

1. Record Nr.	UNINA9910139599503321
Autore	Marques Oge
Titolo	Practical image and video processing using MATLAB // Oge Marques
Pubbl/distr/stampa	Hoboken, New Jersey : , : Wiley-IEEE Press, , 2011 [Piscataqay, New Jersey] : , : IEEE Xplore, , [2011]
ISBN	1-118-09347-X 6613239917 1-283-23991-4 9786613239914 1-118-09348-8
Edizione	[1st edition]
Descrizione fisica	1 online resource (691 p.)
Classificazione	TEC015000 ST 601
Disciplina	502.85/66
Soggetti	Image processing - Mathematics Image processing - Digital techniques
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	LIST OF FIGURES xxi -- LIST OF TABLES xxxix -- FOREWORD xli -- PREFACE xliii -- ACKNOWLEDGMENTS xlix -- PART I IMAGE PROCESSING -- 1 INTRODUCTION AND OVERVIEW 3 -- 1.1 Motivation / 3 -- 1.2 Basic Concepts and Terminology / 5 -- 1.3 Examples of Typical Image Processing Operations / 6 -- 1.4 Components of a Digital Image Processing System / 10 -- 1.5 Machine Vision Systems / 12 -- 1.6 Resources / 14 -- 1.7 Problems / 18 -- 2 IMAGE PROCESSING BASICS 21 -- 2.1 Digital Image Representation / 21 -- 2.1.1 Binary (1-Bit) Images / 23 -- 2.1.2 Gray-Level (8-Bit) Images / 24 -- 2.1.3 Color Images / 25 -- 2.1.4 Compression / 26 -- 2.2 Image File Formats / 27 -- 2.3 Basic Terminology / 28 -- 2.4 Overview of Image Processing Operations / 30 -- 2.4.1 Global (Point) Operations / 31 -- 2.4.2 Neighborhood-Oriented Operations / 31 -- 2.4.3 Operations Combining Multiple Images / 32 -- 2.4.4 Operations in a Transform Domain / 32 -- 3 MATLAB BASICS 35 -- 3.1 Introduction to MATLAB / 35 -- 3.2 Basic Elements of MATLAB / 36 -- 3.2.1 Working Environment / 36 -- 3.2.2 Data Types / 37 -- 3.2.3 Array and Matrix

Indexing in MATLAB / 37 -- 3.2.4 Standard Arrays / 37 -- 3.2.5
Command-Line Operations / 38 -- 3.3 Programming Tools: Scripts and
Functions / 38 -- 3.3.1 M-Files / 39 -- 3.3.2 Operators / 40 -- 3.3.3
Important Variables and Constants / 42 -- 3.3.4 Number
Representation / 42 -- 3.3.5 Flow Control / 43 -- 3.3.6 Code
Optimization / 43 -- 3.3.7 Input and Output / 43 -- 3.4 Graphics and
Visualization / 43 -- 3.5 Tutorial 3.1: MATLAB-a Guided Tour / 44 --
3.6 Tutorial 3.2: MATLAB Data Structures / 46 -- 3.7 Tutorial 3.3:
Programming in MATLAB / 53 -- 3.8 Problems / 59 -- 4 THE IMAGE
PROCESSING TOOLBOX AT A GLANCE 61 -- 4.1 The Image Processing
Toolbox: an Overview / 61 -- 4.2 Essential Functions and Features / 62
-- 4.2.1 Displaying Information About an Image File / 62 -- 4.2.2
Reading an Image File / 64 -- 4.2.3 Data Classes and Data Conversions
/ 65 -- 4.2.4 Displaying the Contents of an Image / 68.
