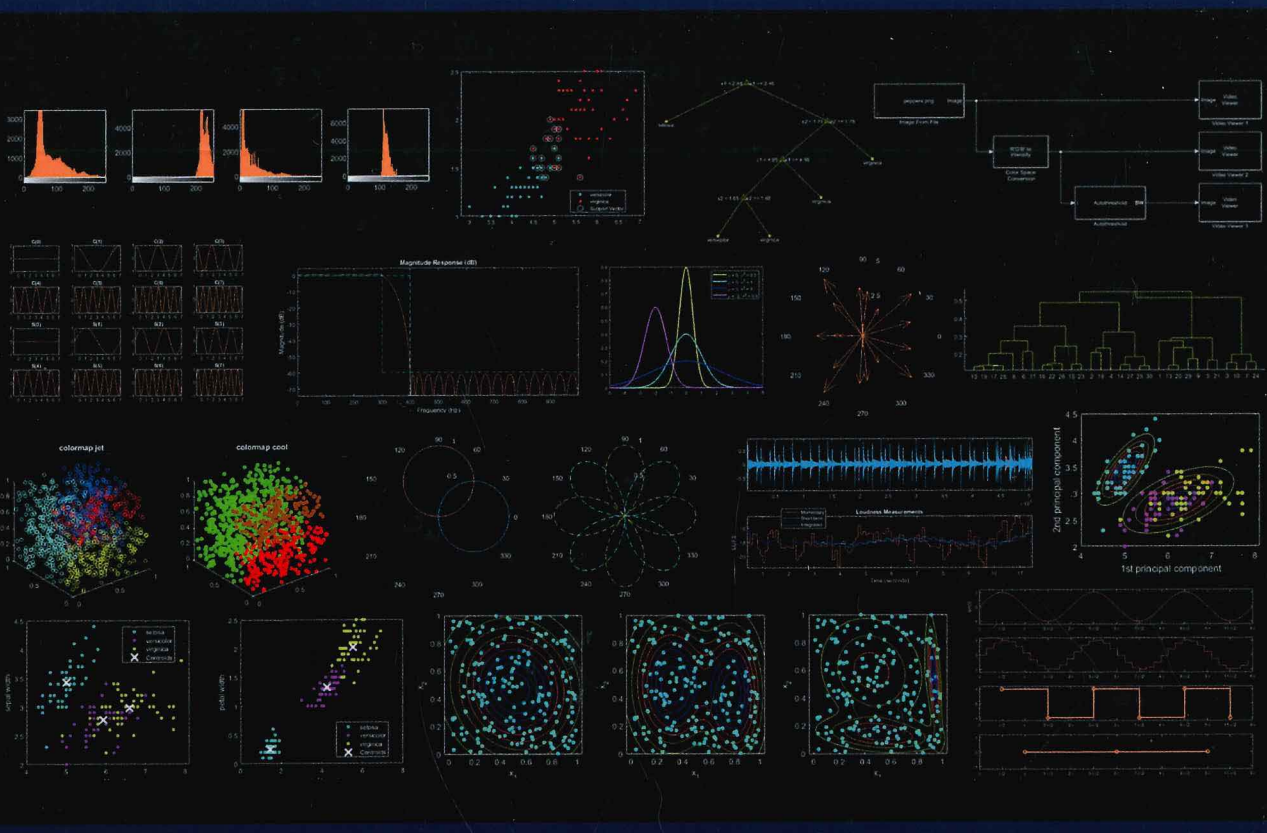

Fundamentals of IMAGE, AUDIO, and VIDEO PROCESSING Using MATLAB®

With Applications To PATTERN RECOGNITION

Ranjan Parekh

CRC Press
Taylor & Francis Group

สำนักหอสมุด มหาวิทยาลัยเชียงใหม่

p65
7,000-

b16586864
0125848
125861X

Fundamentals of IMAGE, AUDIO, and VIDEO PROCESSING Using MATLAB®

With Applications To PATTERN RECOGNITION

สำนักหอสมุดมหาวิทยาลัยเชียงใหม่
CHIANG MAI UNIVERSITY LIBRARY

Ranjan Parekh

CRC Press
Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

Contents

Preface ix
Author xv
Abbreviations xvii

1 Image Processing 1
1.1 Introduction 1
1.2 Toolboxes and Functions 5
1.2.1 Basic MATLAB® (BM) Functions 6
1.2.2 Image Processing Toolbox (IPT) Functions 9
1.2.3 Signal Processing Toolbox (SPT) Functions 13
1.2.4 Wavelet Toolbox (WT) Functions 13
1.3 Import Export and Conversions 14
1.3.1 Read and Write Image Data 14
1.3.2 Image-Type Conversion 16
1.3.3 Image Color 31
1.3.4 Synthetic Images 44
1.4 Display and Exploration 50
1.4.1 Basic Display 50
1.4.2 Interactive Exploration 54
1.4.3 Building Interactive Tools 57
1.5 Geometric Transformation and Image Registration 58
1.5.1 Common Geometric Transformations 58
1.5.2 Affine and Projective Transformations 64
1.5.3 Image Registration 67
1.6 Image Filtering and Enhancement 73
1.6.1 Image Filtering 73
1.6.2 Edge Detection 80
1.6.3 Contrast Adjustment 86
1.6.4 Morphological Operations 92
1.6.5 ROI and Block Processing 95
1.6.6 Image Arithmetic 99
1.6.7 De-blurring 101
1.7 Image Segmentation and Analysis 109
1.7.1 Image Segmentation 109
1.7.2 Object Analysis 111
1.7.3 Region and Image Properties 118
1.7.4 Texture Analysis 125
1.7.5 Image Quality 129
1.7.6 Image Transforms 131
1.8 Working in Frequency Domain 144
1.9 Image Processing Using Simulink 149
1.10 Notes on 2-D Plotting Functions 155
1.11 Notes on 3-D Plotting Functions 182
Review Questions 190

2 Audio Processing 191
2.1 Introduction 191
2.2 Toolboxes and Functions 193
2.2.1 Basic MATLAB® (BM) Functions 193
2.2.2 Audio System Toolbox (AST) Functions 195
2.2.3 DSP System Toolbox (DSPST) Functions 196
2.2.4 Signal Processing Toolbox (SPT) Functions 196
