

VERIFICA: PERFORMANCES ANALYSIS OF A PSO-BASED OPTIMIZATION PROCEDURE IN THE SYNTHESIS OF HARMONIC MULTI-BEAM PATTERN IN TIME-MODULATED ARRAYS

A. Xompero

Abstract

In the recent years, TMAAs have been studied by a new perspective in which part of the sideband radiation is exploited for useful purposes. In particular, the possibility to consider the switch-on instants added to the switch-on times as a new degree of freedom in the synthesis process allows to better control the harmonics radiated patterns, and hence to synthesize patterns at the central frequency and at the harmonic frequencies, as well. This project proposes an harmonic beam-forming synthesis technique based on the particle swarm optimizer (PSO) algorithm: multiple patterns are generated at the central and harmonic frequencies, realizing a multi-frequencies beam patterns with a single antenna array in order to simultaneously receive multiple signal from different direction. The pulse splitting technique is applied, in order to better control the power associated to the harmonic frequencies.

Reference Bibliography: Time Modulated Arrays [1]-[8]; Evolutionary Optimization [9]-[10].

- [1] E. T. Bekele, L. Poli, M. D'Urso, P. Rocca, and A. Massa, "Pulse-shaping strategy for time modulated arrays - Analysis and design," *IEEE Trans. Antennas Propag.*, vol. 61, no. 7, pp. 3525-3537, July 2013.
- [2] P. Rocca, L. Poli, G. Oliveri, and A. Massa, "A multi-stage approach for the synthesis of sub-arrayed time modulated linear arrays," *IEEE Trans. Antennas Propag.*, vol. 59, no. 9, pp. 3246-3254, Sep. 2011.
- [3] L. Poli, P. Rocca, G. Oliveri, and A. Massa, "Harmonic beamforming in time-modulated linear arrays," *IEEE Trans. Antennas Propag.*, vol. 59, no. 7, pp. 2538-2545, Jul. 2011.
- [4] L. Poli, P. Rocca, L. Manica, and A. Massa, "Handling sideband radiations in time-modulated arrays through particle swarm optimization," *IEEE Trans. Antennas Propag.*, vol. 58, no. 4, pp. 1408-1411, Apr. 2010.
- [5] P. Rocca, L. Poli, G. Oliveri, and A. Massa, "Adaptive nulling in time-varying scenarios through time-modulated linear arrays," *IEEE Antennas Wireless Propag. Lett.*, vol. 11, pp. 101-104, 2012.
- [6] P. Rocca, L. Poli, and A. Massa, "Instantaneous directivity optimization in time-modulated array receivers," *IET Microwaves, Antennas & Propagation*, vol. 6, no. 14, pp. 1590-1597, Nov. 2012.
- [7] P. Rocca, L. Poli, L. Manica, and A. Massa, "Synthesis of monopulse time-modulated planar arrays with controlled sideband radiation," *IET Radar, Sonar & Navigation*, vol. 6, no. 6, pp. 432-442, 2012.

- [8] P. Rocca, L. Poli, G. Oliveri, and A. Massa, "Synthesis of time-modulated planar arrays with controlled harmonic radiations," *Journal of Electromagnetic Waves and Applications*, vol. 24, no. 5/6, pp. 827-838, 2010.
- [9] P. Rocca, M. Benedetti, M. Donelli, D. Franceschini, and A. Massa, "Evolutionary optimization as applied to inverse problems," *Inverse Problems - 25 th Year Special Issue of Inverse Problems, Invited Topical Review*, vol. 25, pp. 1-41, Dec. 2009.
- [10] P. Rocca, G. Oliveri, and A. Massa, "Differential Evolution as applied to electromagnetics," *IEEE Antennas Propag. Mag.*, vol. 53, no. 1, pp. 38-49, Feb. 2011.

*This report is submitted in partial fulfillment of the degree of the course "ACM".
Supervisors: Prof. Andrea Massa, Dr. Lorenzo Poli.*