4.2.5 Exploring the Contents of an Image / 69 -- 4.2.6 Writing the
Resulting Image onto a File / 70 -- 4.3 Tutorial 4.1: MATLAB Image
Processing Toolbox-a Guided Tour / 72 -- 4.4 Tutorial 4.2: Basic
Image Manipulation / 74 -- 4.5 Problems / 80 -- 5 IMAGE SENSING
AND ACQUISITION 83 -- 5.1 Introduction / 83 -- 5.2 Light, Color, and
Electromagnetic Spectrum / 84 -- 5.2.1 Light and Electromagnetic
Spectrum / 84 -- 5.2.2 Types of Images / 85 -- 5.2.3 Light and Color
Perception / 86 -- 5.2.4 Color Encoding and Representation / 87 --
5.3 Image Acquisition / 89 -- 5.3.1 Image Sensors / 89 -- 5.3.2
Camera Optics / 92 -- 5.4 Image Digitization / 93 -- 5.4.1 Sampling /
95 -- 5.4.2 Quantization / 96 -- 5.4.3 Spatial and Gray-Level
Resolution / 97 -- 5.5 Problems / 101 -- 6 ARITHMETIC AND LOGIC
OPERATIONS 103 -- 6.1 Arithmetic Operations: Fundamentals and
Applications / 103 -- 6.1.1 Addition / 104 -- 6.1.2 Subtraction / 106
-- 6.1.3 Multiplication and Division / 109 -- 6.1.4 Combining Several
Arithmetic Operations / 110 -- 6.2 Logic Operations: Fundamentals
and Applications / 111 -- 6.3 Tutorial 6.1: Arithmetic Operations / 113
-- 6.4 Tutorial 6.2: Logic Operations and Region of Interest Processing
/ 118 -- 6.5 Problems / 122 -- 7 GEOMETRIC OPERATIONS 125 -- 7.1
Introduction / 125 -- 7.2 Mapping and Affine Transformations / 127
-- 7.3 Interpolation Methods / 130 -- 7.3.1 The Need for Interpolation
/ 130 -- 7.3.2 A Simple Approach to Interpolation / 131 -- 7.3.3 Zero-
Order (Nearest-Neighbor) Interpolation / 132 -- 7.3.4 First-Order
(Bilinear) Interpolation / 132 -- 7.3.5 Higher Order Interpolations / 132
-- 7.4 Geometric Operations Using MATLAB / 132 -- 7.4.1 Zooming,
Shrinking, and Resizing / 133 -- 7.4.2 Translation / 134 -- 7.4.3
Rotation / 134 -- 7.4.4 Cropping / 134 -- 7.4.5 Flipping / 134 -- 7.5
Other Geometric Operations and Applications / 134 -- 7.5.1 Warping /
134 -- 7.5.2 Nonlinear Image Transformations / 135 -- 7.5.3
Morphing / 137 -- 7.5.4 Seam Carving / 137 -- 7.5.5 Image
Registration / 137.
7.6 Tutorial 7.1: Image Cropping, Resizing, Flipping, and Rotation /
138 -- 7.7 Tutorial 7.2: Spatial Transformations and Image Registration
/ 142 -- 7.8 Problems / 149 -- 8 GRAY-LEVEL TRANSFORMATIONS 151
-- 8.1 Introduction / 151 -- 8.2 Overview of Gray-level (Point)
Transformations / 152 -- 8.3 Examples of Point Transformations / 155
-- 8.3.1 Contrast Manipulation / 155 -- 8.3.2 Negative / 157 -- 8.3.3
Power Law (Gamma) Transformations / 157 -- 8.3.4 Log
Transformations / 159 -- 8.3.5 Piecewise Linear Transformations / 160
-- 8.4 Specifying the Transformation Function / 161 -- 8.5 Tutorial
8.1: Gray-level Transformations / 163 -- 8.6 Problems / 169 -- 9
HISTOGRAM PROCESSING 171 -- 9.1 Image Histogram: Definition and
Example / 171 -- 9.2 Computing Image Histograms / 173 -- 9.3
Interpreting Image Histograms / 174 -- 9.4 Histogram Equalization /

