INVESTIGATION OF MODAL BEAM GENERATION FROM ORTHOGONAL MODES OF THE CIRCULAR CANONICAL FAMILY RANDOM ARRAY TOPOLOGY

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This work examines the characteristic modes and measurement of a circular canonical family (CCF) of ad-hoc array topologies in which element radiators are used independently to deliver both sum and difference beams. We present a mathematical framework for the analysis of radiation characteristics from randomly distributed antenna arrays of the generalized circular topologies. Fourier probabilistic methods (i.e. characteristic function analyses) are applied to derive associated *n*-th order characteristic functions governing the radiation pattern. Sum and difference pattern behavior is generated using even and odd element distributions. Additionally, a means of generating orthogonal radiating modes from the CCF topologies is derived using the set orthogonal polynomials. The radiating modes are shown to form a complete and independent set of characteristic radiation modes for the CCF topologies. Numerical simulations are performed using both ANSYS HFSS and MATLAB to demonstrate beam steering and examine the modal pattern characteristics.

To validate our analytical approach, we present measured results of uniformly distributed array topologies, geometrically constrained to a set of 32 elements. Scanned patterns are provided for the sum-difference modes in both the *E* and *H* planes under lossless conditions. These are compared to theoretically-derived pattern behavior, which can be eventually extended to a number of more complex topologies with the derived orthogonal polynomial based amplitude tapering. The results demonstrate the utility of the CCF topology in generating radiation modes; because of this, applying the CCF in radar and electronic warfare technology will lead to greater performance such as enhanced target resolution and increased range capabilities.