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SCHELKUNOFF ARRAY SYNTHESIS METHODS USING ADAPTIVE-ITERATIVE ALGORITHM

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SUMMARY

The adaptive-iterative algorithm is an error-reduction algorithm that has been extensively studied in recent years. Basically, this algorithm is a combination of iterative algorithm with adaptive algorithm. By the co-emergence of these algorithms, a better performance and wider application are hoped to be achieved since each of these algorithms has its own advantages respectively. Although considerable research has been devoted to apply this algorithm in variety of DSP applications such as filter design and signal reconstruction, rather less attention has been paid for application in antenna array synthesis. For that reason, it is the purpose of this thesis to outline the implementation and use of adaptive-iterative algorithm in designing antenna array. In doing so, Schelkunoff Polynomial Method will be used in order to have z-domain information. Intended to achieve the aim of this project, MATLAB program will be employed to present the outcomes of modulus reconstruction on antenna array using adaptive-iterative algorithm. The results and performance of other error-reduction algorithm such as Papoulis algorithm and optimal algorithm are also presented and discussed in this thesis, along with the discussion of adaptive-iterative algorithm for comparison purposes.

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LIST OF SYMBOLS

SYMBOLS	DESCRIPTION
AF	Array Factor
	Phase angles between the far fields
β	Progressive phase shift
d	Inter-element spacing
θ	Observation angle measured from the array axis
F_u	Array factor of Schelkunoff
$g_k(u)$	Output of the aperture constraint at k^{th} iteration
$G_k(u)$	Fast Fourier transform of $g_k(u)$
$G'_k(u)$	Input for the Inverse Fast Fourier transform which is processed data from Schelkunoff polynomial method
$g'_k(u)$	Output of the Inverse Fast Fourier transform
A	Size for the aperture constraint
FFT	Fast Fourier transform
$IFFT$	Inverse Fast Fourier transform
MSE	Mean Square Error
μ	Rate of convergence used in adaptive algorithm
$W_k(u)$	Filter weight at k^{th} iteration
$C_k(u)$	Same sample in the previous estimated input, $g_k(u)$
SNR	Signal power to noise power ratio

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Recently, there has been a great deal of interest in the adaptive-iterative algorithm, which is basically an error reduction algorithm that is implemented with an adaptive manner. This deconvolution algorithm involves iterative Fast Fourier transformation back and forth between the object and Fourier domains and also application of the measured data or known constraints in each domain.

Nowadays, most of the deconvolution algorithms conventionally used exist either as iterative only or adaptive only algorithms. Iterative algorithm is used in its own domain such as signal reconstruction and digital filter design while adaptive algorithm is applied in its own domain which ranges from noise and interference cancellation to signal enhancement. This limits the application because of each of these algorithms is used to suit its own advantages respectively. However, the co-emergence of iterative algorithm with adaptive algorithm will achieve a wide range of application [1]. Furthermore, existing error reduction algorithms such as Papoulis algorithm usually face the problem of slow convergence

The objective of this project is to apply different error reduction algorithms which are Papoulis algorithm, adaptive-iterative algorithm and optimal-iterative along with Gerchberg-Saxton algorithm in antenna array synthesis. These algorithms will be used to construct linear array and also using Schelkunoff polynomial method in order to have z-domain information. Attention is given to the various approaches in the adaptive-iterative algorithm that was developed from the Papoulis algorithm that are Input-Output algorithm, Output-Output algorithm and Hybrid Input-Output algorithm.

Chapter 2 will give the overview of Schelkunoff polynomial method for antenna array synthesis and how it is implemented to control the number of nulls and its direction. Chapter 3 is about Gerchberg-Saxton algorithm while Chapter 4 is on Papoulis algorithm. In Chapter 5, various approaches in adaptive-iterative algorithm will be explained and Chapter 6 deals with the Optimal-Iterative algorithm. Results obtained from the analysis of each algorithm will be presented in Chapter 7 in terms of aperture amplitude distribution and mean square error (MSE) and performance of each design technique is being discussed. Conclusion will be made in Chapter 8, followed by references used for this project and appendices section where readers can find the MATLAB code used in this project.