College of Engineering

TENNESSEE TECH

The Department of

Electrical and Computer Engineering

Announces the Dissertation Defense

of

Barry Kent Daniel

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

October 20, 2020

2:00 p.m.

Tennessee Tech University

Zoom Link: https://tntech.zoom.us/j/97068555243

FIELD OF STUDY

Electrical Engineering, Communication and Signal Processing

Dissertation Topic

Phase-Only Beam Broadening of Contiguous Uniform Sub-Arrayed Arrays

EXAMINING COMMITTEE

Dr. Adam L. Anderson, Committee Co-Chair
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ABSTRACT

In modern antenna systems, beam broadening of sub-arrayed arrays provides continuous coverage of a wide angular extent in a cost-effective manner. While many methods have been published that address beam broadening of traditional (non-sub-arrayed) arrays, there is a knowledge gap in the published literature with respect to efficient beam broadening of contiguous uniform sub-arrayed arrays. This dissertation presents efficient and effective methods for beam broadening of contiguous sub-arrayed arrays where elements of the array are grouped together to have the same element excitations. Particularly, this dissertation focuses on phase-only optimization to preserve maximum power output.

The high dimensionality of the solution space of possible phase settings causes brute force techniques to be infeasible for exhaustively evaluating the entire space. Three metaheuristic global optimization techniques: simulated annealing (SA), genetic algorithm (GA) with elitism, and particle swarm optimization (PSO); and three modified iterative Fourier transform (IFT) methods: integrated IFT (iIFT), decoupled IFT (dIFT), and subarray spaced IFT (ssIFT) are presented to efficiently search the vast solution space of possible phase settings for a solution that effectively satisfies the desired broadened pattern. The results of this study show that satisfactory radar patterns can be obtained more efficiently by using the three modified IFT methods, but the metaheuristic global optimization techniques achieve better effectiveness at the cost of lower efficiency.

BIOGRAPHICAL SKETCH

Barry Kent Daniel was born in Denver, Colorado, in 1970. He was raised in East Tennessee where he graduated from Jefferson County High School as Salutatorian in 1988. He continued his education at Tennessee Technological University (TTU) in Cookeville, Tennessee, where he graduated with a Bachelor of Science in Electrical Engineering and also a Bachelor of Science in Computer Science in December 1995. After graduating from TTU, he worked for Dynetics, Inc. in Huntsville, Alabama as a defense contractor mainly supporting the Missile and Space Intelligence Center (MSIC) and the U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC) on Redstone Arsenal. While in Huntsville he obtained a Master of Science degree in Electrical Engineering with a concentration in radar from the University of Alabama in Huntsville in December 2000. In 2005, he accepted a research and development staff position at Oak Ridge National Laboratory (ORNL) where his research interests include antenna array synthesis, efficient digital processing algorithms, track/data fusion, machine learning, real-time simulation test beds to analyze new waveforms, evaluation of prototype radar designs, and environment models that propagate RF and EO/IR energy. He is currently a candidate for the Doctor of Philosophy Degree in Engineering at Tennessee Technological University.

EDUCATION

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