Optimization of a Planar Array by means of Differentiated Meta-PSO Techniques

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This paper presents the optimization of a planar array that has to guarantee a defined radiation pattern, with tilted main beam and two different frequency bands. The design procedure has been conducted with the application of the recently developed class of Meta-Particle Swarm Optimization techniques.

In fact, in antenna array synthesis the designer has often to face the problem of obtaining a radiation pattern compliant with a given, complex, mask by properly adjusting several degrees of freedom: the number of elements and their spacing, the amplitude and the phase of the excitations, the type of the array element. In many practical cases the constrains on the radiation characteristics of the antenna must be satisfied over one or more frequency bands, and there could also be the requirement of efficient beam scanning on all these bands. The trade-off among all the degrees of freedom become quite complex and standard, analytic, direct array synthesis procedure are often non applicable.

As a possible solution to manage this issue, in previous papers the authors presented the application of Meta Particle Swarm Optimization, a class of recently developed evolutionary optimization techniques that are able to effectively manage simultaneously several parameters and several design goals. In particular, (Selleri et al., AWPL, v.5, 235–238, 2006) introduced several variations of the standard PSO algorithm, based on the employment of more swarms, in order to increase the efficiency of the search over the solution space with a negligible overhead in the algorithm complexity. Moreover the authors (Selleri er al., T-AP, v.56–1, 67–75, 2008), introduced differentiated behaviour for different agents inside the same swarm to improve the performances of the proposed methods and to avoid premature convergence to sub-optimal solutions.

Here, we present the results of the optimization of a planar array that has to guarantee a defined radiation pattern, on two different frequency bandwidths and with tilting feature of the main beam. The optimization has been carried out adopting as free parameters the amplitude and the phase of the excitation coefficients and as well as the array element relative positions.