176 -- 9.5 Direct Histogram Specification / 181 -- 9.6 Other Histogram Modification Techniques / 184 -- 9.6.1 Histogram Sliding / 185 -- 9.6.2 Histogram Stretching / 185 -- 9.6.3 Histogram Shrinking / 186 -- 9.7 Tutorial 9.1: Image Histograms / 188 -- 9.8 Tutorial 9.2: Histogram Equalization and Specification / 191 -- 9.9 Tutorial 9.3: Other Histogram Modification Techniques / 195 -- 9.10 Problems / 200 -- 10 NEIGHBORHOOD PROCESSING 203 -- 10.1 Neighborhood Processing / 203 -- 10.2 Convolution and Correlation / 204 -- 10.2.1 Convolution in the One-Dimensional Domain / 204 -- 10.2.2 Convolution in the Two-Dimensional Domain / 206 -- 10.2.3 Correlation / 208 -- 10.2.4 Dealing with Image Borders / 210 -- 10.3 Image Smoothing (Low-pass Filters) / 211 -- 10.3.1 Mean Filter / 213 -- 10.3.2 Variations / 213 -- 10.3.3 Gaussian Blur Filter / 215 -- 10.3.4 Median and Other Nonlinear Filters / 216 -- 10.4 Image Sharpening (High-pass Filters) / 218 -- 10.4.1 The Laplacian / 219 -- 10.4.2 Composite Laplacian Mask / 220 -- 10.4.3 Directional Difference Filters / 220 -- 10.4.4 Unsharp Masking / 221 -- 10.4.5 High-Boost Filtering / 221 -- 10.5 Region of Interest Processing / 222. 10.6 Combining Spatial Enhancement Methods / 223 -- 10.7 Tutorial 10.1: Convolution and Correlation / 223 -- 10.8 Tutorial 10.2: Smoothing Filters in the Spatial Domain / 225 -- 10.9 Tutorial 10.3: Sharpening Filters in the Spatial Domain / 228 -- 10.10 Problems / 234 -- 11 FREQUENCY-DOMAIN FILTERING 235 -- 11.1 Introduction / 235 -- 11.2 Fourier Transform: the Mathematical Foundation / 237 -- 11.2.1 Basic Concepts / 237 -- 11.2.2 The 2D Discrete Fourier Transform: Mathematical Formulation / 239 -- 11.2.3 Summary of Properties of the Fourier Transform / 241 -- 11.2.4 Other Mathematical Transforms / 242 -- 11.3 Low-pass Filtering / 243 -- 11.3.1 Ideal LPF / 244 -- 11.3.2 Gaussian LPF / 246 -- 11.3.3 Butterworth LPF / 246 -- 11.4 High-pass Filtering / 248 -- 11.4.1 Ideal HPF / 248 -- 11.4.2 Gaussian HPF / 250 -- 11.4.3 Butterworth HPF / 250 -- 11.4.4 High-Frequency Emphasis / 251 -- 11.5 Tutorial 11.1: 2D Fourier Transform / 252 -- 11.6 Tutorial 11.2: Low-pass Filters in the Frequency Domain / 254 -- 11.7 Tutorial 11.3: High-pass Filters in the Frequency Domain / 258 -- 11.8 Problems / 264 -- 12 IMAGE RESTORATION 265 -- 12.1 Modeling of the Image Degradation and Restoration Problem / 265 -- 12.2 Noise and Noise Models / 266 -- 12.2.1 Selected Noise Probability Density Functions / 267 -- 12.2.2 Noise Estimation / 269 -- 12.3 Noise Reduction Using Spatial-domain Techniques / 269 -- 12.3.1 Mean Filters / 273 -- 12.3.2 Order Statistic Filters / 275 -- 12.3.3 Adaptive Filters / 278 -- 12.4 Noise Reduction Using Frequency-domain Techniques / 278 -- 12.4.1 Periodic Noise / 279 -- 12.4.2 Bandreject Filter / 280 -- 12.4.3 Bandpass Filter / 281 -- 12.4.4 Notch Filter / 282 -- 12.5 Image Deblurring Techniques / 283 -- 12.5.1 Wiener Filtering / 286 -- 12.6 Tutorial 12.1: Noise Reduction Using Spatial-domain Techniques / 289 -- 12.7 Problems / 296 -- 13 MORPHOLOGICAL IMAGE PROCESSING 299 -- 13.1 Introduction / 299 -- 13.2 Fundamental Concepts and Operations / 300 -- 13.2.1 The Structuring Element / 301. 13.3 Dilation and Erosion / 304 -- 13.3.1 Dilation / 305 -- 13.3.2 Erosion / 307 -- 13.4 Compound Operations / 310 -- 13.4.1 Opening / 310 -- 13.4.2 Closing / 311 -- 13.4.3 Hit-or-Miss Transform / 313 -- 13.5 Morphological Filtering / 314 -- 13.6 Basic Morphological Algorithms / 315 -- 13.6.1 Boundary Extraction / 317 -- 13.6.2 Region Filling / 319 -- 13.6.3 Extraction and Labeling of Connected -- Components / 321 -- 13.7 Grayscale Morphology / 322 -- 13.7.1 Dilation and Erosion / 323 -- 13.7.2 Opening and Closing / 323 -- 13.7.3 Top-Hat and Bottom-Hat Transformations / 325 -- 13.8

Tutorial 13.1: Binary Morphological Image Processing / 325 -- 13.9
