Optimized 2-Dimensional Platform Placement for Sidelobe Mitigation in Coherent Distributed Arrays

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There is growing interest in coherently coordinating the wireless operations of multiple moving platforms due to the significant potential such arrays hold for future wireless system design. Whereas current platform-centric models require designs of new individual wireless systems to achieve performance gains, coherent distributed arrays (CDAs) can increase operational performance simply by adding additional nodes to the array. Open-loop CDAs, where the array self-aligns without external signal inputs from the intended target location, have the potential to support nearly any wireless application, from communications to remote sensing (J. A. Nanzer *et al.*, Open-Loop Coherent Distributed Arrays, IEEE Trans. on MTT, PP (99), 1-11, 2017).

While other efforts have investigated the requirements of inter-node coordination to achieve coherent gain, research on the effects of arrays with the extreme sparsities manifested in CDAs must be investigated. In particular, sparse array radiation patterns inherently have grating lobes or large sidelobes resulting from the wide separation of the few elements in the array, and radiation of the signal in directions away from the desired mainbeam can be detrimental in many applications. Determination of preferred element locations, represented by platforms in CDAs, has been investigated by the authors for linear arrays with the extreme sparsities anticipated in CDAs, however layout optimization in two-dimensional arrays with similar extreme sparsity has not been investigated.

This work presents the results of an investigation into the optimized location of platforms in a two-dimensional CDA consisting of nine platforms, each with a three-element sub-array with elements separated by 5λ, located within a square 1000λ area. Because of the large solution space, a direct search for the optimal locations is not computationally feasible, thus numerical optimization is required. In this work a genetic algorithm (GA) is implemented, building on prior research in linear array optimization using GAs. The array is optimized based on the level of sidelobe suppression relative to the mainbeam achieved within a 10° region around the mainbeam, which is approximately the spatial filtering that can be achieved with the three-element sub-arrays on each platform. Despite the extreme sparsity of the array, sidelobe suppression of nearly 7 dB was achieved in the best layout after 100 GA generations.