INVESTIGATION OF SUM-DIFFERENCE BEAM GENERATION USING INTERIOR AND PERIMETER ELEMENTS OF PLANAR RANDOM ARRAY TOPOLOGIES

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Wireless communication techniques and network-centric topologies for portable communication networks can be applied in a variety of ways for beamforming applications. It is therefore relevant to examine these in the context of motion-dynamic systems and leverage these capabilities to investigate new distributed beamforming techniques for random arrays. Platforms such as micro air vehicles (MAVs), unattended ground sensors (UGSs), and unpiloted aerial vehicles (UAVs) can all benefit from advances in this area by enabling advantages in stealth, enhanced survivability, and maximum maneuverability. Hence, once each stand-alone transmit/receive module is phased appropriately the random array's ability to create multiple simultaneously-steerable beams can be exploited. This can then be used within many tracking applications, specifically through the use of amplitude monopulse scanning techniques. These architectures use a sum beam (addition of the two beams) in the transmission state, while both sum and difference beams (subtraction of the two beams) are used for reception.

This work examines the theory and measurement of several random array topologies in which the perimeter and interior elements are used independently to provide both the sum and difference beam beams. The beampatterns for these associated distributions can be derived, and when shown in depth, and it can be deduced that these types of distributions use a cosine Fourier transform for the sum beam and a sine Fourier transform for the difference beam. Moreover, it can be seen that as the number of elements increases the mean valued radiation pattern approaches that of a continuous aperture distribution – as expected. Three canonical topologies (square, circular, and triangular) are used to geometrically constrain a set of thirty-two elements and form the random planar arrays in this work. Measured results are provided for the different permutations of sum-difference patterns with the interior-perimeter arrangements. These are compared to theoretically-derived pattern behavior, which is extended to a number of more complex array topologies.