Tutorial 13.2: Basic Morphological Algorithms / 330 -- 13.10 Problems
/ 334 -- 14 EDGE DETECTION 335 -- 14.1 Formulation of the Problem
/ 335 -- 14.2 Basic Concepts / 336 -- 14.3 First-order Derivative Edge
Detection / 338 -- 14.4 Second-order Derivative Edge Detection / 343
-- 14.4.1 Laplacian of Gaussian / 345 -- 14.5 The Canny Edge
Detector / 347 -- 14.6 Edge Linking and Boundary Detection / 348 --
14.6.1 The Hough Transform / 349 -- 14.7 Tutorial 14.1: Edge
Detection / 354 -- 14.8 Problems / 363 -- 15 IMAGE SEGMENTATION
365 -- 15.1 Introduction / 365 -- 15.2 Intensity-based Segmentation /
367 -- 15.2.1 Image Thresholding / 368 -- 15.2.2 Global
Thresholding / 369 -- 15.2.3 The Impact of Illumination and Noise on
Thresholding / 370 -- 15.2.4 Local Thresholding / 371 -- 15.3
Region-based Segmentation / 373 -- 15.3.1 Region Growing / 374 --
15.3.2 Region Splitting and Merging / 377 -- 15.4 Watershed
Segmentation / 377 -- 15.4.1 The Distance Transform / 378 -- 15.5
Tutorial 15.1: Image Thresholding / 379 -- 15.6 Problems / 386 -- 16
COLOR IMAGE PROCESSING 387 -- 16.1 The Psychophysics of Color /
387 -- 16.1.1 Basic Concepts / 388 -- 16.1.2 The CIE XYZ
Chromaticity Diagram / 390 -- 16.1.3 Perceptually Uniform Color
Spaces / 393 -- 16.1.4 ICC Profiles / 395 -- 16.2 Color Models / 396
-- 16.2.1 The RGB Color Model / 396 -- 16.2.2 The CMY and CMYK
Color Models / 398.
16.2.3 The HSV Color Model / 398 -- 16.2.4 The YIQ (NTSC) Color
Model / 401 -- 16.2.5 The YCbCr Color Model / 401 -- 16.3
Representation of Color Images in MATLAB / 401 -- 16.3.1 RGB Images
/ 402 -- 16.3.2 Indexed Images / 403 -- 16.4 Pseudocolor Image
Processing / 406 -- 16.4.1 Intensity Slicing / 406 -- 16.4.2 Gray Level
to Color Transformations / 407 -- 16.4.3 Pseudocoloring in the
Frequency Domain / 408 -- 16.5 Full-color Image Processing / 409 --
16.5.1 Color Transformations / 410 -- 16.5.2 Histogram Processing /
412 -- 16.5.3 Color Image Smoothing and Sharpening / 412 -- 16.5.4
Color Noise Reduction / 414 -- 16.5.5 Color-Based Image
Segmentation / 414 -- 16.5.6 Color Edge Detection / 417 -- 16.6
Tutorial 16.1: Pseudocolor Image Processing / 419 -- 16.7 Tutorial
16.2: Full-color Image Processing / 420 -- 16.8 Problems / 425 -- 17
IMAGE COMPRESSION AND CODING 427 -- 17.1 Introduction / 427 --
17.2 Basic Concepts / 428 -- 17.2.1 Redundancy / 428 -- 17.2.2
Image Encoding and Decoding Model / 431 -- 17.3 Lossless and Lossy
Compression Techniques / 432 -- 17.3.1 Lossless Compression
Techniques / 432 -- 17.3.2 Lossy Compression Techniques / 433 --
17.4 Image Compression Standards / 435 -- 17.4.1 Binary Image
Compression Standards / 435 -- 17.4.2 Continuous Tone Still Image
Compression Standards / 435 -- 17.4.3 JPEG / 436 -- 17.4.4 JPEG
2000 / 437 -- 17.4.5 JPEG-LS / 437 -- 17.5 Image Quality Measures /
438 -- 17.5.1 Subjective Quality Measurement / 438 -- 17.5.2
Objective Quality Measurement / 439 -- 17.6 Tutorial 17.1: Image
Compression / 440 -- 18 FEATURE EXTRACTION AND REPRESENTATION
447 -- 18.1 Introduction / 447 -- 18.2 Feature Vectors and Vector
Spaces / 448 -- 18.2.1 Invariance and Robustness / 449 -- 18.3 Binary
Object Features / 450 -- 18.3.1 Area / 450 -- 18.3.2 Centroid / 450
-- 18.3.3 Axis of Least Second Moment / 451 -- 18.3.4 Projections /
451 -- 18.3.5 Euler Number / 452 -- 18.3.6 Perimeter / 453 -- 18.3.7
Thinness Ratio / 453 -- 18.3.8 Eccentricity / 454.
