California Science Center

CALIFORNIA STATE SCIENCE FAIR
2001 PROJECT SUMMARY

Your Name (List all student names if multiple authors.)
Sara K. Hanna

Project Title (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9)
Performance of Fractal Hybrids in a Quagi Array

Science Fair Use Only

S0611

Division
_ Junior (6-8) _X_ Senior (9-12)

Preferred Category (See page 5 for descriptions.)
6 - Electricity & Electronics

Abstract (Include Objective, Methods, Results, Conclusion. See samples on page 14.)
Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.

Objective: Determine if a combination of fractal and standard elements can optimize the performance of a quagi array.
Materials/Method: Calculated dimensions for fractal driven element at 223.5 MHz based on my previous study. Built element and measured resonance at 213 MHz. Constructed control driven element for 213 MHz. Calculated dimensions for control and fractal parasitic elements. Built all elements with 16 ga wire, attached to wooden blocks with hole bored in the center, allowing interchangability on a 5/8" diameter wooden boom. Antenna performance evaluated at TRW Systems in Sunnyvale, CA using anechoic chamber and network analyzer. VSWR curve of each array combination plotted to determine bandwidth and resonant frequency. Selected frequency test range. Calibrated chamber at test frequencies, using standard gain dipole as a reference. Placed test array in chamber. Measured array directivity and gain by rotating array 360°, collecting data every 2°; repeated for 14 combinations of standard and fractal elements. Transferred test data from TRW computer to ASCII files; imported into a spreadsheet at home for analysis.
Results: Control quagi array had poorer VSWR than expected. All arrays wirh fractal driven element displayed better VSWR. Forward gain of control quagi was higher than the full fractal array, but combination of fracatal driven element and standard parasitic elements yielded the highest gain. Beamwidth of hybrid array (fracatal driven element and standard parasitic elements) matched that of control quagi and was superior to full fractal arrays.
Conclusion: Combining fractal and standard elements in a quagi array can optimize performance (VSWR, gain, directivity). A hybrid of fractal driven element and standard parasitic elements offers optimal performance. This combination yields greatest forward gain, while maintaining directivity and good VSWR across the bandwidth. In all combination of elements, addition of control directors improved performance.

Summary Statement (In one sentence, state what your project is about.)
Evaluating the performance of quagi arrays combining fractal and standard antenna elements.

Help Received in Doing Project (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4.
John Deems of TRW Communications Engineering assisted with the antenna evaluation. My father helped with design and construction techniques. My parents helped prepare my project board.