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Public Lecture

Prof. RAED M. SHUBAIR

Professor of Electrical Engineering, Khalifa University, UAE

"Advances in Array Processing Techniques for Future Mobile Communications"

3:30-4:30 PM, Tuesday, February 23, 2016
G-208 - Building G

Abstract

Signal detection and direction finding for multiple waves impinging on an array of sensors have attracted attention in the literature due to the numerous applications in radar, sonar, and wireless communication. The most popular subspace direction finding algorithms are MUSIC, Root-MUSIC, and ESPRIT. In a multipath scenario, the signals impinging on the sensor array are correlated resulting in a covariance matrix that is singular due to the coherence interference. To compensate for the rank deficit caused by the coherence interference, a pre-conditioning scheme is needed. The most popular scheme for de-correlating coherent signals is spatial smoothing (or averaging), in which the main sensor array is treated as the superposition of overlapping sub-arrays, which is a computationally-expensive process. Beside Spatial Smoothing, another less computationally expensive method for detecting coherent signals is the use of Toeplitz matrix reconstruction. Thorough and careful investigation by the authors of existing literature demonstrated that the Toeplitz technique used does not produce reliable accurate results because the derived Toeplitz matrix is not perfectly symmetric. Perfect symmetry of the Toeplitz reconstruction matrix is a necessary condition to ensure orthogonality between the signal subspace and noise subspace, which in turn makes the use of subspace-based direction finding methods such as MUSIC a valid choice. This seminar presents a new algorithm called Phase Mode Excitation Symmetric Toeplitz (PMEST) for detecting the directions of coherent signals incident on UCA. The developed algorithm first employs Phase Mode Excitation (PME) transformation technique to convert the original UCA into an equivalent fully-mapped Virtual Uniform Linear Array (VULA). The algorithm then implements a special Toeplitz-like matrix reconstruction technique that inhibits perfect symmetry, to alleviate the inaccuracies incurred in the erroneous converted VULA. It is shown that the developed PMEST algorithm is much more robust than other techniques since it incorporates a noise auto-cancellation scheme via suppressing the induced quantization error in the converted VULA steering vector, leading to superior detection capability.

About the Speaker

Prof. Raed Shubair received both B.Sc. (Electrical Engineering) and Ph.D. (Electrical Engineering) from Kuwait University (June 1989) and University of Waterloo, Canada (Feb 1993), respectively. He has been with Khalifa University, UAE (formerly Etisalat University College) since 1993 where he is currently a Full Professor with the Electrical and Computer Engineering Department. Prof. Shubair is a Research Affiliate of University of Waterloo Center for Intelligent Antenna and Radio Systems. He has several research interests in communications, signal processing, antennas, and electromagnetics. Prof. Shubair has many publications which include US patents, book chapters, papers in IEEE transactions and international journals, and papers in IEEE and international conferences and workshops. He is recipient of IEEE IIT Conference Best Paper Award (2004), ACES Society Distinguished Service Award (2005), Electromagnetic Academy Distinguished Service Award (2007), Khalifa University Teaching Excellence Award (2008) and Distinguished Service Award (2010). Prof. Shubair is the lead faculty in his university to be elevated to IEEE Senior Member, back in 2001. He served on the steering, organizing, and technical committees of many international conferences. He has been actively involved in the professional engineering community in UAE. For example, he is founding member of IEEE-UAE Communication/Signal Processing Joint Societies Chapter and IEEE-UAE Engineering in Medicine and Biology Chapter.