2.3 Sound Waves 197
2.4 Audio I/O and Waveform Generation 210
2.5 Audio Processing Algorithm Design 215
2.6 Measurements and Feature Extraction 225
2.7 Simulation, Tuning and Visualization 231
2.8 Musical Instrument Digital Interface (MIDI) 235
2.9 Temporal Filters 237
2.10 Spectral Filters 241
2.11 Audio Processing Using Simulink 254
Review Questions 257

3 Video Processing 259
3.1 Introduction 259
3.2 Toolboxes and Functions 262
3.2.1 Basic MATLAB® (BM) Functions 262
3.2.2 Computer Vision System Toolbox (CVST) Functions 263
3.3 Video Input Output and Playback 264
3.4 Processing Video Frames 272
3.5 Video Color Spaces 278
3.6 Object Detection 282
3.6.1 Blob Detector 282
3.6.2 Foreground Detector 284
3.6.3 People Detector 285
3.6.4 Face Detector 286
3.6.5 Optical Character Recognition (OCR) 288
3.7 Motion Tracking 289
3.7.1 Histogram Based Tracker 289
3.7.2 Optical Flow 291
3.7.3 Point Tracker 293
3.7.4 Kalman Filter 294
3.7.5 Block Matcher 296
3.8 Video Processing Using Simulink 297
Review Questions 300

4 Pattern Recognition 303
4.1 Introduction 303
4.2 Toolboxes and Functions 304
4.2.1 Computer Vision System Toolbox (CVST) 304
4.2.2 Statistics and Machine Learning Toolbox (SMLT) 305
4.2.3 Neural Network Toolbox (NNT) 306
4.3 Data Acquisition 306
4.4 Pre-processing 311

4.5 Feature Extraction 312
4.5.1 Minimum Eigenvalue Method 312
4.5.2 Harris Corner Detector 314
4.5.3 FAST Algorithm 315
4.5.4 MSER Algorithm 316
4.5.5 SURF Algorithm 317
4.5.6 KAZE Algorithm 320
4.5.7 BRISK Algorithm 321
4.5.8 LBP Algorithm 322
4.5.9 HOG Algorithm 324
4.6 Clustering 324
4.6.1 Similarity Metrics 324
4.6.2 *k*-means Clustering 328
4.6.3 Hierarchical Clustering 332
4.6.4 GMM-Based Clustering 335
4.7 Classification 337
4.7.1 *k*-NN Classifiers 338
4.7.2 Artificial Neural Network (ANN) classifiers 339
4.7.3 Decision Tree Classifiers 346
4.7.4 Discriminant Analysis Classifiers 348
4.7.5 Naive Bayes Classifiers 353
4.7.6 Support Vector Machine (SVM) Classifiers 354
4.7.7 Classification Learner App 356
4.8 Performance Evaluation 365
Review Questions 369

Function Summary 371

References 381

Index 385