Contents

Foreword ix
Preface xi
Contributors xiii

I Enhancement

1 Fundamental Enhancement Techniques *Raman B. Paranjape* 3
2 Adaptive Image Filtering *Carl-Fredrik Westin, Hans Knutsson, and Ron Kikinis* 19
3 Enhancement by Multiscale Nonlinear Operators *Andrew Laine and Walter Huda* 33
4 Medical Image Enhancement with Hybrid Filters *Wei Qian* 57

II Segmentation

5 Overview and Fundamentals of Medical Image Segmentation *Jadwiga Rogowska* 69
6 Image Segmentation by Fuzzy Clustering: Methods and Issues *Melanie A. Sutton, James C. Bezdek, Tobias C. Cahoon* 87
7 Segmentation with Neural Networks *Axel Wismüller, Frank Vietze, and Dominik R. Dersch* 107
8 Deformable Models *Tim McInerney and Demetri Terzopoulos* 127
9 Shape Constraints in Deformable Models *Lawrence H. Staib, Xiaolan Zeng, James S. Duncan, Robert T. Schultz, and Amit Chakraborty* 147
10 Gradient Vector Flow Deformable Models *Chenyang Xu and Jerry L. Prince* 159
11 Fully Automated Hybrid Segmentation of the Brain *M. Stella Atkins and Blair T. Mackiewich* 171
12 Volumetric Segmentation *Alberto F. Goldszal and Dzung L. Pham* 185
13 Partial Volume Segmentation with Voxel Histograms *David H. Laidlaw, Kurt W. Fleischer, and Alan H. Barr* 195

III Quantification

14 Two-Dimensional Shape and Texture Quantification *Isaac N. Bankman, Thomas S. Spisz, and Sotiris Pavlopoulos* 215
15 Texture Analysis in Three Dimensions as a Cue to Medical Diagnosis *Vassili A. Kovalev and Maria Petrou* 231
16 Computational Neuroanatomy Using Shape Transformations *Christos Davatzikos* 249
17 Arterial Tree Morphometry *Roger Johnson* 261
18 Image-Based Computational Biomechanics of the Musculoskeletal System *Edmund Y. Chao, N. Inoue, J.J. Elias, and F.J. Frassica* 285
19 Three-Dimensional Bone Angle Quantification *Jens A. Richolt, Nobuhiko Hata, Ron Kikinis, Jens Kordelle, and Michael B. Millis* 299
20 Database Selection and Feature Extraction for Neural Networks *Bin Zheng* 311
21 Quantitative Image Analysis for Estimation of Breast Cancer Risk *Martin J. Yaffe, Jeffrey W. Byng, and Norman F. Boyd* 323
22 Classification of Breast Lesions in Mammograms *Yulei Jiang* 341
23 Quantitative Analysis of Cardiac Function *Osman Ratib* 359
24 Image Processing and Analysis in Tagged Cardiac MRI *William S. Kerwin, Nael F. Osman, and Jerry L. Prince* 375
25 Image Interpolation and Resampling *Philippe Thévenaz, Thierry Blu, and Michael Unser* 393

IV Registration

26 Physical Basis of Spatial Distortions in Magnetic Resonance Images *Peter Jezzard* 425
27 Physical and Biological Bases of Spatial Distortions in Positron Emission Tomography Images *Magnus Dahlbom and Sung-Cheng (Henry) Huang* 439
28 Biological Underpinnings of Anatomic Consistency and Variability in the Human Brain *N. Tzourio-Mazoyer, F. Crivello, M. Joliot, and B. Mazoyer* 449
29 Spatial Transformation Models *Roger P. Woods* 465

30 Validation of Registration Accuracy *Roger P. Woods* . . . 491
31 Landmark-Based Registration Using Features Identified Through Differential Geometry *Xavier Pennec, Nicholas Ayache, and Jean-Philippe Thirion* . . . 499
32 Image Registration Using Chamfer Matching *Marcel Van Herk* . . . 515
33 Within-Modality Registration Using Intensity-Based Cost Functions *Roger P. Woods* . . . 529
34 Across-Modality Registration Using Intensity-Based Cost Functions *Derek L.G. Hill and David J. Hawkes* . . . 537
35 Talairach Space as a Tool for Intersubject Standardization in the Brain *Jack L. Lancaster and Peter T. Fox* . . . 555
36 Warping Strategies for Intersubject Registration *Paul M. Thompson and Arthur W. Toga* . . . 569
37 Optimizing the Resampling of Registered Images *William F. Eddy and Terence K. Young* . . . 603
38 Clinical Applications of Image Registration *Robert Knowlton* . . . 613
39 Registration for Image-Guided Surgery *Eric Grimson and Ron Kikinis* . . . 623
40 Image Registration and the Construction of Multidimensional Brain Atlases *Arthur W. Toga and Paul M. Thompson* . . . 635

V Visualization

41 Visualization Pathways in Biomedicine *Meiyappan Solaiyappan* . . . 659
42 Three-Dimensional Visualization in Medicine and Biology *Richard A. Robb* . . . 685
43 Volume Visualization in Medicine *Arie E. Kaufman* . . . 713
44 Fast Isosurface Extraction Methods for Large Image Data Sets *Yarden Livnat, Steven G. Parker, and Christopher R. Johnson* . . . 731
45 Morphometric Methods for Virtual Endoscopy *Ronald M. Summers* . . . 747

VI Compression Storage and Communication

46 Fundamentals and Standards of Compression and Communication *Stephen P. Yanek, Quentin E. Dolecek, Robert L. Holland, and Joan E. Fetter* . . . 759
47 Medical Image Archive and Retrieval *Albert Wong and Shyh-Liang Lou* . . . 771
48 Image Standardization in PACS *Ewa Pietka* . . . 783
49 Quality Evaluation for Compressed Medical Images: Fundamentals *Pamela Cosman, Robert Gray, and Richard Olshen* . . . 803
50 Quality Evaluation for Compressed Medical Images: Diagnostic Accuracy *Pamela Cosman, Robert Gray, and Richard Olshen* . . . 821
51 Quality Evaluation for Compressed Medical Images: Statistical Issues *Pamela Cosman, Robert Gray, and Richard Olshen* . . . 841
52 Three-Dimensional Image Compression with Wavelet Transforms *Jun Wang and H.K. Huang* . . . 851

53 Medical Image Processing and Analysis Software *Thomas S. Spisz and Isaac N. Bankman* . . . 863

Index . . . 895