

Gridless Channel Estimation for Hybrid MIMO OFDM Systems in the Millimeter Wave Band Using Tensor-Based High-Resolution Techniques

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Abstract: We present a gridless channel estimation scheme for MIMO OFDM systems in the millimeter wave (mmWave) band that is based on R-D Unitary Tensor-ESPRIT in DFT beamspace. Compared to conventional ESPRIT based algorithms in element space, the beamspace approach can be applied to MIMO systems with hybrid architectures. Moreover, the proposed approach significantly reduces the training overhead for communication systems operating in the mmWave band. The proposed procedure involves coarse and fine estimation Steps.

As one alternative for the coarse estimation step, Unitary Tensor-ESPRIT in element space may be applied to the array with a reduced size aperture to obtain initial information about the directions of arrival, the directions of departure, and the propagation delays of the dominant multipath components. Based on these parameters, a more accurate estimation of the angular profiles, propagation delays, and channel gains is performed in a second step by applying 3-D Unitary Tensor-ESPRIT in DFT beamspace in the spatial domains combined with the element space version in the frequency domain. We explain how to combine the received signals from different spatial sectors of interest and how to perform joint processing. The simulation results confirm the tensor gain of the proposed procedure in addition to an improved channel estimation accuracy.

Bio: Prof. Martin Haardt has been a Full Professor in the Department of Electrical Engineering and Information Technology and Head of the Communications Research Laboratory at Ilmenau University of Technology, Germany, since 2001. From 1998 to 2001 he was the Director for International Projects and University Cooperations in the mobile infrastructure business of Siemens in Munich, where his work focused on mobile communications beyond the third generation. His research interests include wireless communications, array signal processing, high-resolution parameter estimation, as well as numerical linear and multi-linear algebra. He is an IEEE Fellow “for contributions to multi-user MIMO communications and tensor-based signal processing”. He has received the 2009 Best Paper Award from the IEEE Signal Processing Society, and the Vodafone (formerly Mannesmann Mobilfunk) Innovations-Award for outstanding research in mobile communications. Prof. Haardt has served as an Associate Editor for the IEEE Transactions on Signal Processing the IEEE Signal Processing Letters, the EURASIP Signal Processing Journal and as a senior editor of the IEEE Journal of Selected Topics in Signal Processing (JSTSP, since 2019). He is a past chair of the Sensor Array and Multichannel (SAM) technical committee of the IEEE Signal Processing Society and a current member of the Fellow Evaluation Committee of the IEEE SPS.