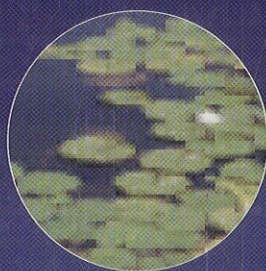
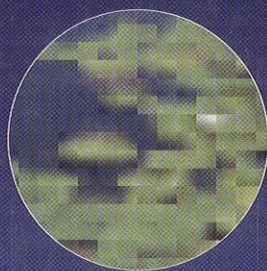
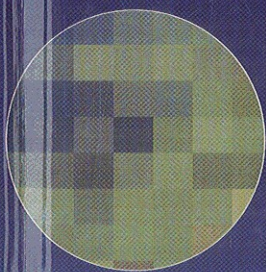


S. ALLEN BROUGHTON • KURT BRYAN

DISCRETE FOURIER ANALYSIS AND WAVELETS

Applications to Signal and Image Processing



 **WILEY**

WWW.
LINK AVAILABLE

CONTENTS

PREFACE	xi
----------------	-----------

ACKNOWLEDGMENTS	xv
------------------------	-----------

1 VECTOR SPACES, SIGNALS, AND IMAGES	1
---	----------

1.1 Overview / 1	
1.2 Some Common Image Processing Problems / 1	
1.3 Signals and Images [†] / 3	
1.4 Vector Space Models for Signals and Images / 9	
1.5 Basic Waveforms—The Analog Case / 17	
1.6 Sampling and Aliasing / 21	
1.7 Basic Waveforms—The Discrete Case / 26	
1.8 Inner Product Spaces and Orthogonality / 29	
1.9 Signal and Image Digitization / 41	
1.10 Infinite-dimensional Inner Product Spaces / 46	
1.11 Matlab Project / 56	
Exercises / 61	

2 THE DISCRETE FOURIER TRANSFORM	71
---	-----------

2.1 Overview / 71	
2.2 The Time Domain and Frequency Domain / 72	
2.3 A Motivational Example / 73	

- 2.4 The One-dimensional DFT / 78
- 2.5 Properties of the DFT / 85
- 2.6 The Fast Fourier Transform / 90
- 2.7 The Two-dimensional DFT / 93
- 2.8 Matlab Project / 97

Exercises / 101

3 THE DISCRETE COSINE TRANSFORM 105

- 3.1 Motivation for the DCT—Compression / 105
- 3.2 Other Compression Issues / 106
- 3.3 Initial Examples—Thresholding / 107
- 3.4 The Discrete Cosine Transform / 113
- 3.5 Properties of the DCT / 117
- 3.6 The Two-dimensional DCT / 120
- 3.7 Block Transforms / 122
- 3.8 JPEG Compression / 124
- 3.9 Matlab Project / 132

Exercises / 134

4 CONVOLUTION AND FILTERING 138

- 4.1 Overview / 138
- 4.2 One-dimensional Convolution / 138
- 4.3 Convolution Theorem and Filtering / 145
- 4.4 2D Convolution—Filtering Images / 150
- 4.5 Infinite and Bi-infinite Signal Models / 156
- 4.6 Matlab Project / 171

Exercises / 174

5 WINDOWING AND LOCALIZATION 182

- 5.1 Overview: Nonlocality of the DFT / 182
- 5.2 Localization via Windowing / 184
- 5.3 Matlab Project / 195

Exercises / 197

6 FILTER BANKS 201

- 6.1 Overview / 201
- 6.2 The Haar Filter Bank / 202
- 6.3 The General One-stage Two-channel Filter Bank / 210

6.4	Multistage Filter Banks /	214
6.5	Filter Banks for Finite Length Signals /	218
6.6	The 2D Discrete Wavelet Transform and JPEG 2000 /	231
6.7	Filter Design /	239
6.8	Matlab Project /	251
6.9	Alternate Matlab Project /	255
	Exercises /	258

7 WAVELETS **267**

7.1	Overview /	267
7.2	The Haar Basis /	269
7.3	Haar Wavelets versus the Haar Filter Bank /	282
7.4	Orthogonal Wavelets /	292
7.5	Biorthogonal Wavelets /	314
7.6	Matlab Project /	318
	Exercises /	321

REFERENCES **327**

SOLUTIONS **329**

INDEX **335**