GOMES | UFC/IFCE, BRAZIL

In this work, we solve the channel estimation (CE) and beamforming optimization (BO) problems in a non-reciprocal RIS-assisted MIMO communication system. Making use of a closed-loop three-phase protocol, we propose a two-stage fourth-order Tucker decomposition-based CE algorithm. In contrast to conventional time-division duplexing (TDD) and frequency-division duplexing (FDD) CE schemes, the proposed framework concentrates all the processing burden for CE and BO on the base station (BS), thereby freeing hardware-limited user terminal (UT) from these tasks. Additionally, we also propose a tensor-based method to jointly optimize the active and passive beamforming via Higher-Order Singular Value Decomposition (HOSVD) of the overall closed-loop tensor channel. Simulation results show that the proposed framework has satisfactory performance in terms of CE accuracy and spectral efficiency compared to benchmark FDD and TDD matrix-based and tensor-based techniques, while alleviating the signal processing burden for CE and BO on the UT side showing robustness when practical system aspects such as imperfect channel, noisy feedback channel and non-reciprocity are considered.

14:00 - 14:30

MULTIDIMENSIONAL BEAMSPACE PROCESSING FOR FMCW AUTOMOTIVE RADAR

M.SC. DAMIR RAKIHMOV | TU ILMENAU, GERMANY

In this talk, a gridless 3-D parameter estimation method for Frequency-Modulated Continuous-Wave (FMCW) automotive radar systems is discussed. It is based on the recently developed framework for high-resolution parameter estimation via 3-D ESPRIT in DFT beamspace. The method is search-free and can estimate jointly azimuth, speed, and range parameters for every target. The algorithm uses a tensor representation of the signals and automatically pairs parameters across different modes. Simulation results show the capability to obtain the high-resolution parameter estimates with the potential for significantly lower computational complexity compared to conventional methods via processing in a reduced-size DFT beamspace.

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14:30 - 15:00

JOINT ACTIVE AND PASSIVE BEAMFORMING DESIGN FOR MULTI-STREAM MIMO RIS SYSTEMS: A TENSOR BASED APPROACH

DR. BRUNO SOKAL | UFC, BRAZIL

In this talk, we discuss two tensor-based algorithms for jointly designing active and passive beamformers in RIS-assisted multi-stream MIMO systems, by modeling the composite channel as a third-order tensor. The first method, based on the truncated higher-order singular value decomposition (T-HOSVD) provides a closed-form solution that utilizes tensor unfoldings, rendering it particularly suitable for low-rank scenarios. The second, tensor alternating optimization (TAO), iteratively refines the design by solving three subproblems, initialized with T-HOSVD. Simulations show that both methods significantly outperform existing approaches. While TAO achieves the highest spectral efficiency, T-HOSVD offers a favorable performance-complexity trade-off, making it attractive for practical deployment.

15:00-15:30

PROBABILISTIC POSITION-AIDED BEAM SELECTION FOR MMWAVE MIMO SYSTEM

M.SC. JOSEPH. K. CHEGE | TU ILMENAU, GERMANY

Millimeter-wave (mmWave) MIMO systems rely on highly directional beamforming to overcome severe path loss and ensure robust communication links. However, selecting the optimal beam pair efficiently remains a challenge due to the large search space and the overhead of conventional methods. This paper proposes a probabilistic position-aided beam selection approach that exploits the statistical dependence between user equipment (UE) positions and optimal beam indices. We model the underlying joint probability mass function (PMF) of the positions and the beam indices as a low-rank tensor and estimate its parameters from training data using Bayesian inference. The estimated model is then used to predict the best (or a list of the top) beam pair indices for new UE positions. The proposed method is evaluated using data generated from a state-of-the art ray tracing simulator and compared with neural network based and fingerprinting approaches. The results show that our approach achieves a high data rate with relatively few training samples and a significantly reduced beam search space. These advantages render it a promising solution for practical mmWave MIMO deployments, reducing the beam search overhead while maintaining a reliable connectivity.

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15:30-16:00

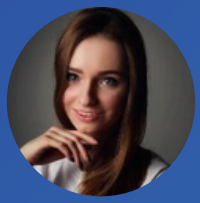
SEMI-BLIND CHANNEL ESTIMATION FOR DMA-BASED SYSTEMS

M.SC. AMARILTON LOPES MAGALHÃES | UFC/IFCE, BRAZIL

Dynamic metasurface antennas (DMAs) are emerging as a promising technology to enable energy-efficient, large array-based multi-antenna systems. This paper presents a simple channel estimation scheme for the downlink of a multiple-input single-output orthogonal frequency division multiplexing (MISO-OFDM) communication system exploiting DMAs. The proposed scheme extracts separate estimates of the wireless channel and the unknown waveguide propagation vector using a simple iterative algorithm based on the parallel factor (PARAFAC) decomposition. Obtaining decoupled estimates of the wireless channel and inner waveguide vector enables the isolation and compensation for its effect when designing the DMA beamformer, regardless of the wireless channel state, which evolves much faster due to its shorter coherence time and bandwidth. Additionally, our solution operates in a data-aided manner, delivering estimates of useful data symbols jointly with channel estimates, without requiring sequential pilot and data stages. To the best of our knowledge, this is the first work to explore this CE approach. Numerical results corroborate the notable performance of the proposed scheme.

16:00-16:30

POLLEN QUANTIFICATION USING BAYESIAN PROBABILITY MASS FUNCTION ESTIMATION WITH AUTOMATIC RANK DETECTION



M.SC. ALLA MANINA | TU ILMENAU, GERMANY

Quantifying pollen mixtures is challenging due to overlapping species signatures and the limitations of manual annotation or classifier-based methods. This research investigates a framework based on low-rank probability mass function (PMF) tensor estimation to quantify species proportions in mixtures. The method combines pure-species signatures with a correlation-based matching strategy and is demonstrated on three-species pollen mixtures, with the potential to scale to larger sets. Experiments on a real pollen dataset show that the method provides more consistent results than Gaussian mixture models and Bayesian PMF estimation without prior knowledge, particularly in cases of highly correlated species and varied mixture proportions.

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