International Journal of Innovative Computing, Information and Control
Volume **7**, Number **5(B)**, May **2011**

 ISSN 1349-4198
pp. **3019–3032**

AN ITERATIVE ALGORITHM FOR JOINT BEAMFORMING AND DOA ESTIMATION

Wenlong Liu[1,2], Qian Liu[2], Minglu Jin[2], Jae Moung Kim[1] and Shuxue Ding[2,3]

[1]School of Information and Communication Engineering
Inha University
Incheon, 402-751, Korea
liuwl@dlut.edu.cn

[2]School of Information and Communication Engineering
Dalian University of Technology
Dalian, Liaoning 116024, P. R. China

[3]School of Computer Science and Engineering
The University of Aizu
Tsuruga, Ikki-machi, Aizu-Wakamatsu City, Fukushima 965-8580, Japan
sding@u-aizu.ac.jp

Received January 2010; revised June 2010

Abstract. *The MUltiple SIgnal Classification (MUSIC) algorithm for DoA is known to degrade due to imprecise knowledge about the array manifold. In this paper, we present a theorem to show how imprecise knowledge affects the performance of the MUSIC algorithm. This theorem proves that performance of the MUSIC algorithm degrades less if the array responses of the sources impinging on the array are less correlated with each other, or if just a single source exists. This result inspired us to develop a method for improving DoA estimation. That is, in estimating a specific source's DoA, we try to remove the influences of other sources from the array output, so that the input includes only a single source approximately. If so, the MUSIC algorithm should be relatively robust, because only one source is approximately involved in the estimation. A beamformer, at least approximately, can serve this purpose. On the other hand, more exact DoA estimation can further improve beamforming. As these two steps iteratively continue, we can obtain much more exact beamforming and DoA estimation. On the basis of this idea, we propose an iterative algorithm for inter-cooperative beamforming and DoA estimation. Our numerical experiments show the validity of the proposed algorithm.*
Keywords: Direction of arrival, Beamforming, Eigen-decomposition

1. **Introduction.** The Spatial Division Multiple Access (SDMA) is a multiple-input and multiple-output (MIMO)-based wireless communication architecture that is primarily suitable for mobile networks. MIMO is a multiple antenna schematic architecture. SDMA enables multi-user access to a communication channel by exploiting the users' spatial separability [1].

The typical processing procedure of SDMA includes two steps:

Step I: Directions of arrival (DoA) estimation.

Assuming that the array manifold is known and all signal sources are located in the array's far-field, one can use DoA estimation algorithms to extract the users' DoAs from the data of array output.

Step II: Beamforming.