18.3.9 Aspect Ratio / 454 -- 18.3.10 Moments / 455 -- 18.4 Boundary
Descriptors / 456 -- 18.4.1 Chain Code, Freeman Code, and Shape
Number / 459 -- 18.4.2 Signatures / 461 -- 18.4.3 Fourier Descriptors
/ 462 -- 18.5 Histogram-based (Statistical) Features / 464 -- 18.6

Texture Features / 466 -- 18.7 Tutorial 18.1: Feature Extraction and Representation / 470 -- 18.8 Problems / 474 -- 19 VISUAL PATTERN RECOGNITION 475 -- 19.1 Introduction / 475 -- 19.2 Fundamentals / 476 -- 19.2.1 Design and Implementation of a Visual Pattern Classifier / 476 -- 19.2.2 Patterns and Pattern Classes / 478 -- 19.2.3 Data Preprocessing / 479 -- 19.2.4 Training and Test Sets / 480 -- 19.2.5 Confusion Matrix / 480 -- 19.2.6 System Errors / 481 -- 19.2.7 Hit Rates, False Alarm Rates, and ROC Curves / 481 -- 19.2.8 Precision and Recall / 482 -- 19.2.9 Distance and Similarity Measures / 485 -- 19.3 Statistical Pattern Classification Techniques / 487 -- 19.3.1 Minimum Distance Classifier / 488 -- 19.3.2 k-Nearest Neighbors Classifier / 490 -- 19.3.3 Bayesian Classifier / 490 -- 19.4 Tutorial 19.1: Pattern Classification / 491 -- 19.5 Problems / 497 -- PART II VIDEO PROCESSING -- 20 VIDEO FUNDAMENTALS 501 -- 20.1 Basic Concepts and Terminology / 501 -- 20.2 Monochrome Analog Video / 507 -- 20.2.1 Analog Video Raster / 507 -- 20.2.2 Blanking Intervals / 508 -- 20.2.3 Synchronization Signals / 509 -- 20.2.4 Spectral Content of Composite Monochrome Analog Video / 509 -- 20.3 Color in Video / 510 -- 20.4 Analog Video Standards / 512 -- 20.4.1 NTSC / 513 -- 20.4.2 PAL / 513 -- 20.4.3 SECAM / 514 -- 20.4.4 HDTV / 514 -- 20.5 Digital Video Basics / 514 -- 20.5.1 Advantages of Digital Video / 515 -- 20.5.2 Parameters of a Digital Video Sequence / 516 -- 20.5.3 The Audio Component / 517 -- 20.6 Analog-to-Digital Conversion / 517 -- 20.7 Color Representation and Chroma Subsampling / 520 -- 20.8 Digital Video Formats and Standards / 521 -- 20.8.1 The Rec. 601 Digital Video Format / 522 -- 20.8.2 The Common Intermediate Format / 523. 20.8.3 The Source Intermediate Format / 524 -- 20.9 Video Compression Techniques and Standards / 524 -- 20.9.1 Video Compression Standards, Codecs, and Containers / 525 -- 20.10 Video Processing in MATLAB / 526 -- 20.10.1 Reading Video Files / 527 -- 20.10.2 Processing Video Files / 527 -- 20.10.3 Playing Video Files / 527 -- 20.10.4 Writing Video Files / 528 -- 20.11 Tutorial 20.1: Basic Digital Video Manipulation in MATLAB / 528 -- 20.12 Tutorial 20.2: Working with YUV Video Data / 534 -- 20.13 Problems / 539 -- 21 VIDEO SAMPLING RATE AND STANDARDS CONVERSION 541 -- 21.1 Video Sampling / 541 -- 21.2 Sampling Rate Conversion / 542 -- 21.3 Standards Conversion / 543 -- 21.3.1 Deinterlacing / 543 -- 21.3.2 Conversion between PAL and NTSC