Guidelines for Student Reports

RECONFIGURABLE CONFORMAL ARRAY SYNTHESIS THROUGH MT-BCS

J. Moseley

Abstract

Monopulse radar applications require the realization of antennas able to generate two different patterns: a sum pattern and a difference pattern. In order to achieve this objective, antenna arrays are usually employed and each pattern is generated by using different and separated feeding networks. This solution allows one to obtain very good performances, but at the expense of a very high cost, due to the doubled complexity of the feeding network.
In order to overcome this disadvantage, a common approach consists in the reduction of the number of elements of the array, reducing then the complexity of the feeding network. This is possible by using arrays with a sparse geometry (i.e. arrays with non-equispaced elements): in this way the elements locations can be used in the design process as an additional degree of freedom, allowing the designer to satisfy the project requirements by using a lower number of elements with respect to the classical uniform array case.
By using two feeding networks it is possible to modify the pattern of the array by changing the excitation applied to each element, but the same cannot be done with the array positions. Hence, it is very important to define a set of element positions which is optimal for both patterns.
The objective of the activity is the development and the analysis of a technique based on Multi Task Bayesian Compressive Sensing for the synthesis of two sparse CONFORMAL arrays:
-with different pattern (sum an difference patterns)
-with the same position for each array element.

Reference Bibliography: Compressive Sensing [1]; Compressive Sensing and Array Synthesis [2]-[7]; Compressive Sensing and Direction-of-Arrival [8]-[10].

[1] A. Massa, P. Rocca, and G. Oliveri, "Compressive Sensing in Electromagnetics - A Review," IEEE Antennas and Propagation Magazine, pp. 224-238, vol. 57, no. 1, Feb. 2015.
[2] G. Oliveri and A. Massa, "Bayesian compressive sampling for pattern synthesis with maximally sparse non-uniform linear arrays," IEEE Trans. Antennas Propag., vol. 59, no. 2, pp. 467-481, Feb. 2011.
[3] G. Oliveri, M. Carlin, and A. Massa, "Complex-weight sparse linear array synthesis by Bayesian Compressive Sampling," IEEE Trans. Antennas Propag., vol. 60, no. 5, pp. 2309-2326, May 2012.
[4] G. Oliveri, P. Rocca, and A. Massa, "Reliable Diagnosis of Large Linear Arrays - A Bayesian Compressive Sensing Approach," IEEE Trans. Antennas Propag., vol. 60, no. 10, pp. 4627-4636, Oct. 2012.
[5] F. Viani, G. Oliveri, and A. Massa, "Compressive sensing pattern matching techniques for synthesizing planar sparse arrays," IEEE Trans. Antennas Propag., vol. 61, no. 9, pp. 4577-4587, Sept. 2013.

[6] G. Oliveri, E. T. Bekele, F. Robol, and A. Massa, "Sparsening conformal arrays through a versatile BCS-based method," IEEE Trans. Antennas Propag., vol. 62, no. 4, pp. 1681-1689, Apr. 2014.
[7] M. Carlin, G. Oliveri, and A. Massa, "Hybrid BCS-deterministic approach for sparse concentric ring isophoric arrays," IEEE Trans. Antennas Propag., vol. 63, no. 1, pp. 378-383, Jan. 2015.
[8] M. Carlin, P. Rocca, G. Oliveri, F. Viani, and A. Massa, "Directions-of-arrival estimation through Bayesian Compressive Sensing strategies," IEEE Trans. Antennas Propag., vol. 61, no. 7, pp. 3828-3838, Jul. 2013.
[9] M. Carlin, P. Rocca, G. Oliveri, and A. Massa, "Bayesian compressive sensing as applied to directions-of-arrival estimation in planar arrays," Journal of Electrical and Computer Engineering, Special Issue on "Advances in Radar Technologies", vol. 2013, Article ID 245867, 12 pages, 2013.
[10] M. Carlin, P. Rocca, "A Bayesian compressive sensing strategy for direction-of-arrival estimation," 6th European Conference on Antennas Propag. (EuCAP 2012), Prague, Czech Republic, pp. 1508-1509, 26-30 Mar. 2012.

This report is submitted in partial fulfillment of the degree of the course "DCM".
Supervisors: Prof. Andrea Massa, Dr. Giacomo Oliveri, Dr. Paolo Rocca.