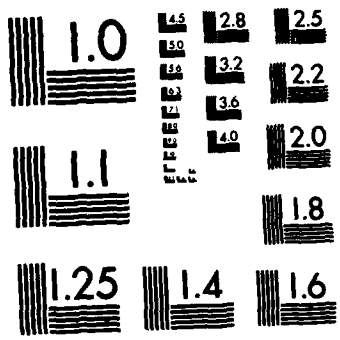
AD-A134 301 ADVANCED ADAPTIVE ANTENNA TECHNIQUES(U) OHIO STATE UNIV COLUMBUS ELECTROSCIENCE LAB R T COMPTON JUL 83 ESL-714505-7 N00019-82-C-0190 1/1

UNCLASSIFIED F/G 9/5 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(12)

OSU

The Ohio State University

AD-A134 301

ADVANCED ADAPTIVE ANTENNA TECHNIQUES

R. T. Compton, Jr.

The Ohio State University

ElectroScience Laboratory

Department of Electrical Engineering
Columbus, Ohio 43212

Final Report 714505-7

Contract N00019-82-C-0190

July 1983

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

Naval Air Systems Command
Washington, D.C. 20361

NOTICES

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2. AD-A134 301	3. Recipient's Accession No.

4. Title and Subtitle ADVANCED ADAPTIVE ANTENNA TECHNIQUES	5. Report Date July 1983
	6.
7. Author(s) R.T. Compton, Jr.	8. Performing Organization Rept. No. ESL 714505-7
9. Performing Organization Name and Address The Ohio State University ElectroScience Laboratory Department of Electrical Engineering Columbus, Ohio 43212	10. Project/Task/Work Unit No.
	11. Contract(C) or Grant(G) No. (C) (G) N00019-82-C-0190
12. Sponsoring Organization Name and Address Naval Air Systems Command Washington, D.C. 20361	13. Type of Report & Period Covered Final Report
	14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This report describes progress under Naval Air Systems Command Contract N00019-82-C-0190 for the final quarterly period. Research on the performance of adaptive arrays based on the Frost algorithm is summarized.

17. Document Analysis a. Descriptors

antennas, adaptive antennas, interference rejection

b. Identifiers/Open-Ended Terms

A-1

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED	Unclassified	4
	20. Security Class (This Page) Unclassified	22. Price

(See ANSI-Z39.18) See Instructions on Reverse OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

I. INTRODUCTION

This report describes progress under Naval Air Systems Command Contract N00019-82-C-0190 for the last quarterly period. This contract has involved research in two areas: (1) the effectiveness of adaptive arrays with frequency hopped signals, and (2) the performance of adaptive arrays based on the Frost algorithm[1].

During the final quarter we have concentrated on the Frost algorithm. Our progress is described below.

II. PROGRESS

During this quarter, we have completed a computer program that calculates the output SINR (signal-to-interference-plus-noise ratio) from a Frost beamformer. The program allows different types of constraints to be entered and then computes the SINR as a function of the signal parameters (arrival angles, powers, etc.). The program assumes a desired signal and one interference signal, both CW.

We have used this program to examine SINR performance with two types of constraints. The first, suggested by Applebaum and Chapman[2], constrains the pattern amplitude and its derivatives in the desired look direction. The second, due to Takao, Fujita and Nishi[3] constrains the pattern in several closely spaced directions near the desired angle. SINR curves have been run for these types of constraints.

The purpose of imposing constraints in an adaptive array is to achieve some desired property, such as a fixed main beam pointing direction or a fixed frequency response in the desired signal direction. However, the effect of constraints is to reduce the SINR achieved by the array below what it would be with an LMS array. LMS weights are optimal weights; they yield the highest possible array output SINR for a given set of signals and array elements. When constraints are imposed on the array, as in the Frost beamformer, the weights are no longer optimal. They are optimal only among the set of weights allowed by the constraints, but they are suboptimal among the set of all possible weights. Thus, the use of constraints reduces the achievable output SINR.

For the types of constraints mentioned above, we have found that the SINR achieved by the Frost array is almost as good as that of an LMS array except when the interference is near the main beam. If the Frost beamformer constrains the main beam so it cannot change, then when interference arrives in the beam, the array cannot respond to the interference properly. The resulting SINR is poorer than it would have been without the constraints. (But, of course, the beam direction is maintained.) Thus, the major difference between the LMS array and the Frost array is that the Frost array has poorer spatial resolution (i.e., poorer ability to achieve a given SINR with closely spaced signals).

One finds that the more tightly the pattern is constrained, the poorer is the resolution of the array. With the Applebaum-Chapman technique, the higher the order of the constraint*, the poorer the array resolution. For the approach of Takao, Fujita and Nishi, the wider the section over which the pattern is fixed, the poorer the array resolution.

---

* A constraint that fixes the first n derivatives of the pattern is called an n^{th} order constraint.

The results of this study will be documented under the follow-on contract while the author is at the Naval Research Laboratory.

II. REPORTS PUBLISHED

The following technical reports have been published under this contract:

1. A.S. Al-Ruwais and R.T. Compton, Jr., "Adaptive Array Behavior with Periodic Envelope Modulated Interference," Report 714505-1, December 1982, The Ohio State University ElectroScience Laboratory, Department of Electrical Engineering, Columbus, Ohio 43212; prepared under Contract N00019-82-C-0190 for Naval Air Systems Command.

2. A.S. Al-Ruwais and R.T. Compton, Jr., "Adaptive Array Behavior with Periodic Phase Modulated Interference," Report 714505-3, July 1983, The Ohio State University ElectroScience Laboratory, Department of Electrical Engineering, Columbus, Ohio 43212; prepared under Contract N00019-82-C-0190 for Naval Air Systems Command.

3. L. Acar and R.T. Compton, Jr., "The Performance of an LMS Adaptive Array with Frequency Hopped Signals," Report 714505-5, June 1983, The Ohio State University ElectroScience Laboratory, Columbus, Ohio 43212; prepared under Contract N00019-82-C-0190 for Naval Air Systems Command.

IV. FINANCIAL

As of July 31, 1983, the funds available under this contract have been spent out.

V. REFERENCES

[1] O.L. Frost, III, "An Algorithm for Linearly Constrained Adaptive Array Processing," Proceedings of the IEEE, Vol. 60, No. 8 (August 1972), p. 926.

[2] S.P. Applebaum and D.J. Chapman, "Adaptive Arrays with Main Beam Constraints," IEEE Trans. on Antennas and Propagation, Vol. AP-24, No. 5 (September 1976), p. 650.

[3] K. Takao, M. Fujita and T. Nishi, "An Adaptive Antenna Array under Directional Constraint," IEEE Trans. on Antennas and Propagation, Vol. AP-24, No. 5 (September 1976), p. 662.

END

FILMED

11-83

DTIC