# Reduction of CRB in Arbitrary Pre-designed Arrays Using Alter an Element Position

H. Bakhshi

*Electrical & Electronic Eng. Dept., Shahed University, Tehran, Iran*
*bakhshi@shahed.ac.ir*

***Abstract*— Simultaneous estimation of range and angle of close emitters usually requires a multidimensional search. This paper offers an algorithm to improve the position of an element of any array designed on the basis of some certain or random rules. In the proposed method one element moves on its original direction, i.e., keeping the vertical distance to each source, to reach the constellation with less CRB. The performance of this method has been demonstrated through simulation and a comparison of the CRB with receptive signals covariance matrix determinant has been made before and after the use of this method.**

***Index Terms*—** Cramer-Rao Bound, Direction of Arrival, Range, Near-field.

## I. INTRODUCTION

Direction of arrival (DOA) estimation usually is found under the assumption that signal sources are in the far field of the array, and hence the wavefront is plannar across the array aperture. Suppose that far field range is defined as $R_f$, so that the range at which the largest departure of the wavefront from a plane wave, across the array, is $\lambda$, where $\lambda$ is the wavelength. Then it is straightforward to show that $R_f \approx D^2/8\lambda$, where $D$ is the array aperture measured in wavelengths [1]. For arrays with small aperture, $R_f$ is rather small and the far field assumption holds very well. However, for arrays with large aperture, e.g., those used in sonar systems, sources are usually located in the near field [2]. Bearing estimation for near-field sources requires simultaneous estimation of the bearing and range, that is because the curvature of wavefront cannot be ignored. This estimation usually requires a multidimensional search.

Previous works on this estimation can be seen in [1-6]. Starer and Nehorai [5] developed an algorithm based on path-following. This algorithm is limited to uniform linear arrays and to sources that are located in the Fresnel region. This region is taken to be between near-field case (having spherical wavefronts) and far-field case (where wavefronts can be estimated in plane form). Collins et al. [6] offer an analytic simulated algorithm to solve the problem of estimating the range and bearing. Their algorithm is also limited to uniform linear arrays.

The works in [7-10] have also focused on transforming the problem of single dimensional search into polynomial rooting in different cases. The aim of this paper is not to offer a constellation, but to

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