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“Semi-Blind Joint Channel and Symbol Estimation for Beyond Diagonal Reconfigurable Surfaces”

Wednesday, July 22, 2026, 2.00 – 3.00 p.m.

Helmholtzbau, H2501

Abstract: In this seminar, we present a semi-blind tensor-based approach for joint channel and symbol estimation in wireless systems assisted by beyond-diagonal reconfigurable intelligent surfaces (BD-RISs). This emerging architecture interconnects the scattering elements on the surface, thereby increasing degrees of freedom for electromagnetic-wave control and enabling performance gains over conventional single-connected RISs. However, this additional flexibility also makes channel estimation significantly more challenging, due to the more complex internal connections of the surface and the larger number of coefficients to be estimated. Unlike conventional approaches, which typically rely on dedicated pilot-assisted channel estimation followed by a separate data decoding stage, the proposed framework directly exploits the transmitted data symbols to better manage the training overhead. We consider a practical mobility scenario in which the user terminal-to-BD-RIS channels vary over time. By reformulating the received signal from a tensor decomposition perspective, we develop two semi-blind receivers: a two-stage method that converts a fourth-order PARATUCK model into a third-order PARAFAC model, and a single-stage iterative method based on a fourth-order TUCKER decomposition. We discuss identifiability conditions for the joint recovery of the channels and symbols, as well as numerical results that highlight the performance advantages and trade-offs of the proposed schemes compared with existing solutions.

Short biography

Prof. Dr. André LF de Almeida, Department of Teleinformatics Engineering, Federal University of Ceará, Brazil



André L. F. de Almeida is a Professor at the Teleinformatics Engineering Department of the Federal University of Ceará. He received a double Ph.D. in Sciences and Teleinformatics Engineering from the University of Nice Sophia Antipolis, France, and the Federal University of Ceará, Fortaleza, Brazil, in 2007. He was awarded multiple times as a visiting professor at the University of Nice Sophia Antipolis, France (2012-2013; 2018-2019; 2022-2024). His research interests

lie in signal processing for communications, sensor array and multichannel processing, multilinear algebra, and wireless communication networks. A significant portion of his research has been devoted to tensor decompositions with applications in wireless communications. He has published over 270 papers in journals and conferences, as well as six book chapters, and is a coinventor of seven international patents.

Prof. Almeida serves as a Senior Area Editor for the IEEE Transactions on Signal Processing and a Senior Area Editor for the IEEE Signal Processing Letters. He is an elected member of the IEEE Signal Processing Society (SPS) Signal Processing Theory and Methods (SPTM) Technical Committee (2022-2024) and an elected member of the EURASIP Signal Processing for Multi-Sensor Systems Technical Area Committee (SPMuS TAC) (2016-2018 and 2019-2022), where he currently serves as the Vice Chair. He has served as an Associate Editor for several journals, including the IEEE Transactions on Signal Processing (2012-2014, 2014-2016), IEEE Signal Processing Letters (2016-2018, 2018-2020), and IEEE Transactions on Vehicular Technology (2020-2022). He also served on the IEEE SPS Sensor Array and Multichannel (SAM) Technical Committee for two terms (2015-2018 and 2018-2021). From 2022 to 2023, he served as the IEEE SPS Director-at-Large for Regions 7 & 9. In 2024, he was elected Chief Editor for the IEEE SPS SigPort (2025-2027).

Prof. Almeida has been involved in organizing and chairing several IEEE SPS conferences. In particular, he was a General Co-Chair of the 2017 IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP'2017), Technical Co-Chair of the IEEE GlobalSIP'2018 and IEEE GlobalSIP'2019 Symposia on Tensor Methods for Signal Processing and Machine Learning, Technical Co-Chair of the 11th IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM'2020), and General Co-Chair of the 2023 IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP'2023). He is the Technical Co-Chair of the IEEE Sensor Array and Multichannel workshop (SAM'2026). He is a research fellow of the CNPq (the Brazilian National Council for Scientific and Technological Development). Prof. Almeida is a co-recipient of the 2018 IET Communications Premium Best Paper Award and a co-recipient of the 2022 IET Signal Processing Premium Best Paper Award. He also co-received the Best Paper Award at the 19th IEEE International Conference on OFDM and Frequency Domain Techniques (2016), the WCNPS'2022 Best Paper Award, and Best Paper Awards at the 35th and 38th editions of the Brazilian Symposium of Telecommunications and Signal Processing (2020 and 2023). In 2018, Prof. Almeida was elected a Member of the Brazilian Academy of Sciences.