Signals / 545 -- 21.3.3 Color Space Conversion / 545 -- 21.3.4 Aspect Ratio Conversion / 546 -- 21.3.5 3:2 Pull-Down / 547 -- 21.4 Tutorial 21.1: Line Down-Conversion / 548 -- 21.5 Tutorial 21.2: Deinterlacing / 550 -- 21.6 Tutorial 21.3: NTSC to PAL Conversion / 556 -- 21.7 Tutorial 21.4: 3:2 Pull-Down / 557 -- 21.8 Problems / 559 -- 22 DIGITAL VIDEO PROCESSING TECHNIQUES AND APPLICATIONS 561 -- 22.1 Fundamentals of Motion Estimation and Motion Compensation / 561 -- 22.2 General Methodologies in Motion Estimation / 564 -- 22.2.1 Motion Representation / 566 -- 22.2.2 Motion Estimation Criteria / 567 -- 22.2.3 Optimization Methods / 567 -- 22.3 Motion Estimation Algorithms / 568 -- 22.3.1 Exhaustive Search Block Matching Algorithm / 568 -- 22.3.2 Fast Algorithms / 570 -- 22.3.3 Hierarchical Block Matching Algorithm / 571 -- 22.3.4 Phase Correlation Method / 573 -- 22.4 Video Enhancement and Noise Reduction / 573 -- 22.4.1 Noise Reduction in Video / 574 -- 22.4.2 Interframe Filtering Techniques / 575 -- 22.5 Case Study: Object Segmentation and Tracking in the Presence of Complex Background / 576 -- 22.6 Tutorial 22.1: Block-based Motion Estimation / 579 -- 22.7 Tutorial 22.2: Intraframe and Interframe Filtering Techniques / 585 -- 22.8 Problems / 589.

Appendix A: HUMAN VISUAL PERCEPTION 591 -- A.1 Introduction / 591
-- A.2 The Human Eye / 592 -- A.3 Characteristics of Human Vision /
596 -- A.3.1 Resolution, Viewing Distance, and Viewing Angle / 596 --
A.3.2 Detail and Sharpness Perception / 598 -- A.3.3 Optical Transfer
Function and Modulation Transfer Function / 599 -- A.3.4 Brightness
Perception / 600 -- A.3.5 Contrast Ratio and Contrast Sensitivity
Function / 603 -- A.3.6 Perception of Motion / 605 -- A.3.7
Spatiotemporal Resolution and Frequency Response / 606 -- A.3.8
Masking / 608 -- A.4 Implications and Applications of Knowledge
about the Human Visual System / 609 -- Appendix B: GUI
DEVELOPMENT 611 -- B.1 Introduction / 611 -- B.2 GUI File Structure /
611 -- B.3 Passing System Control / 613 -- B.4 The UserData Object /
615 -- B.5 A Working GUI Demo / 616 -- B.6 Concluding Remarks /
618 -- REFERENCES 619 -- INDEX 627.

Sommario/riassunto

"The book provides a practical introduction to the most important topics in image and video processing using MATLAB (and its Image Processing Toolbox) as a tool to demonstrate the most important techniques and algorithms. The contents are presented in a clear, technically accurate, objective way, with just enough mathematical detail. Most of the chapters are supported by figures, examples, illustrative problems, MATLAB scripts, suggestions for further reading, bibliographical references, useful Web sites, and exercises and computer projects to extend the understanding of their contents"--
