Accepted Manuscript

Regular paper

Reduction of Dynamic Range Ratio through Competition over Resources to Synthesize Planar Array Antennas

Reza Gholami, Bijan Zakeri, Hajar Abedi, Sina Mohseni

PII: S1434-8411(16)30739-7
DOI: http://dx.doi.org/10.1016/j.aeue.2016.09.008
Reference: AEUE 51682

To appear in: *International Journal of Electronics and Communications*

Received Date: 15 March 2015
Accepted Date: 12 September 2016

Please cite this article as: R. Gholami, B. Zakeri, H. Abedi, S. Mohseni, Reduction of Dynamic Range Ratio through Competition over Resources to Synthesize Planar Array Antennas, *International Journal of Electronics and Communications* (2016), doi: http://dx.doi.org/10.1016/j.aeue.2016.09.008

Reduction of Dynamic Range Ratio through Competition over Resources to Synthesize Planar Array Antennas

Reza Gholami, Bijan Zakeri, Hajar Abedi, and Sina Mohseni

Faculty of Electrical and Computer Engineering, Communication Engineering Department, Babol Noshirvani University of Technology. reza.gholami@stu.nit.ac.ir; zakeri@nit.ac.ir; abedi.hajar@yahoo.com; sina.mohseni@stu.nit.ac.ir

Abstract

To synthesize planar arrays, a new optimization algorithm namely Competition Over Resources (COR) is presented. This method imposes deeper nulls with the constraint of Side Lobe Level (SLL). COR is a new meta-heuristic algorithm based on competitive behavior of animal groups over food resources. The algorithm restricts Dynamic Range Ratio (DRR) in order to achieve a better control of the mutual coupling and feed network. Simulation results for optimal patterns, possessing multiple and broad nulls, are presented. The approach is implemented based on the position-only and the space/amplitude optimization. Furthermore, in order to find the better performance in imposing deeper nulls and reducing SLL, a comparative evaluation between Particle Swarm Optimization (PSO) and COR is presented. Numerical results show that COR has better performance compared with PSO.

Keywords: Antenna arrays, broad null, dynamic range ratio, competition over resources, null control, pattern synthesis

1. Introduction

Planar array antennas find wide applications in radar and communication systems. In this type of antenna, main goal is to determine the physical layout of the array to produce the desired pattern. One of the most important parameters is Side Lobe Level (SLL). Through developments in computer technology, the numerical optimization techniques have been improved. Among these techniques, evolutionary algorithms such as genetic algorithm (GA) [1-2], differential evolution [3], and Particle Swarm Optimization (PSO) [4-6] have been successfully reported. Many synthesis methods are concerned with reducing SLL while preserving the gain of the main beam [7-8]. PSO has been shown to be an effective alternative relative to other evolutionary algorithms in handling certain kinds of optimization problems [9].

Due to increase in electromagnetic environment pollution, using nulls in prescribed direction becomes more and more important to maximize signal-to-interference ratio (SIR) [10-13]. Null steering techniques have been used to control the amplitude, phase, and the spacing to achieve the suppression of interfering signals from prescribed directions [14-17]. Dynamic Range Ratio (DRR) is defined as the ratio maximum and minimum value of the amplitude distribution, is usually high in the low SLL [18-21]. The higher DRR will complicate the design of the feed. A small value of DRR is desirable to achieve a better control of the mutual coupling. Furthermore,