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BLIND JOINT ANGLE AND FREQUENCY ESTIMATION WITH ANTENNA ARRAY

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Abstract. *This paper links joint 2D-angle and frequency estimation problem to the trilinear model, and derives a novel blind joint angle and frequency estimation algorithm, which can be considered as a generalization of ESPRIT and has wider application than ESPRIT. The proposed algorithm supports small sample sizes and also has better performance than joint approximate diagonalization (JADE) method. Simulation results verify its useful behavior.*

Keywords: Angle estimation, Frequency estimation, Uniform circular array, Trilinear model

1. **Introduction.** In the past few years, the method of blind joint angle and frequency estimation has been applied to/involved in the field of radar and wireless communications. A precise estimation of these parameters is helpful to attain a better channel estimate and thus enhances the system performance [1]. Optimal techniques based on maximum likelihood [2] are often applicable but might be computationally prohibitive. Similarly, Refs. [3-6] present some ESPRIT-based joint angle and frequency estimation methods. Since the year 1980s, the ideas of ESPRIT have revolutionized sensor array signal processing. However, ESPRIT has excellent performance only in condition of uniform linear array and L-shape array, and its method is also constricted in the parameter matrix with Vandermonde characteristic. In addition, other methods have been searched and introduced in joint angle and frequency estimation. In [7,8], High-order cumulants, as well as joint approximate diagonalization have been used respectively. Besides the essential requirement of non-Gaussian signals, high-order cumulant method also requires the statistical characteristic of signal and larger snapshots for good performance. In this paper, trilinear decomposition-based joint angle and frequency estimation for uniform circular array is investigated.

Trilinear model or trilinear decomposition has a distinctive and attractive feature: it is often unique [9]. Trilinear decomposition can be regarded as a generalization of ESPRIT in signal processing fields [10]. Our work links the uniform circular array parameter estimation problem to the trilinear model and derives a novel blind angle and frequency estimation algorithm, whose performance is better than joint approximate diagonalization. ESPRIT method cannot directly be used to estimate the array parameter for uniform circular array. Our proposed algorithm overcomes the shortcoming of ESPRIT, and the algorithm has wider application than ESPRIT. Also the algorithm, which does not require the information of signal statistical characteristic, supports small sample sizes. The research results can be used for wireless location, array signal processing and mobile communication such as TD-SCDMA system.